Essays in International Trade

Inauguraldissertation
zur Erlangung des akademischen Grades
eines Doktors der Wirtschaftswissenschaften
der Universität Mannheim

vorgelegt von
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Juli 2012

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Mündliche Prüfung:	**12. September 2012**

To my family

Acknowledgements

First of all, I would like to thank my advisors Eckhard Janeba and Wilhelm Kohler for their excellent guidance, encouraging support, and thoughtful discussions. I was tremendously fortunate to have them as advisors, and I am profoundly grateful for their confidence in me. They have given me invaluable comments both on the content of my research and on the way of presenting it.

I am especially grateful to Marc-Andreas Muendler for giving me the opportunity to spend a valuable time at the University of California, San Diego, and for his constant guidance and support.

I am also very grateful to CDSE for providing an exciting research environment. I have enjoyed a lot the friendly atmosphere both at CDSE and at the research group in trade and public finance. I have greatly benefited from my colleagues, both present and past. I would like to thank Jennifer Abel-Koch and Gonzague Vannoorenberghe for creating a great study group and for the inspiring discussions on international trade. I would also like to thank them, and Bjoern Sass, Benjamin Protte, and Hannes Kamerer for their constant and constructive comments.

I further wish to thank my cohort colleagues Michael Grill, Philipp Eisenhauer , Christina Kolerus, Verena Niepel, Pia Pinger, Isabel Ruhmer, and Christopher Walsh, who helped me overcome the first year and much more. Many other colleagues are part of great memories from Mannheim, in particular Petra Loerke, Vinh Cao, Alessandra Donini, Agustin Arias, Edgar Vogel, and Maryam Kazemi-Manesh. I thank them for making my time in Mannheim full of pleasant memories. I am also indebted to all my friends overseas and outside university, for cheering me up in busy times and for whom I did not always have the time they deserved.

Finally, yet foremost, I have to thank my family: My husband Uli for being a never-ending source of encouragement, support, and love. My parents, Sinécio and Ilori, who with their love, faith, and generosity, have always been my pillars and examples throughout my life. And my brother, Leonardo, who has always encouraged me and has always been an example to me. I thank them for supporting my decision to study in Germany, for understanding my absence, and for understanding that distance is sometimes painful, and sometimes a relative concept. *Obrigada minha família, por tudo.*

Contents

Chapter 1

General Introduction

This thesis examines four different topics in the area of international trade. Chapter 2 uses Brazilian firm-level data to study the relation between quality upgrading and pricing across firms and destination countries. Chapter 3 studies the links between income inequality and the patterns of trade and export prices. Chapter 4 analyses how GATT/WTO (General Agreement on Tariffs and Trade/World Trade Organization) membership affects the price volatility of import and export countries. Finally, Chapter 5 looks at the Jewish Diaspora to study the effect of Jewish networks on trade flows. Each Chapter is treated in a separate, self-contained article, and chapters are connected through the microeconomic theory and microeconometric methods applied. The thesis contributes to the literature on trade flows and trade prices, firm heterogeneity, product quality, and networks in international trade.

While Chapter 5 focuses on trade flows, Chapters 2, 3, and 4 offer explanations for the sources of price variation across firms and countries, both from the demand and supply side. Cross-border price differentials are one of the most strinking manifestations that the economy remains largely segmented along the borders. In a world with perfect competition and without product quality differentiation, prices across borders reflect production and transportation costs and, hence, should vary according to these characteristics. Although, when countries import and export different product qualities, and when there are market imperfections such as market power, firm composition, and discrimination, prices across destination markets also reflect those characteristics.

Chapter 2 studies the relation between product quality and pricing across products, firms, and destination countries. The relation between prices and product quality has attracted a lot of attention from the literature. Many studies have found that prices vary systematically across destination countries and suggested that demand for product quality explains this variation (countries with higher income have preferences over higher quality products, and pay higher prices for them). Although, without direct information on product quality variation, it has not been possible to disentangle product quality from other sources of price variation, such as market competition, firm composition, and destination country characteristics.

Chapter 2 uses direct evidence on producer quality upgrading over time, which makes it possible to separate the quality effect from other sources of price variation. Using a difference-in-difference-in-differences approach, that discerns quality upgrading by destination market and timing, Chapter 2 presents evidence of quality-based market segmentation, by which firms raise quality and prices at high-income destinations. Results reveal that differences in prices across destination countries are not driven by differences in markups, market share, or elasticities of substitution, but by demand for high quality in high-income countries. To my knowledge, the study presented in Chapter 2 is the first one to provide direct evidence on quality upgrading over time and to sort out the different effects that drive price variation across firms and destination countries.

One important simplification from Chapter 2 is the assumption that all individuals in a country have similar preferences and consume the same type of quality, i.e., high (low) income countries consume high (low) quality. Chapter 3, which is a joint work with Eckhard Janeba, relaxes this assumption and studies the effect of the second moment of the income distribution on trade and product prices. The contribution of Chapter 3 is to provide first firm-level evidence of the links between income inequality and the patterns of trade and export prices. To identify the mechanism behind these links, we propose a model in which a country has a continuum of individuals, who differ in their skill/ability. We consider three income groups (poor, middle income, and rich) with different preferences over high and low quality products, and show that the aggregate demand depends on the distribution of skills and income in a country. Because preferences over different types of goods depend on the individual income, a more unequal income distribution leads to higher average prices. We confirm this prediction using detailed firm-level data for Brazilian exporters and establish new stylized facts. Results reveal that not only the first moment, but also the second moment of the income distribution in the destination country determines export prices: Prices are sistematically higher in high income and more unequal destinations. This result holds only for differentiated goods, and in particular for varieties with high vertical differentiation. Results suggest that product quality and markups are adjusted to serve different markets, and in particular to serve more distant, richer, and more unequal markets.

Chapter 4, which is a joint work with Vinh Cao, studies the importance of multilateral trade agreements for price behavior, in particular the effect of GATT/WTO membership on the volatility of import and export prices. Since Rose (2004), many researchers have questioned the role of GATT/WTO for trade promotion and the advantages of adhering to the WTO principles. Besides trade promotion, GATT/WTO may help for convergence in expectations and policy transparency in ways that promote stability. At the firm-level, reduction in trade barriers by multilateral treaties may force competition and reduce the market power of firms, such that producers can no longer pass along their production cost shocks. Moreover, under multilateral trade agreements, firms can better react to market-specific demand shocks by switching to alternative markets. Thus, multilateral trade agreements may play a risk-reducing role and act as device for a more stability-oriented price setting behavior. We show first empirical evidence of the effect of GATT/WTO membership on world trade prices and on price volatility. Results suggest a surprisingly strong and robust empirical regulatility: GATT/WTO membership reduces the volatility of prices over time for both import and export countries. Using price levels, results reveal that GATT/WTO membership increases prices over time for exporters, and this effect is captured solely by differentiated goods. We find similar results for FTAs. Since the channel that explains the effect of FTA and WTO membership on prices is alike, the results for FTA represent an important verification of the importance of multilateral trade agreements for price behavior.

Chapter 5, which is a joint work with Gabriel Felbermayr, shifts the attention from export prices to export flows and the importance of networks in international trade. Using a newly build data on the Jewish population, which allows for a rich panel data analysis, Chapter 5 studies the importance of informal networks in explaining bilateral trade flows. Evaluating the effect of the Jewish Diaspora on trade is particularly interesting: (i) the creation of the State of Israel provides high variation in the migration flows; (ii) the Jewish population exhibits a deep and abiding commitment to life in community and is known for building strong networks. Using a theory-based gravity model and the pseudo-maximum likelihood estimation as our main econometric strategy, we find robust trade creation effects of networks. In our benchmark specification for the period 1951-2000, the jewish networks lead to a trade creation of 0.85%, compared to 23.6% of trade creation due to free trade agreements. We show that the high trade creation effects found in the earlier literature are due to omitted variables bias, leading to overestimation of the network effect. Results are robust to several specifications, and, using the tariff equivalent, we find no evidence of a decrease of the network effect over time. The analysis shown in Chapter 5 adds to the literature on the importance of trade barries, in particular informal trade barriers, for international exchange.

The thesis is organized in such a way that the chapters can be read independently of each other. References are collected in the bibliography.

Chapter 2

Quality Upgrading and Price Heterogeneity: Evidence from Brazilian Exporters

2.1 Introduction

A growing body of literature has documented a systematic variation in export prices across destination countries. While the literature has suggested quality differences as one plausible explanation,[1] the lack of direct data on producer quality has limited the empirical evidence to the use of proxies. Thus, it has not been possible to separate the quality effect from other sources of price variation, such as market competition, firm composition, and further destination country characteristics.[2] [3]

[1] Hummels and Klenow (2005) and Hallak (2006) find that prices increase with exporter and importer income per capita, respectively, suggesting that high-income countries consume and produce high quality products. Similar evidence is found at the firm-level (see Manova and Zhang (2012) and Bastos and Silva (2010b)), and using a structural approach such as Khandelwal (2010) and Hallak and Schott (2011).

[2] Crozet, Head, and Mayer (2011) study French wine producers and offer the only direct evidence on how quality ratings affect prices and exports. They focus on price variation across firms (rather than across destination markets) in a cross-section analysis, which does not allow disentangling the sources of price variation.

[3] Understanding the sources of price variation is crucial for policy analysis. The literature suggests that countries with intermediate levels of productivity and product quality may be the big winners of globalization: in the catch-up phase, wage, productivity and quality differentials in countries such as Brazil, China and India create profit incentives for firms to increase product quality, and raise their gains from trade (Sutton 2007). In particular for Latin-American economies, it has been argued that firms have increased product quality to high-income countries, while the domestic market and neighboring low-income

I use producer quality information of Brazilian exporters over time, proposing a new methodology that allows sorting out product quality from other sources of price variation. Using a difference-in-difference-in-differences approach that discerns quality upgrading by destination market and timing, combined with matching techniques, I find evidence of quality-based market segmentation: firms increase product quality and prices in high-income destinations. The results reveal that differences in prices across destination countries are not driven by differences in markups, market share, elasticities of substitution, or selection effects, but rather by demand for high quality in high-income countries. To my knowledge, this is the first study that provides direct evidence on quality upgrading over time, and that sorts out the different sources of price variation across firms and destination countries.

To provide a framework for the empirical analysis, I present a stylized partial equilibrium model that combines quality upgrading, skill upgrading, and product innovation investments. The model considers two markets heterogeneous in income, North (high income) and South (low income), and heterogeneous firms that endogenously set prices and quality to these markets. The model generates three testable predictions. First, for firms that invest in product innovation it is optimal to increase product quality and product prices. Second, due to the differing willingness to pay for quality across countries, firms have relatively stronger profit incentives to increase product quality for high-income (Northern) countries. For a sufficiently low income in Southern countries, consumers in the South only consume low quality products. Thus, quality upgrading and market segmentation explain higher prices in Northern countries. Third, producing high quality requires better qualified workers. Hence, firms that upgrade quality also increase their share of skilled workers.

I test the model using novel and uniquely rich Brazilian firm-level data, which allows me to build a direct and comprehensive measure of quality upgrading, rather than relying on proxies. The data includes: (i) export price data by firm, product, and destination country; (ii) employer-employee data with workers' characteristics; and (iii) a detailed firm innovation survey, including self-reported measures on the importance of product quality upgrading.[4] Additional variables such as world import and export flows help to control

countries have continued consuming low quality varieties (See Brambilla, Lederman, and Porto (2010) and Verhoogen (2008)). However, price variation across countries could also reflect markup pricing, as shown by Simonovska (2010). The current literature does not allow disentangling these effects.

[4]The PINTEC (2000) firm innovation survey is available for a representative sample of 3,750 Brazilian manufacturing exporters, and contains 154 questions related to product and process innovation. Some

for changes in market shares and further time-varying characteristics. The richness of the combined data enables the separation of the quality effect from other sources of price variation.

The econometric approach used to identify market segmentation through quality is a difference-in-difference-in-differences (DDD) strategy over the period 1997-2000. I use matching techniques to control for self-selection in quality upgrading, and discuss several identification issues in Sections 5 and 6. The DDD discerns firms that upgraded quality from those that did not, by export market over time. I evaluate price changes due to changes in product quality, mainly for the European Union (North) and Mercosur (South), and conduct several placebo exercises to test whether the effect of quality on prices is driven by other factors unrelated to quality.[5] The period under analysis, 1997-2000, provides a unique empirical setting. In this period, termed by Sutton (2007) as the catch-up phase of trade liberalization in mid-level economies[6], firms made important efforts to bridge the quality gap. Their efforts to increase product quality were 30% higher in comparison to later years (PINTEC 2003)[7], and export orientation was the main determinant of product innovation (Kannebley, Porto, and Pazello 2005). Anecdotal evidence suggests that many firms created an *export type product* in this period, a higher quality variety to be exported to high-income destinations.

Results show that producers raise quality and prices in high-income (Northern) countries, and that demand for high quality explains higher prices in Northern countries, confirming the first two predictions of my stylized model. I discuss the markup hypothesis, highlighting that price differences across destinations are driven by demand for quality, rather than by markup pricing or different elasticities of substitution. In particular, the results reveal that firms that do not upgrade quality do not receive a price premium in Northern

questions are specifically related to product quality upgrading and the firm's export destination market.

[5]As quality is an endogenous variable, I achieve identification by evaluating differences across groups over time, combined with firm-product-country fixed effects, period fixed effects and various time-varying firm, product and destination country characteristics. Several placebo exercises confirm the validity of the methodology.

[6]The first phase of trade liberalization occurred mainly until 1995, when tariffs fell from an average of 29% in 1991 to zero in 1995. According to Sutton (2007), the second (catch-up) phase happens when wage and capability differentials create profit incentives for firms in low-wage countries to build capability. This process carries main benefits to mid-level economies.

[7]The most cited reasons for manufacturing exporters to innovate were: to improve product quality (80% of the firms) and to maintain market share (82% of the firms) (PINTEC 2000). For 86% of the firms, foreign consumers were the main source of information for product development (PINTEC 2000).

countries, and those that upgrade quality only receive a price premium in Northern countries. Regarding the third prediction of the model, the results document that firms jointly increasing product quality and workers' skills charge higher prices.[8]

Several placebo exercises and robustness checks are conducted to deal with the concern of endogeneity of quality upgrading. In particular, the results reveal that price differentials across countries are not driven by self-selection of firms, are specific to quality upgrading, and are not related to other changes at the firm-level, such as process innovation.[9] The analysis is extended in different ways. In particular, the Chapter shows that results are not specific to the European Union and Mercosur, and that the effect of quality on prices is captured by the firms' main product (in terms of sales), for which the firm has higher profit incentives to invest in quality.[10]

This Chapter is related to broad literature investigating the relationship between quality, prices and trade, which has shown that prices and quality increase with exporter income per capita (Flam and Helpman (1987) and Hummels and Klenow (2005)) and importer income per capita (Hallak 2006). These results are supported by Khandelwal (2010) and Hallak and Schott (2011), who relax the direct price-quality relation and infer quality from both price and market share data. Their results suggest that high-income countries consume and produce high quality products. With the availability of firm-level data, many papers have uncovered several dimensions of firm-product price heterogeneity. Manova and Zhang (2012) and Bastos and Silva (2010b) document a systematic price variation across destination countries, attributing this price variation to quality sorting: firms export high quality products to high income and distant countries.[11] Recently, Crozet, Head, and Mayer (2011) have focused on the wine industry, finding within a cross-section that firms ranked as high-quality producers charge higher prices and export more to a larger number

[8]However, I show that quality and skills do not cancel out each other. Instead, the level effect of quality upgrading remains significant, suggesting that skill upgrading might not entirely explain increases in producer quality.

[9]For process innovation (technology upgrading), there is no price differential across destinations, suggesting that firms receive a premium in Northern countries from increasing product quality, but not from producing existing products with better technology.

[10]According to Eckel, Iacovone, Javorcik, and Neary (2011), a firm with quality competence may obtain higher quality premia for the products closer to the core competence. Thus, incentives to invest in the quality of the core variety are higher.

[11]Similar results are found by Görg, Halpern, and Muraközy (2010) for Hungarian firms.

of markets.[12] While they are interested in the variation across firms in a cross-section, which does not allow to control for firm-level unobserved heterogeneity, I study the firm price variation across time and across destination countries. Combining data on quality upgrading over time with price data, I offer a quality-based explanation for price variation across destinations and industries, and separate the different sources of price variation.

This Chapter is also related to literature investigating product quality, wage inequality, and the gains from trade for developing economies. The literature suggests that countries with intermediate levels of productivity and product quality may be the big winners of globalization: in its catch-up phase, wage, productivity and quality differentials in countries such as Brazil, China and India create profit incentives for firms to increase product quality, with subsequent dynamics leading to gains from trade.[13] Particularly for Latin-American economies, it has been argued that firms increased product quality to high income countries after trade liberalization, while the domestic market and neighboring low income countries continued consuming low quality varieties. For Mexican firms, Verhoogen (2008) finds that more productive firms export more and pay higher wages, suggesting that these firms produce higher quality to export to high income destinations. A similar argument is shown by Brambilla, Lederman, and Porto (2010) in explaining the skill composition of Argentinean firms. I build on a similar argument for the Brazilian economy, although this chapter differs in directly considering price data and producer quality information over time, which allows sorting out the quality effect without relying on proxies for quality.

Finally, this Chapter is also related to literature on firm heterogeneity, a central feature in the trade literature over the past decade. An additional evidence of this Chapter relates to the isomorphism between different heterogeneous firm models. I empirically show that firms are indeed heterogeneous in quality, and confirm the predictions from the theoretical literature. However, by showing that quality varies not only across firms, but also within firms across destination countries, I show that efficiency sorting models (with heterogeneity in productivity)[14] and quality sorting models (with heterogeneity in the ability to produce

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[12] Their cross-section results focus on effects across firms (rather than across countries). Moreover, the cross-section analysis does not allow sorting out different sources of firm and price heterogeneity.

[13] See Sutton (2007) for a discussion on the winners of globalization. Sutton (2007) argues that trade liberalization per se does not benefit countries in the intermediate range. However the dynamics that follow with subsequential phases of liberalization, with foreign direct investment, and capability transfers, may determine the big winners of globalization.

[14] Examples of such models are Melitz (2003) and Melitz and Ottaviano (2008).

product quality)[15] may be non-isomorphic.[16]

The Chapter is organized as follows. Section 2 develops the theoretical framework. Section 3 provides the data and descriptive statistics. Section 4 presents the empirical strategy. Section 5 shows the results and Section 6 provides further extensions. Section 7 concludes.

2.2 Product innovation and market segmentation

To provide a framework for the empirical analysis, this section presents a partial equilibium model of trade, product quality upgrading, and market segmentation. The model combines product quality (as in Verhoogen (2008)), workers skills (similar to Brambilla, Lederman, and Porto (2010)), and fixed innovation costs (similar to Bustos (2011)).

The model has two important sources of heterogeneity. From the production side, some firms pay a fixed product innovation cost F^I and increase product quality. From the demand side, income differences lead to a different willingness to pay for quality. Firms endogenously set prices and quality.

2.2.1 Demand

The demand side of the model follows Verhoogen (2008). There are two markets, North and South. In each market, indexed by $c = N, S$, there are K statistically identical consumers, indexed by k. The utility that each consumer k in country c derives from consuming a product from firm j is given by:

$$U_{kjc} = u(x_o) + \theta_{jc} + \epsilon_{kjc} \tag{2.1}$$

where x_o is the consumption of the numeraire good, ϵ_{kjc} is a consumer-specific random deviation, and θ_{jc} is the quality parameter of one unit of a product consumed in country c and sold by firm j.

Consider the optimization problem for an individual with income y_c. After paying p_{jc} to buy one unit of his most preferred differentiated product, the individual spends the residual

[15] Examples of such models include Baldwin and Harrigan (2011) and Hallak and Sivadasan (2011).

[16] For these models to be isomorphic, one would need to assume that firm-level technological change is also destination country specific. However, in my results, I show that the asymmetric effect across countries is specific to quality upgrading. It does not hold for other firm-level changes, such as technology upgrading.

income $(y_c - p_{jc})$ on the numeraire good. Optimization yields the indirect utility[17]

$$V_{kjc} = \theta_{jc} - p_{jc}u'(y_c) + \epsilon_{kjc} \tag{2.2}$$

where $u'(y_c)$ is the marginal utility of income. The inverse of $u'(y_c)$ captures the quality valuation: the lower $u'(y_c)$, the higher is the willingness to pay for quality.[18]

As is standard in discrete choice models[19], for ϵ_{kjc} a random deviation that follows a type 1 extreme-value distribution, the expected demand for each good can be represented as a standard multinomial-logit formulation:

$$x_{jc} = \frac{K_c \exp\left[\frac{1}{\mu}(\theta_{jc} - p_{jc}u'(y_c))\right]}{\sum_{z\in Z^c} \exp\left[\frac{1}{\mu}(\theta_{zc} - p_{zc}u'(y_c))\right]} \tag{2.3}$$

where K_c is the mass of consumers in country c, Z_c is the set of all available products in c and μ is a parameter that captures the degree of differentiation between goods.[20]

2.2.2 Production

For simplicity, there is a fixed number of firms J in the source country producing a differentiated product. Similar to Brambilla, Lederman, and Porto (2010), to produce one unit of a product, the firm needs standard manufacturing inputs and activities, as well as inputs and activities to differentiate the product and produce a certain level of quality. The first requires a units of labor. The second requires $b\theta_{jc}^{\beta}$ units of labor, with $\beta > 1$.[21] θ_{jc} is the vertical differentiation parameter, i.e., the quality level the firm decides to produce. Thus, producing higher quality requires more skilled workers. For simplicity, I assume, as Brambilla, Lederman, and Porto (2010), that standard manufacturing activities require only unskilled labor, while producing a certain level of quality requires skilled labor. Wages

[17]As shown in Verhoogen (2008), product price p_{jc} needs to be small relative to the consumer's income y_c. Then the first-order expansion of the sub-utility yields equation (2.2). Note that $u(y_c)$ does not affect the choice probability and will drop out of the aggregate demand, leading to equation (2.2).

[18]For a given quality level θ_{jc}, individuals with lower $u'(y_c)$ are willing to pay higher prices.

[19]See McFadden (1974), McFadden (1978).

[20]As $\mu \to 0$, the model approaches perfect competition (see Verhoogen (2008)).

[21]There are decreasing returns of vertical differentiation. When quality increases, there are diminishing returns of reaching an additional consumer (search efforts are higher and shifting the demand function becomes more difficult). This assumption follows Brambilla, Lederman, and Porto (2010), for quality differentiation, and Arkolakis (2010), for marketing investments. In Arkolakis (2010), as marketing expenditure increases, marketing efficiency declines and it becomes more difficult to shift demand. Higher values of β correspond to more intense diminishing returns.

of the unkilled workers are normalized and wages of the skilled workers are denoted by w.[22] I distinguish firms according to the innovation costs. Some firms pay a fixed innovation cost F^I to increase product quality. Since firms innovate to upgrade quality, the innovation cost does not affect the production of standard manufacturing activities (conducted by unskilled workers), but only the costs of producing the quality differentiated variety (activities performed by the skilled workers).[23] [24]

Firms that incur cost F^I can more efficiently produce a certain quality level, by a factor $\gamma_j > 1$ (a firm-specific random draw). Firms with sufficiently low γ_j will not incur the innovation cost to increase product quality. The total cost functions TC for innovative firms I and non-innovative firms NI are, respectively,

$$TC_j^I = \left(a + \frac{b\theta_{jc}^{\beta} w}{\gamma_j} \right) x_j(\theta_{jc}, p_{jc}) + F^I \tag{2.4}$$

$$TC_j^{NI} = \left(a + b\theta_{jc}^{\beta} w \right) x_j(\theta_{jc}, p_{jc}) \tag{2.5}$$

with $\gamma_j > 1$ for innovative firms and aggregate demand (demand in North and South) for a firm j defined as $x_j = x_{jN} + x_{jS}$.

Firms with $\gamma_j > 1$ will incur the fixed cost F^I; for firms with sufficiently low γ_j it is not optimal to pay the fixed innovation cost F^I. The maximization problem for innovative I and non-innovative NI firms follow:

Innovative firms **I** maximize profits $\pi_j^I = \pi_{jN}^I + \pi_{jS}^I - F^I$, where π_{jN}^I and π_{jS}^I are the profits before fixed cost in each destination country $c = N, S$:

$\pi_{jc}^I = \left(p_{jc} - a - \frac{b\theta_{jc}^{\beta} w}{\gamma_j} \right) x_{jc}(\theta_{jc}, p_{jc})$, with $c = N, S$.

Non-innovative firms **NI** maximize profits $\pi_j^{NI} = \pi_{jN}^{NI} + \pi_{jS}^{NI}$, where π_{jN}^{NI} and π_{jS}^{NI} are the profits before fixed cost in each destination country $c = N, S$:

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[22] There is a large homogeneous goods sector that employs skilled and unskilled workers in fixed proportions. This pins down wages, as in Brambilla, Lederman, and Porto (2010).

[23] The innovation costs differ from the technological upgrading in Bustos (2011), where the fixed cost represents a standard process innovation.

[24] F^I could be, for instance, investment in softwares for product design or product engineering. These costs will not affect standard manufacturing activities but will increase the productivity of the skilled workers (e.g., after the innovation cost, designers have more time for product development, will be more creative and able to produce highly differentiated products). Thus, one can think of the innovation cost as a skill-biased innovation, which will lead to the production of higher quality.

$\pi_{jc}^{NI} = \left(p_{jc} - a - b\theta_{jc}^{\beta} w\right) x_{jc}(\theta_{jc}, p_{jc})$, for $c = N, S$.

Firms choose p_{jc} and θ_{jc} and maximize profits for each country of destination c. The vertical differentiation parameter θ_{jc} is chosen to equalize its marginal cost to the inverse of $u'(y_c)$, which represents the quality valuation. Using equation (2.3), the solution for θ_{jc} is given by:

$$\theta_{jc} = \left(\frac{\gamma_j}{\beta b w} \frac{1}{u'(y_c)}\right)^{\frac{1}{\beta-1}} \tag{2.6}$$

with $\gamma_j = 1$ for non-innovative firms.

The parameter θ_{jc} increases with the quality valuation $\frac{1}{u'(y_c)}$: firms produce high quality for markets willing to consume high quality. θ_{jc} also increases with γ_j: for firms that invest in product innovation, for which $\gamma_j > 1$, it is optimal to increase product quality. For firms that did not incur the innovation cost, it is too costly to increase product quality by the same amount. Note that, because of a higher optimal θ_{jc}, innovative firms (that initially reduced marginal costs by γ_j) increase marginal costs by $\gamma_j^{\frac{1}{\beta-1}}$ by producing a higher quality level.

The solution for prices follows

$$p_{jc} = a + \frac{1}{u'(y_c)} + \left(\frac{\gamma_j}{bw}\right)^{\frac{1}{\beta-1}} \left(\frac{1}{\beta u'(y_c)}\right)^{\frac{\beta}{\beta-1}} \tag{2.7}$$

with $\gamma_j = 1$ if the firm does not incur the F^I innovation cost.

2.2.3 Product quality and export destinations: effect on the profile of prices

I derive three predictions from the model, which are tested empirically using Brazilian firm-level data. I study which firms upgrade product quality and to which markets they upgrade quality, i.e., whether firms segment the market and offer higher quality at higher prices to Northern countries. These predictions can be summarized as follows:

Prediction 1: *Innovative firms sell higher quality at higher prices after innovation.*

Heterogeneity in γ_j leads innovative firms to produce higher quality at higher prices. From the solution for θ_{jc}, if a firm innovates, it optimally produces a higher level of θ_{jc}, since $\gamma_j > 1$. A higher γ_j leads to higher quality (from equation 2.6) and to higher prices (from equation 2.7). Thus, innovative firms jointly increase price and quality.

Prediction 2: *Northern consumers buy the quality upgraded product and pay higher prices. For a sufficiently low income y_S, Southern consumers choose low quality products and pay low prices.*

Since Northern consumers have a higher quality valuation ($\frac{1}{u'(y_N)} > \frac{1}{u'(y_S)}$), it is optimal for the firm to choose a higher θ_{jc} to sell in Northern countries. From equation (2.7), $\frac{1}{u'(y_N)} > \frac{1}{u'(y_S)}$ implies that $p_N > p_S$ for a given firm j.

From equation 2.7, since $\gamma_j > 1$, $\frac{\partial p^I_{jc}}{\partial \frac{1}{u'(y_c)}} > \frac{\partial p^{NI}_{jc}}{\partial \frac{1}{u'(y_c)}}$: the difference in prices is higher for innovative firms. For a sufficiently low y_S and a residual income $y_S - p_{jc}$, Southern consumers can only afford consuming the low quality product with price p_L, such that $x_o + p_L \approx y_S$ and $u(y_S - p_H) \approx 0$, for p_H the price of a high quality product.[25]

An important caveat of the model refers to the non-innovative firms exporting to Northern countries. The model predicts that $p^I_{jN} > p^{NI}_{jN} > p^{NI}_{jS}$. Given a different willingness to pay in North and South, non-innovative firms would increase (by less than innovative firms) prices to the North. This result follows from the equation for prices $p_{jc} = a + \frac{1}{u'(y_c)} + \frac{\theta_{jc}}{(\beta u'(y_c))^\beta}$ and may be interpreted as a markup pricing, such as shown in Simonovska (2010) for Internet prices across countries. In the empirics, I show that the difference $p^{NI}_{jN} - p^{NI}_{jS}$ is not statistically significant for the set of non-innovative firms. For a more complete analysis, one could extend the model to an approach similar to Fajgelbaum, Grossman, and Helpman (2011), in which consumers are heterogeneous within a country, and quality and prices increase in income. In this case, there would be a share of the population in Northern countries consuming low quality at low prices, as I show in the empirics.

Prediction 3: *Innovative firms jointly increase product quality and the share of skilled workers and hire $\gamma_j^{\frac{1}{\beta-1}}$ more skilled workers than non-innovative firms. The increase in costs affects the profile of prices.*

[25] Note that prices may not be too similar to income, such that the first-order expansion of sub-utility in equation 2.1 holds.

By assumption of the model, quality differentiation activities are performed by skilled workers, while standard manufacturing activities are performed by unskilld workers. Using the solution for θ_{jc}, the demand for skilled workers for innovative firms is given by: $\frac{b\theta_{jc}^{\beta}}{\gamma_j} = \left(\frac{\gamma_j}{b}\right)^{\frac{1}{\beta-1}} \left(\frac{1}{\beta w u'(y_c)}\right)^{\frac{\beta}{\beta-1}}$. Thus, relative to non-innovative firms, innovative firms hire more skilled workers by a factor of $\gamma_j^{\frac{1}{\beta-1}}$, and charge higher prices.[26]

2.3 Data

2.3.1 The Brazilian economy in the 1990s

The period under analysis in the empirical part of the Chapter is 1997-2000. To understand firms' behavior in this period, I provide a background on the Brazilian economy in the 1990s.

The 1990s represent a particular moment for the Brazilian economy: economic stability after the end of decades of inflation, trade liberalization, the introduction of the *Real* as the new currency in 1994, high increases in productivity, and a sharp currency devaluation in 1999. Trade liberalization created opportunities for Brazilian exporters but also represented a challenge, once they faced tougher competition and needed to adapt their products to be able to compete in tougher markets.[27] The local currency, pegged to the U.S. dollar until 1999, was overvalued in the last years of this period. Thus, firms were able to import better technology at lower prices and to adapt their production to international standards. In 1999, the change in the exchange rate regime to free float culminated in a sharp devaluation that created additional incentives for firms to export.

Firm internal R&D activities were 40% higher in the period 1998-2000 in comparison to the later years (PINTEC 2003). As shown in Figure 2.1, among the reasons for manufacturing exporters to innovate, the most cited in the period 1998-2000 were (1) *to maintain their*

[26]For simplicity, the demand for unskilled workers does not change.

[27]Mündler (2004) studies the effects of trade barriers on the productivity of Brazilian firms in the period 1986-98. His results indicate that foreign competition pressures are an important source of productivity change. Bloom, Draca, and Rennen (2011) look at the effect of competition with Chinese products on innovation rates in developed countries. They find that trade liberalization caused developed countries to increase their investments in technology due to competition. Martin and Méjean (2011) study the effect of low-income countries' competition on quality upgrading of French firms.

market share and, (2) *to improve product quality* (PINTEC 2000).[28] When asked about the most important market and the most important strategic change, most firms answered they *innovate to meet foreign consumers requirements* and *innovate to change product design*, respectively.[29] Moreover, anecdotal evidence suggests that many firms created an *export type product* in this period, a variety associated with higher quality and in conformity with the international quality standards, such as requested in Japan and European countries. Firms adapted their production lines to reach consumers with high willigness to pay for quality, while Mercosur countries continued consuming the low quality varieties as before. The anedoctal evidence is supported by the PINTEC (2000) innovation survey used in this Chapter. If we consider firms that exported *exclusively* to Mercosur, very few of them did product innovation. Moreover, out of 472 firms that exported exclusively to Mercosur in the year 2000, only 6 of them reported high efforts to increase product quality and to meet foreign consumer requirements (PINTEC (2000) innovation survey).[30] These numbers support the anecdotal evidence that firms increased product quality to meet demand for quality in high-income countries. Firms exporting only to neighbor markets had low profit incentives to increase product quality.

A similar argument for futher Latin-American economies is found in Verhoogen (2008) and Brambilla, Lederman, and Porto (2010). Brambilla, Lederman, and Porto (2010) claim that exporting to high-income countries requires higher quality and better skilled workers, while selling to neighboring Mercosur countries may require the same quality level from the domestic sales. Verhoogen (2008) uses a similar argument for the Mexican economy in the 1990s. [31]

[28]These informations are available for 3750 exporters surveyed in the period 1998-2000. For instance, concerning the market, firms were asked whether they innovated to maintain their market shares, to enter new markets or to increase their market shares. Most firms answered to maintain their market shares.

[29]For instance, concerning strategic changes, firms are asked whether they changed (i) the organizational structure, (ii) the marketing strategies, (iii) the product design or (iv) certifying norms. The highest mean of positive responses was attributed to changes in product design, followed by certifying norms.

[30]This number if higher if one considers general efforts of the firm to increase product quality, not related to foreign consumers. However, the innovation rate is still much smaller for firms that exported exclusively to Mercosur. The innovation rate in this case is of roughly 10% for firms that exported exclusively to Mercosur in the year 2000, compared to roughly 45% for the rest of the sample.

[31] Verhoogen (2008) focuses on the effect of quality upgrading on wage dispersion. Verhoogen (2008) argues that after trade liberalization, Mexican firms had one product for the home market and one to be exported to the United States. The argument is illustrated with the example of the enterprise Volkswagen. Volkswagen produced at that time the Original Beetle with old technology to sell in the home market, and the New Bettle and Jetta with state-of-the-art technology to export to the U.S. market.

The period was also marked by high increases in productivity: the productivity increase in 2000 was of 6.5% and in the years before it outnumbered 10% per year in some industries (Bonelli, 2001). Moreover, in an attempt to protect the home industry and to increase exports, the government implemented several programs to support firms to meet international standards, upgrade quality and be able to compete in tougher markets. Some important policies in this period were: (i) sectoral policies that included export financing facilities from the BNDES (the Brazilian Development Bank); (ii) the creation of the *Ministry of Development, Industry and Foreign Trade* (MDIC) in 1999; and (iii) special R&D incentives from the Ministry of Technology (Bonelli, 2001).[32]

2.3.2 Data sources

The data set is uniquely rich and combines three main information of Brazilian firms: (i) the three dimensional export and price data, (ii) information on process and product innovation, and (iii) workers characteristics. The firm-level data is matched with additional information, including the NBER-UN World Bilateral Trade Data and further data described in 3.2.2, which provide a set of control variables for product, sector, and country characteristics.

Firm-level data: innovation, export prices, and workers data

The firm-level data is matched using the unique CNPJ tax number. The main data sources used are the Brazilian three dimensional exports data from SECEX (Foreign Trade Secretariat) and the PINTEC Survey (Brazilian Firm Industrial Innovation Survey). The data also contains further firm characteristics and information on formally employed workers at the firm.

SECEX exports data:[33] Contains annualized data on export sales, quantities and weights (mainly kilograms) by *firm, product and destination country* for the universe of Brazilian

[32] Moreover, many other policies were created to help small and medium sized exporters, many of them specific to the European market.

[33] The data comes from the Brazilian customs declarations for merchandize exports that is collected for every exporting firm by the SECEX (*Secretaria de Comércio Exterior* - Foreign Trade Secretariat).

manufacturing exporters. The period used is 1997-2000. The classification of products follows the 8 digit level NCM classification (*Nomenclatura Comum do Mercosul*). The first six digits of NCM correspond to the first 6 digits HS classification (international Harmonized System), which allows comparison with international databases.[34]

All export values are reported in U.S. dollars (USD) *free on board* (f.o.b.). Values are deflated by the US CPI (United States Consumer Price Index) from August 1994.[35]

With the SECEX data, I create a measure of average prices as $Uprice_{fcgt} = \frac{Value_{fcgt}}{Quant_{fcgt}}$, in which $Value_{fcgt}$ represents sales and $Quant_{fcgt}$ the quantity sold of product g by firm f to country c at time t. Thus, $Uprice_{fcgt}$ represents the yearly average price by g, f, c and t. The precise steps to build the SECEX dataset are explained in the online Data Appendix.

Table 2.1 shows price variation in terms of standard deviations. Since most results shown in the empirical section refer to European Union and Mercosur, the standard deviation in Table 2.1 refers to these markets. The upper part of the table shows that the standard deviation of log prices across destinations for a firm-product pair is on average 0.188 in the year 1997 and 0.200 in the year 2000. The lower part of Table 2.1 shows that the deviation of log prices within product-country pairs across firms is, on average, 0.459 and 0.486 in the years 1997 and 2000, respectively.[36] As expected, in both cases the variation is high for differentiated goods and low for homogeneous goods.

PINTEC Industrial Innovation Survey: the PINTEC (*Pesquisa Industrial de Inovação Tecnológica*) conducts a triennial innovation survey among Brazilian firms. In this Chapter I use the wave 1998-2000, which contains detailed information concerning the firms' innovative efforts in the period 1998-2000.[37] Overall, there are 154 questions related to *product and process innovation.* For instance, for product innovation, firms are asked whether they improved a product in the period 1998-2000.[38] Firms are also asked about the impor-

[34]The correspondence between the NCM 6 digit and the HS 6 digit allows matching the Brazilian data with the NBER-UN bilateral world trade data documented by Feenstra, Lipsey, Deng, Ma, and Mo (2005), as well as with the Rauch (1999) classification of goods. I match the information of the HS classification with the SITC classification (Standard International Trade Classification) in order to be able to use the Rauch (1999) classification of goods and the NBER-UN world trade data.

[35]The reason for the base August 1994 is the introduction of the new currency, the real, in July 1994.

[36]The standard deviation is small comparing to the results reported by Manova and Zhang (2012) for Chinese firms. In the case of Chinese expoters, the standard deviation within firm-product across countries and within product-country across firms are, respectively, 0.46 and 0.90.

[37]The innovation questionnaire is available at:
`http://www.pintec.ibge.gov.br/downloads/PUBLICACAO/Publicacao%20PINTEC%202000.pdf`.

[38]Corresponds to Questions 7 and 8 from the survey. In Question 7 firms are asked whether they improved a product already existent in the market (already sold by other firms). In Question 8 firms are

tance of product innovation to improve *product quality* and asked for which market they innovate (domestic versus foreign).[39] The main variables used for the quality treatment are described in Table 2.2. Moreover, many other questions allow for robustness checks, including information on the main destination market (EU, Asia, Mercosur, US, other american countries), whether the firm invested in product design and whether the firm innovated to *maintain the market share*[40]. The questions also allow evaluating asymmetries across products (e.g., the share of sales of the innovated product in the domestic and in the foreign market). See description of main variables in Table 2.2. For further information, see the online Data Appendix.

The data also contains several characteristics of workers formally employed at the firms. The employer-employee data form the *Relação Anual de Informações Sociais* provides, at the firm level, the following variables of interest: (i) average wages, (ii) share of workers with primary, high-school and tertiary education, (iii) number of workers as a proxy for firm size, and (iv) share of workers by occupation, according to the International Labour Office (ILO) ISCO-88 classification of occupations. The variables are summarized in Table 2.3. More information is found in the online Data Appendix.

Since this Chapter is interested in manufacturing exporters, all other industries are left out of the sample, which makes the data comparable to other studies on the Brazilian economy, such as Arkolakis and Muendler (2011). Figure 2.2 shows the share of exports of the main industries that exported products to European Union and Mercosur. Firms are divided into industries according to their decision to upgrade product quality.[41]

The SECEX exports data and the employer-employee data are available for the universe of Brazilian manufacturing exporters. The Innovation Survey from PINTEC is available for a representative sample of 3,750 manufacturing exporters.[42] Of those, 3,070 exported in the

asked if they improved a product that was new to the market

[39]Question 77 asks the importance of product innovation to increase *product quality*. Question 106 asks where are located the consumers to which the firm innovated. Most firms that innovated answered they innovated to meet foreign consumers requirements.

[40]Firms are asked whether they innovated to maintain the market, to increase market share, to enter new markets, to increase the scope of product, to increase production capacity or production flexibility, to reduce labour costs, to reduce energy costs, among others.

[41]The list of industries used is found in the Data Appendix.

[42]The survey was conducted with manufacturing exporters, non-manufacturing exporters and domestic firms, with a total of 10,658 firms. The interest of this work lies in manufacturing exporters, and therefore the sample includes 3,750 firms. Note that also intermediaries and their commercial resales of manufactures are removed from the sample. Thus, the products and firms from the sample are comparable to the sample

year 2000 and 2,868 exported in the year 1997. In order to identify the quality upgrading effect over time (before and after the innovation survey), only permanent exporters are kept in the sample. This reduces the sample to 2,443 firms. New exporters and quitters are analyzed separately only for robustness checks.[43]

Table 2.4 presents summary statistics for the 2,443 permanent exporters, for the years 1997 and 2000, by innovative behavior and year. Innovative firms have higher revenues and sell more products in more destination markets. Although, an interesting fact from Table 2.4 is that the two groups have *similar trends* from the year 1997 to 2000. Despite for the variables related to workers' characteristics, the variation over time for the two groups follow similar patterns. Moreover, the fact that workers' characteristics face different trends in the two groups is an interesting result: as stated in Prediction 3, innovative firms need better skilled workers to produce higher quality, and therefore would also increase workers skills over time.

Control variables

World bilateral trade flows: The bilateral trade flows data comes from the NBER-UN yearly trade data, documented by Feenstra, Lipsey, Deng, Ma, and Mo (2005). The NBER-UN trade data provides an accurate measure of trade flows using the Standard International Trade Classification (SITC 2 - Division), 4 digits, which is matched with the HS classification.[44] The one-by-one mapping between the first six digits of the Brazilian NCM product classification and the first 6 digits HS (international Harmonized System) classification allows the concordance with the world trade data. The values are mainly reported by the importing country, leading to a more accurate measure (because of differences between c.i.f. and f.o.b. prices , s. Feenstra, Lipsey, Deng, Ma, and Mo (2005)).

With the NBER-UN data it is possible calculate different measures of market power and a

used in other studies, as Arkolakis and Muendler (2011) and Eaton, Kortum, and Kramarz (2004).

[43] For the comparison between European Union and Mercosur, I keep only firms that exported to both groups of countries in both years (1997 and 2000). Thus, I also drop all firms that exported exclusively to Mercosur, which represent 472 firms in the year 2000. Thus, the sample reduces to 1,400 firms. As a comparison regarding sample size, in the study on innovation and technology upgrading with Argentinian firms, Bustos (2011) uses a sample of 1,639 surveyed firms.

[44] The U.S. Imports data from the NBER-UN provides a concordance concordance between SITC 2 and the HS 6 digits classification.

proxy for production (measured by the importance of each sector in the destination market). The variables are defined in Table 2.3.

World trade elasticities: Data on import demand elasticities from Broda, Greenfield, and Weinstein (2010). The elasticities are available at the 3-digit HS for 73 countries.

GDP per capita: Data on GDP per capita ($CGDP_c$) comes from the Penn World Table (PWT) 6.2. The version 6.2 uses the year 2000 as the base year.

Income inequality: Income inequality data (Gini coefficient and income deciles) comes from the UNO-WIDER (United Nations World Institute for Development Economics Research)[45]. In case of duplicate values for a year-country pair, I choose the highest quality rating, keep the latest revision, keep if the area covered is the whole country, and give preference to disposable income information.[46] [47]

To classify products between differentiated and non-differentiated goods, I use the Rauch (1999) classification of goods.[48]

2.4 Empirical strategy

The identification strategy to test Predictions 1, 2 and 3 follows a difference-in-difference-in-differences (DDD) strategy. To control for the possible endogeneity and non-random self-selection of quality upgrading, I combine the DDD with matching techniques. Moreover, Sections 5 and 6 discuss several robustness checks and placebo exercises to address the endogeneity concern. For the DDD, the price outcome is compared between the years

[45] Data available at http://www.wider.unu.edu/research/Database/en_GB/wiid/.

[46] The precise steps to drop duplicate values are: (i) keep the highest quality rating, (ii) keep the latest Revision, (iii), keep if the area covered is the whole country, (iv) keep if the income unit is the household, (v) keep if the statistical unit is the person, (vi) keep if the income definition is Disposable Income, (vii) drop if information on currency is not available.

[47] Information on the Gini coefficient is available for all countries in the sample of EU and Mercosur countries, except for Paraguay in the year 2000. For Paraguay I use the information from the year 1999. For robustness checks using additional countries, I need to expand the Gini coefficient in case the information is missing for a given year: for the cross-section 2000, for instance, information on the Gini coefficient was available only for 73 countries. Thus, in case the information for the year 2000 is missing, I use information from the years 1999 and 2001, respectively. Similar for 1997, which increases the sample to 91 countries.

[48] Rauch (1999) uses the 4 digit SITC product classification (issued by the United Nations) to aggregate the trade data in three groups of commodities: (i.) w, homogeneous (organized exchange) goods: goods traded in an organized exchange; (ii.) r, reference priced goods: not traded in an organized exchange, but which have some quoted reference price, as industry publications; and (iii.) n differentiated goods: without any quoted price.

1997 (t_0, before treatment) and 2000 (t, after treatment) for the EU (treated) and Mercosur countries (control group) for firms that upgraded product quality (treated) and firms that did not (control group). Figure 2.3 presents in a simple way the structure of the treatment effects. A further layer for identification refers to differentiated (treated) and homogeneous goods (control group). The main assumption is that, controlling for firm-product-country fixed effects, period fixed effects, and several time-varying variables, the price effect identifyed is due to quality differences across groups. To test Prediction 3 from the stylized model, the treated group is represented by firms that did both skill and quality upgrading over time.

Since the identification requires variation over time, only *permanent* exporters active in the destination markets of interest are kept in the sample. Most of the results refer to EU and Mercosur, and in Section 6 the analysis is extended to further destination countries. Mercosur and EU are used in the main analysis for two main reasons. First, besides the United States, the EU and Mercosur represent the main markets for Brazilian products. Second, following the motivation from Section 3.1, EU and Mercosur represent the extremes of the quality varieties exported by Brazilian firms. For the EU, a market with a high share of high-income individuals, firms are willing to innovate and to upgrade quality. For Mercosur, a market with a high share of low-income individuals, firms have low profit incentives to introduce their high quality product (e.g. because of entry and marketing costs, or production capacity constraints). Thus, for these two groups, there is a lower probability that the firm ships a mix of quality products to the same market.[49] [50]

2.4.1 Quality upgrading

A firm upgrades product quality from time t_0 to t if the following questions are answered affirmatively in the innovation survey: (1) *undertook product innovation* and (2) *product innovation was important to increase product quality.* Table 2.2 describes the questions.

[49] In some South American countries as Chile, for instance, it is less clear whether consumers buy the low quality variety or the high quality variety. This is also the case of some new European countries not in the European Union by 2000.

[50] Robustness checks are carried using only the EU countries with similar (high) income per capita and same currency: France, Germany, Netherlands, Luxembourg and Austria. The effect is slightly higher in magnitude, but the significance does not change.

For $Qual_{ft_0}$ the initial level of quality of a firm f, if the firm answers positively both questions, then $Qual_{f,t} > Qual_{ft_0}$. The dummy variable for quality upgrading over time follows:

$$Upgrade_{ft} = \begin{cases} 1 & \text{if } t > t_0 \wedge Qual_{ft} > Qual_{ft_0} \\ 0 & \text{if } t < t_0 \vee Qual_{ft} = Qual_{ft_0} \end{cases}$$

As alternative treatment measures for $Upgrade_{ft}$, different questions from the PINTEC (2000) innovation survey are used for robustness checks. Since most firms are multiproduct firms, I also use information on the importance (percentage of sales) of the innovated product in the export volume. Further questions from the innovation survey refer to changes in product design changes to adapt to international rules and certifying norms.

According to **Prediction 1** from the theoretical model, if a firm invests in product innovation and increases product quality ($Upgrade_{ft} = 1$), then $\Delta_{t,t_0}Uprice_{fcgt} > 0$, for $Uprice_{fcgt}$ the yearly average export price of product g from firm f sold to country c in time t (see variables description in Table 2.2). For simplicity of exposition, the stylized model from section 3 assumed that each firm produces one variety. In the sample used in the estimations, around 77% of the firms are multiproduct firms. Thus, products are indexed by g and firms by f. Asymmetries across products are discussed later in this section.

Firms that did not upgrade quality over time, for which $Upgrade_{ft} = 0 \; \forall t$, are used as a control group. Note that $Upgrade_{ft} = 0 \; \forall f$ in t_0. Selection issues are discussed in Sections 5 and 6. A vector of variables X_{fcgt} controls for many firm, product, and market characteristics that might vary over time, described in Table 2.3. The DD specification follows:

$$log(Uprice_{fcgt}) = \mathbf{Upgrade}_{ft}\gamma_{dd} + log(\mathbf{X}_{fcgt})\beta + \delta_{fcg} + \mu_t + u_{fcgt} \tag{2.8}$$

where the TREATED group is composed by firms that upgraded product quality over time ($Upgrade_{ft} = 1$); $log(\mathbf{X}_{fcgt})$ is a vector of control variables described in Table 2.3; δ_{fcg} is a firm-product-country unobserved heterogeneity; μ_t is a time-varying intercept; and u_{fcgt} is an error term.

The coefficient of interest, γ_{dd}, shows the effect of quality upgrading on the profile of prices, expected to be positive.

Moreover, according to **Prediction 2**, firms increase product quality to attend demand from Northern countries. The motivation and plausibility for this prediction has been discussed in Section 3.1. As a hypothesis, products sold to the EU by innovative firms received the quality treatment, while products exported to Mercosur did not receive the treatment over time (control group). The DDD specification follows:

$$log(Uprice_{fcgt}) = \mathbf{Upgrade}_{ft}*\mathbf{EU}\gamma_{ddd}+Upgrade_{ft}\alpha_1+EU\alpha_2+log(X_{fcgt})\beta+\delta_{fcg}+\mu_t+u_{fcgt} \tag{2.9}$$

where the TREATED group are the products exported to the ($EU = 1$), by firms that upgraded product quality over time ($Upgrade_{ft} = 1$).
In the DDD specification, the coefficient of interest is γ_{ddd}. The effect is expected to be positive: higher prices in the EU are explained by imports from firms that innovate and upgrade product quality.

Since the treatment is not a random assignment, I combine the DDD with matching techniques in Section 6. Section 5 discusses the markup hypothesis and the role of the elasticity of substitution, and several robustness checks and placebo exercises are conducted in Sections 5 and 6.
Results for equation (2.9) are shown for different types of goods, using the Rauch (1999) classification of goods. Since homogeneous goods do not have (or have little) scope for quality differentiation, the coefficient of γ_{ddd} is expected to be positive and significant only for differentiated goods. For non-differentiated goods (the sum of reference priced goods and homogeneous goods) results are expected to be non-significant.[51]

2.4.2 An integrated quality and skill upgrading mechanism

According to Prediction 3, producing higher quality requires a higher share of skilled workers.[52] Thus, by increasing the level of quality θ_{jc}, firms also increase the quality of their workers.
The prediction on complementarity is tested using a *skill upgrading mechanism*. The

[51]

[52] Firms that upgrade product quality need better qualified workers. Similar cases were analysed in the literature before by, e.g., Yeaple (2005) for technology choice, and Brambilla, Lederman, and Porto (2010) for quality choice.

variation in workers skills over time (*skill upgrading*) is proxied by the increase in the firm's share of workers with tertiary education ($\Delta_{t,t_0} ShareHighEduc_f$), the increase in the firm's share of professionals ($\Delta_{t,t_0} ShareProfessionals_f$) and the increase in firm's average wages ($\Delta_{t,t_0} Wages_f$) between 1997 (t_0) and 2000 (t). The variation over time is compared to the median of the industry i, taken as the threshold.[53] The dummy variable for skill upgrading follows:

$$Skills_{ft} = \begin{cases} 1 & \text{if } t > t_0 \wedge \\ & \Delta_{t,t_0} ShareProfessionals_f > median(\Delta_{t,t_0} ShareProfessionals)_{\mathbf{i}} \wedge \\ & \Delta_{t,t_0} ShareHighEduc_f > median(\Delta_{t,t_0} ShareHighEduc)_{\mathbf{i}} \wedge \\ & \Delta_{t,t_0} Wages_f > \wedge median(\Delta_{t,t_0} Wages)_{\mathbf{i}} \\ 0 & otherwise \end{cases}$$

$Skills_{ft}$ means that a firm upgraded the quality of the labor force from t_0 to t if the variation in workers characteristics is higher than then median variation in the same industry i.[54] Prediction 3 of the model suggests that skill upgrading over time ($Skills_{ft} = 1$) leads to increases in prices, $\Delta_{t,t_0} Uprice_{ft} > 0$.

The effect of quality and skill upgrading on prices is estimated as follows:

$$log(Uprice_{fcgt}) = Skills_{ft} * Upgrade_{ft} \gamma_{dds} + Skills_{ft} \beta_1 + Upgrade_{ft} \beta_2 + log(\mathbf{X}_{fcgt}) \beta_3 + \delta_{fcg} + u_{fcgt} \tag{2.10}$$

where the TREATED group is composed by firms that upgraded product quality and workers' skills over time ($Skills_{ft} * Upgrade_{ft}$). The coefficient of interest is γ_{dds} and is expected to be positive. Firms that jointly increase product quality and workers' skills charge higher prices. The variable $Skills_{ft}$ is also tested separately.

One important critique to the *skill upgrading mechanism* could be that wages may be determined ex post and they would, in this case, reflect rent-sharing and not skill upgrading.

[53] If a firm increased these shares and the average wages more than the industry median between 1997 (t_0) and 2000 (t), then the firm upgraded workers' skills in this period.

[54] With this assumption, it might happen that some firms below the median upgraded workers' skills too, what would underestimate the results. Although, the assumption rules out a possible bias due to trends in specific industries. Another concern with this specification relates to negative values of the median (in case the whole industry had a negative shock). Thus, alternatively, I estimate the results only for the industries that have not suffered negative shocks in the period. I also estimate results without wages. Results are robust in both cases.

See, for instance, the discussion of rent-sharing in Frías, Kaplan, and Verhoogen (2009).
As a robustness check, the same analysis is conducted without wages, using the variable $Skills_{ft}^{nowage}$. This variable considers only the $\Delta_{t,t_0}ShareProfessionals_f$ (measure of white-collar occupation) and $\Delta_{t,t_0}ShareHighEduc_f$ (measure of education), which are ex ante decisions of the firm, as follows.

$$Skills_{ft}^{nowage} = \begin{cases} 1 & \text{if } t > t_0 \wedge \\ & \Delta_{t,t_0}ShareProfessionals_f > median(\Delta_{t,t_0}ShareProfessionals)_{\mathbf{i}} \wedge \\ & \Delta_{t,t_0}ShareHighEduc_f > median(\Delta_{t,t_0}ShareHighEduc)_{\mathbf{i}} \wedge \\ 0 & otherwise \end{cases}$$

2.5 Results

This section presents evidence of quality-based market segmentation: firms increase product quality and prices to high-income countries, and the effect is not driven by markups, elasticities of substitution, or firm selection. The section is divided as follows. Section 5.1 confirms prediction 1 from the stylized model: firms jointly increase product quality and product prices. Section 5.2 confirms prediction 2 from the model: firms that upgrade quality raise quality and prices to high-income countries. Section 5.3 shows that higher prices in high-income countries are not driven by different markups or elasticities of substitution, but are rather a result from quality upgrading and market segmentation. Finally, Section 5.4 discusses prediction 3 from the model on the complementarity between quality upgrading and workers' skills.
Results in Section 5 are shown for European Union and Mercosur and, in Section 6, they are extended to further countries. Since I am interested in the variation *over time*, results are reported for permanent exporters to the EU and Mercosur.[55] The control variables $\mathbf{x}_{gfc}$ used are described in Table 2.3.

[55]Permanent exporters are firms exporting to these markets in all years.

2.5.1 Quality upgrading as an explanation for price differences across firms

Table 2.5 confirms the first prediction from the model: firms that increased product quality over time charge higher prices. The estimation strategy is the DD described in equation 2.8. Estimations are shown using firm-product-country fixed effects, a period dummy and various control variables, described in Table 2.3.[56] Columns (1) to (3) include different measures of market share. Columns (1) to (3) show results for differentiated goods and include different firm-product and country characteristics. Columns (4) to (6) show results for homogeneous goods. As expected, the effect on prices is only observed for differentiated goods, with scope for quality differentiation. The results are robust to several measures of market power and to other firms' characteristics.

2.5.2 Market segmentation: innovative firms upgrade quality to Northern countries

Table 2.6 shows the results for the DDD, which corresponds to Prediction 2 from the model. Northern countries have a high demand for high quality products. Thus, firms increase product quality to attend this demand, which implies higher costs and higher prices. In particular, in the period of the Brazilian economy under analysis, firms innovated to adapt to foreign consumer requirements and to maintain their foreign markets, as discussed in Section 3.1. As shown in Columns (1) to (3), for differentiated goods the effect of quality upgrading on prices is captured by products sold to the EU. This is shown by the interaction term $Upgrade_{ft} * EU$: firms increased product quality and product prices to EU countries. As expected, results for homogeneous goods are not significant.[57]

[56] The data is clustered at the firm level. Alternatively, clustering by firm-product level does not change the significance of the results.

[57] Note that the level effect, $Upgrade_{ft}$ is not significant but even negative. This reinforces the fact that firms upgraded quality to Northern countries, since EU captures the whole effect.

2.5.3 Further evidence of market segmentation: higher prices in Northern countries can not be explained only by markups

The markup hypothesis

One important concern is pricing to market. It could be that the observed price variation across countries reflects markups and not quality shifts, yet the analysis controls for several measures of market power and market competition. Variation in markups across countries has been shown, e.g., by Simonovska (2010). To overcome this caveat, I present further evidence that supports the quality hypothesis.

As a first falsification exercise, I compare sales of non-innovative firms across markets. If the price effect is due to a (first degree) price discrimination in European countries and not due to quality upgrading, non-innovative firms should receive a price premium from their exports to the EU. Using a EU dummy, Table 2.7 shows that there is no significant price difference across destination for non-innovative firms over time. EU is not significant.[58] Thus, the variation in prices across countries can not be attributed to higher markups in Northern countries.

This analysis also rules out the possibility that prices are driven by market-specific shocks in Northern countries, or by changes in transportation costs: in this case, we would observe also for non-innovative firms an increase in prices to the EU. In contrast, results are not significant, as shown in Table 2.7.

A second falsification exercise is to compare sales to the South for firms that upgraded product quality compared to those that did not.[59] It could be that, after incuring the innovation cost to increase product quality, firms also sell the high quality variety to Southern markets. And, in case firms export high quality to the South, they should receive a price premium in the South. Thus, Table 2.8 studies whether innovative firms increase prices to the South after quality upgrading (in comparison to firms that did not upgrade quality). Interestingly, the variable $Upgrade_{ft}$ has no effect on prices, i.e., firms that upgrade quality do not receive any price premium in the South in comparison to firms that did not upgrade quality. Thus, if there is only a small demand for high quality in Southern countries, firms have low incentives to introduce the high quality variety in the South. Results from Table

[58] The effect is also not significant for the $COREPRODUCT_{ft}$ (the firms' most important variety, defined in Table 2.2).

[59] Innovative and non-innovative firms are active in both markets.

2.8 support the hypothesis that the price premium is driven by exports to the EU.

Markups and the elasticity of substitution

Using the 3 HS digit demand elasticities computed by Broda, Greenfield, and Weinstein (2010), Table 2.9 studies whether results are robust to different elasticities of substitution across countries. In case the demand elasticity is different across countries, price variation across markets could reflect pricing to market, and not quality differences.

To test whether the effect is driven by the elasticity of substition, the HS 3 digit sectors are divided according to the *similarity in the demand elasticity* in the EU and Mercosur, resulting in two groups:

$SimilarHIGH = 1$ if both Mercosur and EU have a relatively high demand elasticity in a given HS 3 digit sector. An elasticity is defined as high if it is *above the median elasticity* in the HS 3 digit sector. The median is computed across all countries for which elasticity data is available (73 countries).

$SimilarLOW = 1$ if both Mercosur and EU have a relatively low demand elasticity in a given HS 3 digit sector. An elasticity is defined as low if it is *below the median elasticity* in the HS 3 digit sector. Also in this case, the median is computed across all countries for which data is available.

Thus, $SimilarHIGH$ and $SimilarLOW$ are measures of relative similarity in the elasticity, comparing to other countries in the world.

Finally, the sample is divided according to the relative similarity in the elasticity (both high and low). The first sample corresponds to observations for which $SimilarHIGH = 1$ or $SimilarLOW = 1$ (in this case EU and Mercosur have similar elasticities, high or low). The second sample corresponds to observations for which $SimilarHIGH = 0$ or $SimilarLOW = 0$ (in this case EU and Mercosur have relatively different elasticities, either high or low).

If the price effect is not a result from different elasticities across destinations (implying markup pricing), the effect of $Upgrade_{ft} * EU$ will hold for sectors in which Mercosur and EU have relatively similar elasticities (either $SimilarHIGH = 1$ or $SimilarLOW = 1$). Results in Table 2.9 shows that this is the case. Columns (1) to (3) reveal that the effect of quality upgrading on prices is significant for sectors with relatively similar elasticities across countries. Columns (4) to (6) present results for sectors with different elasticities. Thus, results can not be explained only by different elasticities of substitution across countries.

2.5.4 An integrated quality and skill upgrading mechanism: upgrading workers' skills reinforces the effect of quality on prices

Innovative firms need more skilled workers to produce higher quality, a result shown in Prediction 3 of the model. Table 2.10 shows the results for the unified quality and skill upgrading mechanism.

Columns (1) and (2) show the results for $Skills_{ft}$: increasing workers' skills leads to higher prices. In Columns (3) and (4), the interaction term combining quality and skill upgrading $Skills_{ft} * Upgrade_{ft}$ is added. Results reveal that firms jointly increasing product quality and workers' skills charge higher prices. While the level effect of $Skills_{ft}$ is not significant and even negative, the level effect for the variable $Upgrade_{ft}$ remains significant, suggesting that the complementarity among quality upgrading and skills is not perfect. Thus, factors different from workers' skills help explaining the effect of product quality on prices.

The analysis shown in columns (1) to (4) includes information on wages. As discussed in Frías, Kaplan, and Verhoogen (2009), wages might reflect rent-sharing. In this case, it would not capture skill upgrading. Thus, columns (5) to (8) present results including the interacton term $Skills_{ft}^{nowage} * Upgrade_{ft}$ (using only information on workers education and occupation, ex ante decisions of the firm). Results in columns (6) and (8) suggest that using information on wages might generate an upward bias in the coefficient of $Skills_{ft}^{nowage} * Upgrade_{ft}$, even though the significance of the results does not change [60].

The level effect of $Skills_{ft}^{nowage}$ is even negative and significant once the interaction term with quality is added. This negative result might capture observations for which skill upgrading is related to process innovation and not to product innovation.[61] Thus, while the effect of quality upgrading has a positive and robust effect on prices, the effect of skill upgrading on prices might reflect process upgrading as well.

[60] Although, further analysis is needed to study which firms are in each of the groups.

[61] One can easily imagine cases in which skill upgrading is related to technology upgrading, and not directly to product upgrading.

2.6 Identification of the Price Variation

2.6.1 Price variation across countries is not observable for other sources of firm heterogeneity unrelated to quality

Results in Tables 2.11 and 2.12 show that price differences across firms and countries are not observable to other changes in firms' characteristics, but are rather specific to quality upgrading. In particular, I look at process innovation for comparison.

The PINTEC (2000) innovation survey contains information on process innovation activities, as described in Table 2.2. The variable for process innovation $Process_{ft}$ is constructed in a similar way to $Upgrade_{ft}$:

$Process_{ft} = 1$ for firms that answered they did *process innovation* in time t, and zero otherwise.

Results in Table 2.11 reveal that $Process_{ft}$ is not significant, which is a plausible result. Following the efficiency sorting models of trade[62], more productive firms have lower marginal costs and charge lower prices. Thus, these models would predict a negative effect of process innovation (technology upgrading) on prices. Importantly, controlling for efficiency, $Upgrade_{ft}$ remains positive and significant in all specifications.

The interaction term $Process_{ft} * EU$ in Table 2.12 reveals that differences in prices *across countries* are not driven by process innovation. As expected, prices are not higher in Northern (EU) countries for firms that increased production efficiency, wich supports the hypothesis of a quality-based market segmentation. The only significant value is found at the 10% level, without controlling for important changes in country characteristics.[63]

Results suggest that differences in prices across countries can be attributed to quality upgrading.

[62] Such as Melitz (2003) and Melitz and Ottaviano (2008).

[63] Similar robustness checks are carried using further questions from the innovation survey. For instance, whether the firm changed the organizational structure (question v150 from the innovation survey). Results are similar to the ones reported in Table 2.12.

2.6.2 A placebo exercise using 1998 (year before treatment) as the treatment year: The effect of quality on prices is not driven by firms' characteristics

Table 2.13 shows that the results are not driven by firm selection. The results from Table 2.6 could be driven by firm-specific characteristics not related to quality upgrading. To overcome this issue, the price variation in the period 1997-1998 (before treatment) is evaluated for the firms that received the treatment in the later period, compared to the control group that did not receive the treatment. The variable of interest is defined as $\mathbf{UpgradePlacebo}_{ft}$, where $UpgradePlacebo_{ft} = 0$ in the year 1997 for all firms, and $UpgradePlacebo_{ft} = 1$ in the year 1998 for firms that received the treatment ($Upgrade_{ft} = 1$) in the subsequent period (1998-2000). Results in Table 2.13 reveal that the effect of the placebo variable $UpgradePlacebo_{ft}$ on prices is not significant, which supports the hypothesis that the effect on prices is not firm-specific, but rather quality-driven.

2.6.3 Results using different set of countries: The quality effect is not driven by EU and Mercosur

The results from Section 5 are extended to different groups of countries. The variable $Group$ is defined as $Group = 1$ for Northern countries, and $Group = 0$ for Southern countries. The groups are defined as:

$Group_1 = 1$ if country is EU or United States; zero if Mercosur.

$Group_2 = 1$ if country is United States; zero if Mercosur.

$Group_3 = 1$ if country is United States or Canada; zero if Mercosur.

$Group_4 = 1$ if country is EU, United States or Canada; zero if South America.

Results are shown in Table 2.14. In all cases, the interaction term $\mathbf{Upgrade}_{f,t} * Group$ is positive and significant, which confirms that results are not specific to the EU and Mercosur.

2.6.4 Propensity score matching and self-selection into quality upgrading

An additional strategy to address the possible endogeneity of quality upgrading is to control for self-selection into quality ugprading. The causal effect of quality upgrading on prices assumes that $E(luprice_{treated} - luprice_{control}|Upgrade = 1) = E(luprice_{treated}|Upgrade = 1) - E(luprice_{control}|Upgrade = 1)$, i.e., the difference in prices of firms that increased product quality, compared to the outcome of firms had they not increased quality. The problem is that the outcome of any firm is observed under either quality upgrading or not, but never both, leading to a missing counterfactual.

The concern with self-selection is less severe in this Chapter given the additional within-firm treated and control group of North and South countries, which generates additional counterfactuals within the firm. However, the possible selection bias from the missing counterfactural is addressed by creating control groups using matching techniques.

The intuition behind finding an appropriate control group is to find a group that is as close as possible to the firm that increased product quality in terms of the predicted probability to increase product quality. The underlying assumption for validity is that conditional on a vector of firm observable characteristics **X**, potential outcomes with and without the treatment are independent of the treatment status, i.e., outcome of treament firms p_1 and control firms p_0 are orthogonal to the greatment status ($Upgrade$): $(p_o, p_1) \perp Upgrade|X$. The variables used for the the vector X are: number of employees, total revenues, number of products, foreign ownership information, share of white collar workers, and average wages. I match within a year and within industries, and therefore the control group is created within narrowly defined industries, instead of using the whole manufacturing industry. The matching technique used is the nearest neighbor matching.

The matching combined with the difference-in-differences approach controls for divergence in the paths of performance between the firms that increased product quality and the matched control firms that had similar characteristics in the pre-quality treatment year. In this way it is possible to control for observed and unobserved effects. Examples of papers using propensity score matching combined with the DD approach are Arnold and Javorcik (2009) and De Loecker (2007). As discussed by Blundell and Costa Dias (2000), while matching accounts for differences in observable characteristics, the combination with

the DD provides scope for an unobserved determinant of participation as long as it can be represented by separable individual- and/or time-specific components of the error term.
Results reveal that the propensity score matching performs well in correcting the bias. The average probability to participate in the treatment for all the individuals is roughly 40%. The calculated bias before and after matching for each variable shows that the change in the bias is of 20% on average. The differences between treatment group and control group are reduced considerably in case of variables with a large bias before matching. In this way, the control group is similar enough to the treatment group to be used for the estimation of the average treatement effect on the treated (ATT).
Table 2.15 shows the results for the nearest neighbor matching strategy. Results for the ATT reveal that individuals in the treated group realized an increase in prices of 52%. A similar treatment is considered for sales to the EU, compared to sales to Southern countries. In this case, the results reveal that the treated group realized an increase in prices of 55%. Note that these numbers are much higher than the results found in Tables 2.5-2.16, without the propensity score matching. One reason for the higher coefficients is the sample of firms used for the matching, since not all firms could be matched. Using the smaller set of firms for estimations as in Table 2.6 reveals a sightly higher coefficient. Moreover, the propensity score matching puts more weight on cells with a high share of treated, while the former estimations with a full vector of control variables gives more wight to cells with balanced numbers of treated and control individuals. Importantly, in both cases estimations are positive and statistically significant, confirming the hypothesis of the effects of quality upgrading on prices and the asymmetric increases in product quality.

2.6.5 Asymmetries across products, sectors and the importance of the core product for quality upgrading

In the sample used in this Chapter, 77% of the firms in the sample are multiproduct firms. For those firms, it is possible to identify in the innovation survey the importance of the innovated product to total sales of the firm. Table 2.17 show that the results are robust to firms tat export few products, as well as to firms for which the percentage of sales of the innovated product is higher than 50%. Moreover, Table 2.16 shows results for asymmetries across products for multiproduct firms.

Columns (1) to (4) from Table 2.17 show the results for firms for which the percentage of exports of the innovated product is higher than 50%. The underlying idea is to use a cleaner quality treatment, since multi-product firms may upgrade quality of only a set of their products. For this purpose, in columns (1) to (4) I use the following question from the PINTEC (2000) innovation survey: *what is the percentage of foreign sales of the innovated product*.[64] Results reveal similar effects for this sample of firms. Moreover, columns (5) to (8) shows results for the intensive margin of products. In these columns, I use a sample of firms that exported at most two HS 8-digit products in the period, for European Union and Mercosur. Asymmetric effects of quality on prices across countries are again confirmed for firms with few products, yet the magnitude of the results is much larger.

Table 2.16 presents further results of asymmetries across products. According to Eckel, Iacovone, Javorcik, and Neary (2011), firms invest more in the quality of the products closer to their core competence, since they may obtain higher margins with these products. Thus, the profile of prices is positively correlated with the profile of sales and the effect of $Upgrade_{ft}$ on prices is expected to be higher for the core product. The $COREPRODUCT_{ft}$ is defined as the 8-digit variety representing the firm's highest sales.[65] [66]

This hypothes is isconfirmed in columns (1) and (2) of Table 2.16, for differentiated goods. The core product captures the effect of quality upgrading on prices, a result shown by the interaction term $COREPRODUCT * Upgrade_{ft}$. As expected, for homogeneous goods no effect is observed, as shown in columns (5) and (6).

The results for the core product are plausible, given the importance of the core variety for firms' sales. Around 77% of the firms in the sample are multiproduct firms. The core product represents more than 75% of exports for 38% of the multiproduct firms, and more

[64] This question refers to the variables v74 and v75 from the innovation survey. With this variables, I create the variable $HighShareX_{ft}$, shown in Table 2.2.

[65] 77% of the firms in the sample are multiproduct firms. For 60% of the multiproduct firms, the coreproduct corresponds to more than 50% of the sales

[66] In the period under analysis, only 2 firms from the sample changed their 8 digit $COREPRODUCT_{ft}$. This does not imply that there is no product level dynamics within the firm. First, I find evidence of changes in the product mix for varieties that are not in the core. Second, there is quality variation within an 8-digit product and, most likely, product churning within an 8-digit product. Third, I evaluate only *permanent exporters*, which have less variation in their core business. Thus, the fact that the core product remains stable for those firms does not contradict the results from Iacovone and Javorcik (2010), Bernard, Redding, and Shott (2011) and Nocke and Yeaple (2008) on product level dynamics within the firm.

than 50% of exports for 73% of the multiproduct firms. Thus, sales are highly concentrated in the core product.[67]

Columns (3) and (4) show results for asymmetries across sectors, using the Khandelwal (2010) classification of short and long quality ladders ($LADDER_{st}$, for a sector s and time t). The long quality ladders are classified as sectors with higher scope for quality differentiation (sectors above the median ladder). Thus, the effect of quality upgrading on prices should be magnified for these sectors. As shown in columns (3) and (4) in Table 2.16, for differentiated goods the effect of quality upgrading on prices is captured by the sectors classified as long quality ladders. This result is shown by the interaction term $LADDER_{st} * Upgrade_{ft}$. For homogeneous goods, no effect is observed, as expected.

The results are in line with Chatterjee, Dix-Carneiro, and Vichyanond (2011). They study multiproduct Brazilian exporters between 1997 and 2006 and find that, with a real exchange rate depreciation, firms adapt prices and quantities across products. Produts closer to the firms' core competence perceive higher increases in markups, since for the core product the firm has lower marginal costs of production. However, they do not find any evidence of variation across countries. Moreover, for the purposes of their study, they do not make use innovation data, and, thus, can not sort out markups from quality differences.

Concerning possible effects of the exchange rate shock from 1999, two important facts must be mentioned. First, there are no exchange rate differences across markets following the devaluation of the real Brazilian exchange rate: a graphical analysis of the exchange rates reveals that the size of the devaluation does not vary across countries. Thus, the difference in prices between the two markets can not be due to the devaluation. Second, the exchange rate shock was largely unexpected, which rules out the possibility that some exporters were able to foresee higher revenues after the devaluation.

2.7 Conclusion

This Chapter investigates whether firms segment the market and adapt product quality and product prices according to market conditions. Direct and detailed information on self-reported quality upgrading over time allows studying whether the observable product

[67] These results are in line with the results reported in Arkolakis and Muendler (2011).

price variation is due to quality variation, or to other factors, such as markups, elasticities of substitution, destination country characteristics, or selection effects.

Using a difference-in-difference-in-differences approach, the Chapter finds evidence of quality-based market segmentation, by which firms raise quality and prices to high-income countries. Results reveal that differences in prices across countries are not driven by markups, but by demand for high quality.

The Chapter discusses self-selection into quality upgrading and shows several robustness checks and placebo exercises that confirm the validity of the DDD strategy. The analysis is extended in different ways. First, using different North/South countries, the Chapter shows that results are not specific to the EU and Mercosur. Second, it shows that price differences across countries are specific to quality upgrading, and do not hold for other changes in firm's characteristics. Third, asymmetries across products reveal that the core product captures the whole effect of quality upgrading on prices.

In a nutshell, by sorting out different sources of price variation, the Chapter shows that quality is a relevant margin of firm level adjustment and that firms segment destination markets. Controlling for market structure and firms' characteristics, where the firm exports to matters. In particular, this is true despite different markups across destinations.

Table 2.1: Variation in export prices. Standard deviation for the years 1997 and 2000

	Obs	Mean	Std.Dev.	Min	Max
Variation in export prices across destinations within firm-product pairs					
Standard deviation of prices across destinations:					
Total trade, year 1997	9902	**0.188**	0.407	0	4.321
Differentiated goods, year 1997	8514	0.196	0.410	0	4.321
Homogeneous goods, year 1997	214	0.056	0.223	0	2.638
Total trade, year 2000	16030	**0.200**	0.464	0	5.705
Differentiated goods, year 2000	13025	0.201	0.454	0	5.705
Homogeneous goods, year 2000	245	0.094	0.272	0	2.019
Variation in export prices across firms within country-product pairs					
Standard deviation of prices across firms:					
Total trade, year 1997	6611	**0.459**	0.772	0	5.766
Differentiated goods, year 1997	5321	0.499	0.797	0	5.766
Homogeneous goods, year 1997	168	0.072	0.179	0	1.746
Total trade, year 2000	10768	**0.486**	0.824	0	6.150
Differentiated goods, year 2000	8173	0.511	0.821	0	6.150
Homogeneous goods, year 2000	203	0.212	0.618	0	4.015

Table 2.2: Description of the dependent variable and main explanatory variables

Variable	**Variable description**	**Data Source**
Average prices:		
$Uprice_{fcgt}$	Average US dollars f.o.b. export prices by firm f, country c and product g at time t: $\frac{Value_{fcgt}}{Quant_{fcgt}}$, where $Value_{fcgt}$ is the export value and $Quant_{fcgt}$ the export quantity.	SECEX
Quality Upgrading and Product and Process Innovation:		
$Upgrade_{ft}$	$Upgrade_{ft} = 1$ if $t > t_0$ and if Firm did product innovation (questions v07 and v08 from PINTEC (2000) Survey) AND product innovation was important to increase product quality (question v77)[1]	PINTEC
$Process_{ft}$	$Process_{ft} = 1$ if $t > t_0$ and if Firm did process innovation (questions v10 and v11 from PINTEC (2000) Survey)	PINTEC
$HighShareD_{ft}$	Share of domestic sales of the innovated product (questions v71 and v72)[2]	PINTEC
$HighShareX_{ft}$	Share of foreign sales of the innovated product (questions v74 and v75)	PINTEC
Coreproduct:		
$Coreproduct_{ft}$	First ranked 8 digit NCM product according to the firm's world sales	SECEX

Notes: The innovation survey is available at:
`http://www.pintec.ibge.gov.br/downloads/PUBLICACAO/Publicacao%20PINTEC%202000.pdf`

1. Question v77 us according to the importance of product quality: (i) high, (ii) medium, (iii) low or (iv) did not do product innovation. I assume that product innovation was important if the firm answered either (i) or (ii).
A robustness check using only with (i) does not change the main results.

2. Alternatively, question v73 refers to the share of domestic sales of the non-innovated products.

Table 2.3: List of control variables $\mathbf{x}_{gfc}$

Variable	Variable description	Data Source
Country characteristics:		
GDP_c	*GDP* of country c (measure of country size)	PWT 6.2
$CGDP_c$	*GDP* per capita of c	PWT 6.2
$Gini_c$	Gini coefficient in c	UNO-WIDER
$Dist_c$	Distance to country c	CEPII
$Contiguity_c$	Contiguity to country c	CEPII
$Language_c$	Common official primary language	CEPII
Firm-product characteristics:		
$Scope_{fc}$	Scope of the firm: number of goods sold by f in each destination c.	SECEX-Brazil
$Ndest_{gf}$	*Extensive margin of entry*: number of c to which the firm f exports good g.	SECEX-Brazil
$Quant_{gfc}$	*Intensive margin*: quantity exported of good g to country c by firm f.	SECEX-Brazil
$Revenues_f$	Total export revenues of f (measure of firm size).	SECEX-Brazil
$Wages_f$	Annualized average december wages of workers in firm f, deflated to the US-CPI August 1994.	RAIS-Brazil
$Nworkers_f$	Number of workers in f (measure of firm size).	RAIS-Brazil
$ShareHighEduc_f$	Share of workers in f with tertiary education.	RAIS-Brazil
$ShareProfe_f$	Share of professional workers in f (ISCO-88 classification).	RAIS-Brazil
$ShareWhite_f$	Share of white collar workers in f.	RAIS-Brazil
$ShareBlue_f$	Share of blue collar workers in f.	RAIS-Brazil
$Mktshare_{gfc}$	Market share of fg in c with respect to the sum of firms exporting g to c.	SECEX-Brazil
Other market characteristics:		
$ShareImp_{c,s}$	$\frac{Imp_{cs_i}}{\sum_{j \neq i} Imp_{cs_j}}$. Share of imports of c in sector s_i with respect to all sectors $j \neq i$	NBER-UN
$ShareExp_{c,s}$	$\frac{Exp_{cs_i}}{\sum_{j \neq i} Exp_{cs_j}}$. Share of exports of c in sector s_i as *proxy for production in c*	NBER-UN
$Mktshare_{fc,s}$	Share of imports in s_i from Brazilian firms with respect to total imports from the World	NBER-UN
$Nfirms_{gc}$	Number of Brazilian firms selling g in country c (competition measure)	SECEX-Brazil

Notes

[1] The distance from firm f to country c is assumed to be the same for all Brazilian firms.

Figure 2.1: Reasons for firms to innovate. Set of firms that did product innovation, according to the PINTEC (2000) innovation survey, wave 1998-2000

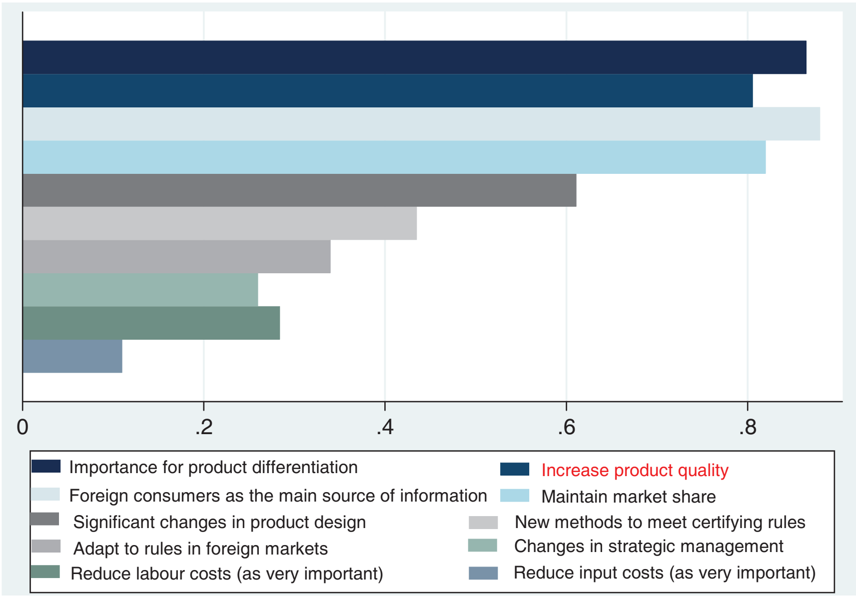


Table 2.4: Firm-level summary statistics for permanent exporters: by innovative behavior and year

	Innovative Firms				**Non-innovative Firms**			
	1997		**2000**		**1997**		**2000**	
Variable	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev
$Revenues_{ft}$	1.41e+08	2.38e+08	1.40e+08	3.99e+08	2.17e+07	4.44e+07	1.56e+07	4.12e+07
FDI_{ft}	0.428	0.495	0.559	0.496	0.195	0.396	0.221	0.415
$Ndestinations_{gft}$	30.240	18.198	30.043	18.201	16.945	15.317	16.662	1
$Nproducts_{ft}$ (scope)	176.220	162.581	144.295	154.230	44.766	84.695	41.600	77.996
$Nworkers_{ft}$	4049.300	5740.197	2972.693	3763.597	908.570	2019.499	673.194	1355.703
$ShareHighEduc_{ft}$	0.169	0.118	0.203	0.128	0.119	0.107	0.141	0.129
$ShareProfessionals_{ft}$	0.128	0.067	0.135	0.084	0.097	0.078	0.0100	0.087
$ShareTechnicians_{ft}$	0.146	0.070	0.155	0.083	0.123	0.084	0.136	0.105
$Wages_{ft}$	9204.780	4486.152	5240.148	2534.877	5681.827	3576.581	3815.166	2466.484
Number of firms	1166		1166		1277		1277	

Figure 2.2: Share of exports to the EU and Mercosur of the 10 top manufacturing industries. Industries divided according to the firms' decision to upgrade quality (year 2000).

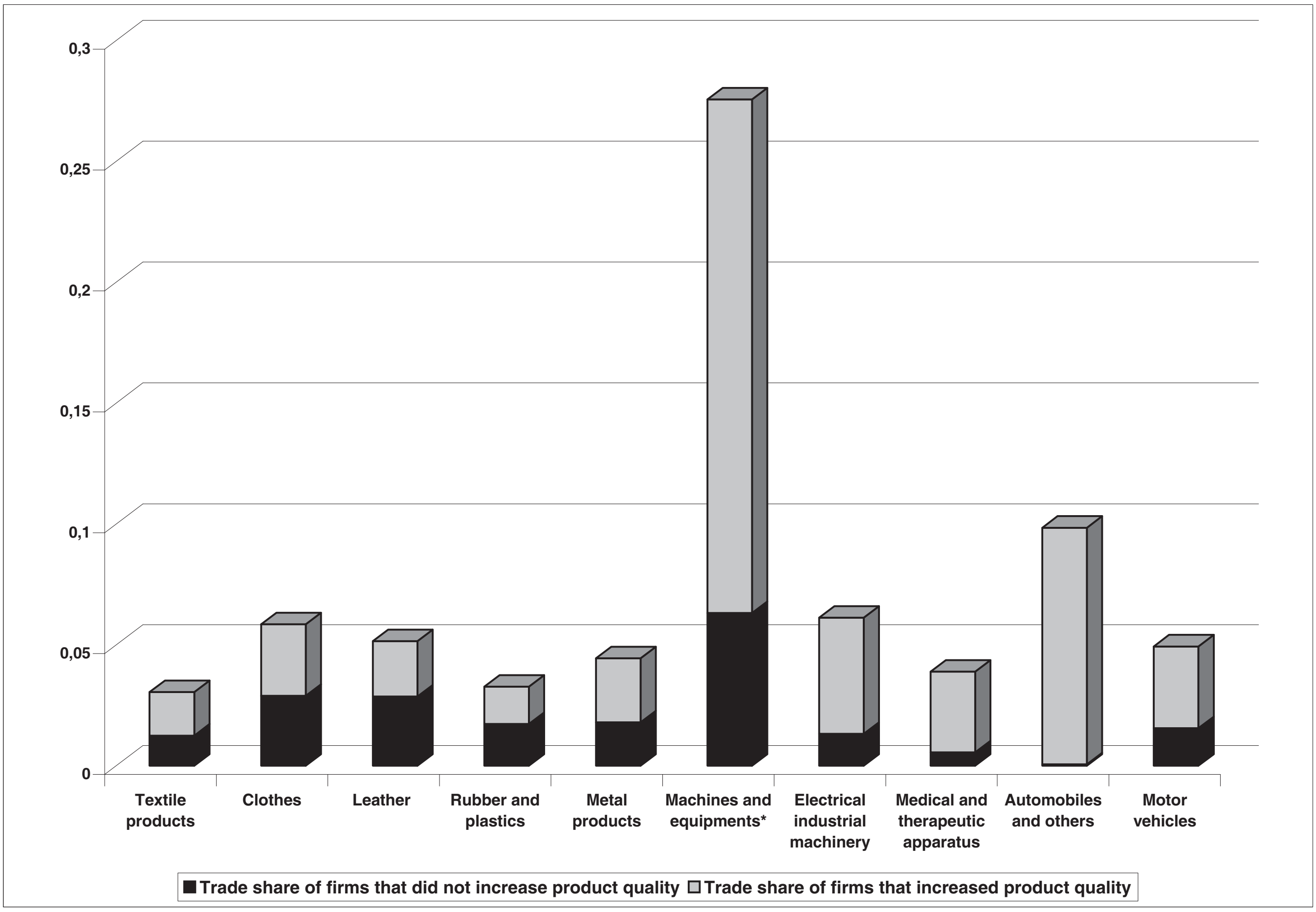


Table 2.5: Effect of Quality Upgrading ($\mathbf{Upgrade}_{ft}$) on Prices.

Dependent variable:	Differentiated goods			Non-differentiated goods		
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbf{Upgrade}_{ft}$	0.0515***	0.0483***	0.0584***	-0.122	-0.159	-0.127
	(0.0112)	(0.0110)	(0.0389)	(0.160)	(0.161)	(0.164)
$\log(Nworkers_{f}t)$	0.0615*	0.0708**	0.0488	0.428**	0.475***	0.629***
	(0.0328)	(0.0332)	(0.0335)	(0.169)	(0.168)	(0.212)
$\log(CGDP_{ct})$	0.952***	0.855***	0.945***	-0.117	0.0198	0.403
	(0.220)	(0.219)	(0.219)	(0.990)	(0.987)	(1.000)
$\log(Gini_{ct})$	-0.130	-0.113	-0.0991	0.486	0.463	0.692
	(0.230)	(0.229)	(0.230)	(0.940)	(0.940)	(0.955)
$\log(Ndestinations_{gft})$	0.00119	0.0198	0.0145	-0.356**	-0.504***	-0.437**
	(0.0385)	(0.0401)	(0.0388)	(0.167)	(0.180)	(0.172)
$Mktshare_{fct,s}$	0.153			-1.407**		
	(0.101)			(0.582)		
$ShareImp_{ct,s}$	-4.469			70.63		
	(5.294)			(47.51)		
$ShareExp_{c,s}$	-4.500			44.60		
	(6.606)			(86.75)		
$\log(Scope_{fct})$		-0.0414			0.258*	
		(0.0312)			(0.151)	
$Mktshare_{gfct}$		0.108***			0.160*	
		(0.0281)			(0.0925)	
$\log(Nfirms_{gct})$			-0.0143			-0.224*
			(0.0267)			(0.132)
$ShareProfessionals_{ft}$			-0.586			0.0220
			(0.386)			(1.532)
$ShareHighEduc_{ft}$			-0.179			-0.422
			(0.169)			(0.929)
$\log(Wages_{ft})$			-0.0289			0.0444
			(0.0385)			(0.191)
Period FE	yes	yes	yes	yes	yes	yes
Firm-product-country FE	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes
Observations	37,234	37,234	37,234	4,209	4,209	4,209
R-squared	0.106	0.110	0.106	0.085	0.072	0.096

Notes: Products are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.6: Effect of Quality Upgrading on Prices, for EU (North) and Mercosur (South).

Dependent variable:	**Differentiated goods**			**Non-differentiated goods**		
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)
Upgrade$_{ft}$ * **EU**	0.148***	0.128***	0.144***	0.229	0.268	0.157
	(0.0232)	(0.0231)	(0.0235)	(0.253)	(0.252)	(0.257)
Upgrade$_{ft}$	0.0181	0.0198	0.0266	-0.230	-0.284	-0.200
	(0.0405)	(0.0404)	(0.0410)	(0.200)	(0.199)	(0.203)
$\log(Nworkers_{f}t)$	0.0620*	0.0710**	0.0487	0.420**	0.465***	0.611***
	(0.0328)	(0.0332)	(0.0335)	(0.169)	(0.168)	(0.214)
$\log(CGDP_{ct})$	0.243	0.247	0.249	-1.202	-1.261	-0.357
	(0.354)	(0.351)	(0.357)	(1.555)	(1.560)	(1.597)
$\log(Gini_{ct})$	-0.0932	-0.0795	-0.0653	0.428	0.390	0.638
	(0.231)	(0.230)	(0.230)	(0.942)	(0.943)	(0.959)
$\log(Ndestinations_{gft})$	0.00161	0.0198	0.0147	-0.351**	-0.500***	-0.431**
	(0.0385)	(0.0401)	(0.0388)	(0.168)	(0.180)	(0.172)
$Mktshare_{fct,s}$	0.157			-1.420**		
	(0.101)			(0.582)		
$ShareImp_{ct,s}$	-5.308			66.76		
	(5.302)			(47.71)		
$ShareExp_{c,s}$	-4.691			48.23		
	(6.604)			(86.86)		
$\log(Scope_{fct})$		-0.0402			0.261*	
		(0.0312)			(0.151)	
$Mktshare_{gfct}$		0.105***			0.164*	
		(0.0282)			(0.0925)	
$ShareProfessionals_{ft}$			-0.606			-0.0145
			(0.386)			(1.534)
$\log(Nfirms_{gct})$			-0.00474			-0.218
			(0.0270)			(0.133)
$ShareHighEduc_{ft}$			-0.175			-0.456
			(0.169)			(0.931)
$\log(Wages_{ft})$			-0.0303			0.0432
			(0.0385)			(0.192)
Period FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Firm-product-country FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Constant	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Observations	37,234	37,234	37,234	4,209	4,209	4,209
R-squared	0.107	0.111	0.107	0.084	0.072	0.095

Notes: Products are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.7: Effect of EU on Prices for the Sample of Non-Innovative Firms.

Dependent variable:	**Differentiated goods**			**Homogeneous goods**		
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)
EU	0.0555	0.0219	0.0439	-0.305	-0.260	-0.300
	(0.0668)	(0.0750)	(0.0799)	(0.213)	(0.213)	(0.231)
$\log(Nworkers_ft)$	-0.00866	0.0136	-0.0417	0.488	0.332	0.264
	(0.111)	(0.115)	(0.120)	(0.310)	(0.381)	(0.312)
$\log(CGDP_{ct})$	0.0253	-0.0247	-0.0265	0.108	0.165	0.154
	(0.0967)	(0.0738)	(0.0712)	(0.223)	(0.219)	(0.211)
$\log(Gini_{ct})$	0.103	0.0862	0.0824	0.164	0.211	0.196
	(0.221)	(0.208)	(0.205)	(0.435)	(0.437)	(0.439)
$\log(Ndestinations_{gft})$	-0.0383	0.00445	-0.0158	-0.454	-0.612	-0.471
	(0.0927)	(0.0931)	(0.0769)	(0.471)	(0.754)	(0.497)
$Mktshare_{fct,s}$	0.115			-0.236		
	(0.0795)			(0.171)		
$ShareImp_{ct,s}$	-1.604			0.964		
	(1.378)			(8.435)		
$ShareExp_{c,s}$	0.350			-1.263		
	(2.529)			(11.47)		
$\log(Scope_{fct})$		-0.0970			0.291	
		(0.0834)			(0.601)	
$Mktshare_{gfct}$		0.0901**			0.117**	
		(0.0424)			(0.0541)	
$ShareProfessionals_{ft}$			-1.301			-3.905
			(1.276)			(2.779)
$\log(Nfirms_{gct})$			-0.00430			-0.0769
			(0.0193)			(0.0681)
$ShareHighEduc_{ft}$			0.0240			-0.0341
			(0.306)			(0.594)
$\log(Wages_{ft})$			-0.0526			0.181
			(0.0636)			(0.207)
Period FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Firm-product FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Constant	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Observations	17,325	17,325	17,325	1,937	1,937	1,937
R-squared	0.943	0.943	0.943	0.942	0.942	0.942

Notes: *R^2 include the contribution of fixed effects.
Notes: Differentiated goods are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.8: Effect of Quality Upgrading on Prices for Sample of Sales *within Mercosur*.

Dependent variable:	**Differentiated goods**			**Non-differentiated goods**		
Upgrade$_{ft}$	0.0481	0.0498	0.0547	-0.227	-0.315	-0.247
	(0.0437)	(0.0435)	(0.0443)	(0.261)	(0.260)	(0.269)
log($Nworkers_ft$)	0.0278	0.0317	0.0118	0.348	0.448*	0.809**
	(0.0406)	(0.0408)	(0.0414)	(0.244)	(0.241)	(0.335)
log($CGDP_{ct}$)	1.977	0.524	0.544	-13.15	-6.921	-4.818
	(3.107)	(2.993)	(3.029)	(21.17)	(20.90)	(21.05)
log($Gini_{ct}$)	-2.838	-0.931	-1.031	15.96	9.421	9.855
	(3.757)	(3.610)	(3.642)	(25.03)	(24.74)	(24.91)
log($Ndestinations_{gft}$)	-0.0278	-0.00904	-0.0147	-0.380	-0.564**	-0.539**
	(0.0410)	(0.0429)	(0.0413)	(0.234)	(0.252)	(0.244)
$Mktshare_{fct,s}$	0.183*			-1.720**		
	(0.104)			(0.715)		
$ShareImp_{ct,s}$	-7.929			30.16		
	(5.904)			(55.51)		
$ShareExp_{c,s}$	-3.928			-54.64		
	(8.611)			(157.9)		
log($Scope_{fct}$)		-0.0315			0.310	
		(0.0348)			(0.210)	
$Mktshare_{gfct}$		0.404***			0.188	
		(0.0648)			(0.141)	
$ShareProfessionals_{ft}$			-0.599			0.565
			(0.408)			(2.143)
log($Nfirms_{gct}$)			0.00218			-0.307
			(0.0317)			(0.208)
$ShareHighEduc_{ft}$			-0.120			-0.0399
			(0.177)			(1.200)
log($Wages_{ft}$)			-0.0345			0.0471
			(0.0395)			(0.229)
Period FE	yes	yes	yes	yes	yes	yes
Firm-product-country FE	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes
Observations	21,427	21,427	21,427	2,824	2,824	2,824
R-squared	0.121	0.121	0.121	0.171	0.174	0.222

Notes: Products are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.9: Effect of Quality Upgrading on Prices within Sectors of Similar/Different Elasticities of Substitution. Differentiated Goods.

Dependent variable: $ln(uprice)_{fcgt}$	**Differentiated goods** Similar elasticities across countries			**Differentiated goods** Different elasticities across countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Upgrade$_{ft}$ * **EU**	**0.188****	**0.205****	**0.205****	**0.287****	**0.290****	**0.329****
	(0.0805)	(0.0798)	(0.0811)	(0.131)	(0.131)	(0.133)
Upgrade$_{ft}$	-0.133**	-0.126**	-0.143**	-0.0586	-0.0643	-0.0757
	(0.0631)	(0.0630)	(0.0634)	(0.102)	(0.103)	(0.104)
log($Nworkers_{f}t$)	0.0532	0.0615	0.0533	0.0332	0.0117	0.0245
	(0.0408)	(0.0412)	(0.0413)	(0.0912)	(0.0928)	(0.0965)
log($CGDP_{ct}$)	0.0114	-0.0415	-0.125	-0.176	-0.0892	-0.372
	(0.504)	(0.497)	(0.508)	(0.813)	(0.811)	(0.828)
log($Gini_{ct}$)	-0.0925	-0.120	-0.0925	0.0985	0.175	0.125
	(0.310)	(0.307)	(0.308)	(0.577)	(0.572)	(0.575)
log($Ndestinations_{gft}$)	0.00710	0.0324	0.0147	0.181*	0.155	0.195*
	(0.0550)	(0.0580)	(0.0554)	(0.105)	(0.110)	(0.106)
$Mktshare_{fct,s}$	0.125			0.696***		
	(0.133)			(0.241)		
$ShareImp_{ct,s}$	16.34			-4.935		
	(12.16)			(7.090)		
$ShareExp_{ct,s}$	-1.062			-18.73*		
	(10.74)			(11.37)		
log($Scope_{fct}$)		-0.0749*			0.0806	
		(0.0445)			(0.0850)	
$Mktshare_{gfct}$		0.283***			0.372***	
		(0.0772)			(0.116)	
log($Nfirms_{gct}$)			0.00736			0.0811
			(0.0364)			(0.0598)
$ShareProfessionals_{ft}$			-0.542			-0.784
			(0.505)			(0.972)
$ShareHighEduc_{ft}$			0.0742			0.438
			(0.206)			(0.392)
log($Wages_{ft}$)			-0.0195			-0.0721
			(0.0467)			(0.0919)
Period FE	yes	yes	yes	yes	yes	yes
Firm-product-country FE	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes
Observations	22,254	22,254	22,254	9,836	9,836	9,836
R-squared	0.117	0.120	0.116	0.084	0.084	0.080

Notes: Differentiated goods are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.10: Effect of Skill Upgrading on Prices: An Integrated Quality and Skill Upgrading Mechanism.

Dependent variable:	Differentiated goods							
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Upgrade$_{ft}$			0.147***	0.152**			0.243***	0.234**
			(0.0570)	(0.0608)			(0.0933)	(0.102)
Skills$_{f,t}$ $*$ **Upgrade**$_{ft}$			**0.395*** **	**0.376*** **				
			(0.105)	**(0.108)**				
Skills$_{ft}$	**0.113** **	**0.146*** **	-0.0592	-0.0274				
	(0.0499)	**(0.0512)**	(0.0590)	(0.0609)				
Skills$^{nowage}_{f,t}$ $*$ **Upgrade**$_{ft}$							**0.259** **	**0.246** **
							(0.116)	**(0.124)**
Skills$^{nowage}_{ft}$					**0.391*** **	**0.384*** **	-0.339***	-0.264***
					(0.0658)	**(0.0693)**	(0.0324)	(0.0433)
$\log(Nworkers_f t)$	0.0106	0.0591	0.00905	0.0480	0.0296	0.0976	0.0648	0.120
	(0.0713)	(0.0774)	(0.0709)	(0.0770)	(0.104)	(0.114)	(0.105)	(0.114)
$\log(CGDP_{ct})$		0.899***		0.828**		0.0588		0.121
		(0.340)		(0.342)		(0.537)		(0.537)
$\log(Gini_{ct})$		-0.0537		-0.179		-0.108		-0.193
		(0.369)		(0.367)		(0.664)		(0.665)
$\log(Ndestinations_{gft})$		-0.125*		-0.0893		-0.236*		-0.206
		(0.0658)		(0.0659)		(0.133)		(0.133)
$Mktshare_{fct,s}$		0.137		0.121		-0.0552		-0.0574
		(0.143)		(0.142)		(0.230)		(0.230)
$Mktshare_{gfct}$	0.439***		0.409***		0.341***		0.365***	
	(0.0749)		(0.0755)		(0.117)		(0.118)	
Period FE	yes	yes	yes	yes	yes	yes	yes	yes
Firm-product-country FE	yes	yes	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes	yes	yes
Observations	32,090	32,090	32,090	32,090	32,090	32,090	32,090	32,090
R-squared	0.048	0.051	0.052	0.057	0.058	0.057	0.058	0.057

Notes: Differentiated goods are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.11: Effect of Quality Upgrading and Process Innovation on Prices.

Dependent variable:	**Differentiated goods**			**Non-differentiated goods**		
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)
$\textbf{Upgrade}_{ft}$	0.0251***	0.0351***	0.0212***	-1.279*	-0.966	-1.280*
	(0.0035)	(0.0034)	(0.0037)	(0.737)	(0.760)	(0.737)
$\textbf{Process}_{ft}$	-0.0327	-0.0271	-0.0208	-0.298*	-0.324*	-0.308*
	(0.0304)	(0.0302)	(0.0307)	(0.179)	(0.179)	(0.180)
$\log(Nworkers_f t)$	0.0551	0.0689*	0.0556	0.429*	0.400	0.355
	(0.0364)	(0.0368)	(0.0370)	(0.245)	(0.250)	(0.271)
$\log(CGDP_{ct})$	0.934***	0.836***	0.946***	1.205	1.291	1.853
	(0.245)	(0.244)	(0.244)	(1.313)	(1.288)	(1.306)
$\log(Gini_{ct})$	-0.183	-0.155	-0.174	0.922	0.787	1.246
	(0.262)	(0.261)	(0.261)	(1.252)	(1.253)	(1.268)
$\log(Ndestinations_{gft})$	-0.00573	0.0249	0.00103	-0.485**	-0.660***	-0.491**
	(0.0474)	(0.0498)	(0.0478)	(0.229)	(0.251)	(0.227)
$Mktshare_{fct,s}$	0.186*			-1.810**		
	(0.112)			(0.732)		
$ShareImp_{ct,s}$	-5.984			0.654		
	(5.615)			(74.09)		
$ShareExp_{c,s}$	-7.391			-15.38		
	(7.144)			(102.4)		
$\log(Scope_{fct})$		-0.0706*			0.272	
		(0.0386)			(0.202)	
$Mktshare_{gfct}$		0.107***			0.129	
		(0.0292)			(0.0983)	
$ShareProfessionals_{ft}$			-0.253			-0.780
			(0.436)			(1.974)
$\log(Nfirms_{gct})$			-0.0104			-0.451**
			(0.0300)			(0.175)
$ShareHighEduc_{ft}$			0.174			-0.999
			(0.179)			(1.015)
$\log(Wages_{ft})$			-0.0487			0.0743
			(0.0407)			(0.205)
Period FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Firm-product-country FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Constant	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Observations	37,234	37,234	37,234	4,209	4,209	4,209
R-squared	0.103	0.105	0.109	0.050	0.035	0.111

Notes: Products are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.12: Effect of Quality Upgrading and Process Innovation on Prices, for EU and Mercosur.

Dependent variable:	**Differentiated goods**			**Non-differentiated goods**		
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbf{Upgrade}_{ft} * \mathbf{EU}$	0.171**	0.141*	0.166**	0.0647	0.0743	0.0343
	(0.0727)	(0.0725)	(0.0738)	(0.458)	(0.458)	(0.458)
$\mathbf{Upgrade}_{ft}$	-0.0184	-0.00122	-0.0218	-1.311	-1.004	-1.268
	(0.0853)	(0.0852)	(0.0857)	(0.818)	(0.838)	(0.814)
$\mathbf{Process}_{ft} * \mathbf{EU}$	0.0463	0.0561	0.0484	-0.119	-0.148	-0.308
	(0.0797)	(0.0792)	(0.0797)	(0.369)	(0.368)	(0.377)
$\mathbf{Process}_{ft}$	-0.0412	-0.0371	-0.0308	-0.255	-0.270	-0.191
	(0.0335)	(0.0333)	(0.0339)	(0.225)	(0.224)	(0.230)
$\log(Nworkers_ft)$	0.0563	0.0698*	0.0561	0.421*	0.390	0.333
	(0.0364)	(0.0368)	(0.0370)	(0.248)	(0.253)	(0.275)
$\log(CGDP_{ct})$	-0.0877	-0.0369	-0.0678	1.154	1.259	2.583
	(0.451)	(0.449)	(0.464)	(3.058)	(3.052)	(3.091)
$\log(Gini_{ct})$	-0.117	-0.0961	-0.111	0.967	0.845	1.447
	(0.263)	(0.262)	(0.263)	(1.273)	(1.274)	(1.298)
$\log(Ndestinations_{gft})$	-0.00407	0.0256	0.00225	-0.485**	-0.657***	-0.483**
	(0.0474)	(0.0499)	(0.0478)	(0.229)	(0.251)	(0.228)
$Mktshare_{fct,s}$	0.205*			-1.807**		
	(0.112)			(0.735)		
$ShareImp_{ct,s}$	-6.529			-1.357		
	(5.632)			(74.56)		
$ShareExp_{c,s}$	-7.267			-17.27		
	(7.149)			(103.4)		
$\log(Scope_{fct})$		-0.0694*			0.270	
		(0.0386)			(0.202)	
$Mktshare_{gfct}$		0.104***			0.131	
		(0.0293)			(0.0989)	
$ShareProfessionals_{ft}$			-0.260			-1.009
			(0.437)			(2.002)
$\log(Nfirms_{gct})$			0.00710			-0.477***
			(0.0307)			(0.179)
$ShareHighEduc_{ft}$			0.181			-0.900
			(0.179)			(1.024)
$\log(Wages_{ft})$			-0.0513			0.0685
			(0.0407)			(0.206)
Period FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Firm-product-country FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Constant	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Observations	37,234	37,234	37,234	4,209	4,209	4,209
R-squared	0.104	0.105	0.104	0.051	0.035	0.051

Notes: Products are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.13: Effect of Quality Upgrading on Prices for a Placebo Year (pre-treatment year as the treatment year, $UpgradePlacebo_{ft}$).

Dependent variable:	**Differentiated goods**			**Non-differentiated goods**		
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)
$\textbf{UpgradePlacebo}_{ft} * \textbf{EU}$	-0.0157	-0.0175	-0.0154	-0.110***	-0.120***	-0.107***
	(0.0214)	(0.0180)	(0.0193)	(0.0329)	(0.0368)	(0.0320)
$\textbf{UpgradePlacebo}_{ft}$	0.00485	0.00375	0.0146	0.0150	0.0112	0.0208
	(0.0312)	(0.0320)	(0.0263)	(0.0440)	(0.0426)	(0.0403)
$\log(Nworkers_f t)$	-0.0259	-0.0294	-0.00460	-0.0381	-0.0307	-0.0392
	(0.0507)	(0.0508)	(0.0582)	(0.0425)	(0.0326)	(0.0533)
$\log(CGDP_{ct})$	0.118	0.240	0.292	-0.543	-0.494	-0.671
	(0.255)	(0.252)	(0.227)	(0.630)	(0.572)	(0.666)
$\log(Ndestinations_{gft})$	0.0323	0.0212	0.0211	-0.0306	0.0248	-0.0194
	(0.0511)	(0.0560)	(0.0576)	(0.0341)	(0.0339)	(0.0310)
$Mktshare_{fct,s}$	-0.0306			0.300***		
	(0.0392)			(0.0903)		
$ShareImp_{ct,s}$	16.05			4.284		
	(12.41)			(5.626)		
$ShareExp_{ct,s}$	-11.49			33.64		
	(8.571)			(30.49)		
$\log(Scope_{fct})$		0.00783			-0.195	
		(0.0368)			(0.133)	
$Mktshare_{gfct}$		0.407***			-0.0202	
		(0.112)			(0.103)	
$\log(Nfirms_{gct})$			-0.00791			0.000902
			(0.0204)			(0.0555)
$ShareProfessionals_{ft}$			-0.166			-0.800
			(1.190)			(0.490)
$ShareHighEduc_{ft}$			0.318**			0.465**
			(0.135)			(0.185)
$\log(Wages_{ft})$			0.197			0.0523
			(0.190)			(0.0918)
Period FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Firm-product-country FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Constant	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Observations	34,477	34,477	34,442	3,446	3,446	3,446
R-squared	0.001	0.006	0.003	0.033	0.046	0.038

Notes: Products are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.14: Effect of Quality Upgrading on Prices for different **North/South** groups of countries.

	Differentiated goods							
Dependent variable:	Group1: EU, Mercosur and USA		Group2: Mercosur and USA		Group 3: Mercosur, Canada and USA		Group 4: Canada, USA, EU and South America	
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Upgrade$_{ft}$ * **Group1**	0.233***	0.231***						
	(0.0675)	(0.0678)						
Upgrade$_{ft}$ * **Group2**			0.234***	0.221***				
			(0.0451)	(0.0721)				
Upgrade$_{ft}$ * **Group3**					0.239***	0.213***		
					(0.0501)	(0.0698)		
Upgrade$_{ft}$ * **Group4**							0.241***	0.249***
							(0.0475)	(0.0484)
Upgrade$_{ft}$	-0.0591*	-0.031	-0.0488	-0.0499	-0.0169	-0.0166	-0.0731*	-0.0609
	(0.0307)	(0.046)	(0.0359)	(0.0370)	(0.0598)	(0.0565)	(0.0397)	(0.0396)
$\log(Nworkers_f t)$	0.0387	0.0427	-0.00257	-0.00896	0.0108	0.00871	-0.0156	-0.0139
	(0.0351)	(0.0355)	(0.0399)	(0.0350)	(0.0419)	(0.0425)	(0.0294)	(0.0293)
$\log(CGDP_{ct})$	-0.0648	-0.0279	4.678	0.469	0.879	0.819	-0.297	-0.262
	(0.401)	(0.412)	(3.149)	(0.356)	(1.105)	(1.101)	(0.267)	(0.264)
$\log(Gini_{ct})$	-0.0201	-0.0418	-6.595*	-1.439***	-2.112	-2.239	-0.192	-0.196
	(0.262)	(0.267)	(3.801)	(0.529)	(1.449)	(1.519)	(0.169)	(0.182)
$\log(Ndestinations_{gft})$	0.0532	0.0681	0.0275	0.0259	0.0309	0.0347	0.0269	0.0427
	(0.0501)	(0.0585)	(0.0410)	(0.0391)	(0.0506)	(0.0545)	(0.0376)	(0.0401)
$Mktshare_{fct,s}$	0.236**		0.245**		0.288**		0.0825	
	(0.115)		(0.103)		(0.115)		(0.0968)	
$ShareImp_{ct,s}$	-0.0538		-2.984		-3.069		-1.801	
	(5.712)		(5.423)		(6.249)		(5.029)	
$ShareExp_{c,s}$	-4.442		2.899		-0.743		-7.681	
	(7.321)		(8.811)		(9.449)		(7.084)	
$\log(Scope_{fct})$		-0.0382		-0.0167		-0.0104		-0.0583
		(0.0391)		(0.0323)		(0.0419)		(0.0632)
$Mktshare_{gfct}$		0.329***		0.312***		0.259***		0.355***
		(0.0626)		(0.0659)		(0.0812)		(0.0469)
Period FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Firm-product-country FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Constant	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Observations	44,586	44,586	28,779	28,779	29,900	29,900	64,627	64,627
R-squared	0.106	0.109	0.104	0.090	0.125	0.125	0.097	0.101

Notes: Differentiated goods are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.15: Effect of the ATT using Propensity Score Matching combined with the DDD

Sample	**Treated**	**Controls**	**Difference**
A.			
Unmatched	3.0639	3.2993	-0.2353
ATT	3.0639	2.5408	**0.5232**
B.			
Unmatched	3.3859	3.1639	0.2220
ATT	3.3859	2.8271	**0.5588**

Table 2.16: Asymmetries across Products (core product $CORE$) and Sectors (sector ladder-length $LADDER$).

Dependent variable:	Differentiated goods					
$ln(uprice)_{fcgt}$	(1)	(2)	(3)	(4)	(5)	(6)
Upgrade$_{ft}$	0.0394	0.0374	0.0455	0.0400	0.0375	0.0470
	(0.0451)	(0.0465)	(0.0500)	(0.0458)	(0.0469)	(0.0505)
CORE $*$ **Upgrade**$_{ft}$	0.0833**	0.0786**	0.0805**			
	(0.0334)	(0.0321)	(0.0321)			
LADDER $*$ **Upgrade**$_{ft}$				0.0516**	0.0472**	0.0524***
				(0.0196)	(0.0198)	(0.0179)
$\log(Nworkers_f t)$	0.0555	0.0653	0.0441	0.0635	0.0728	0.0507
	(0.0565)	(0.0582)	(0.0553)	(0.0538)	(0.0558)	(0.0523)
$\log(CGDP_{ct})$	0.926**	0.838**	0.926**	0.947***	0.850**	0.936**
	(0.355)	(0.362)	(0.366)	(0.341)	(0.350)	(0.354)
$\log(Gini_{ct})$	-0.121	-0.105	-0.0918	-0.140	-0.124	-0.111
	(0.345)	(0.330)	(0.339)	(0.335)	(0.320)	(0.329)
$\log(Ndestinations_{gft})$	0.00637	0.0251	0.0187	0.00123	0.0198	0.0148
	(0.0523)	(0.0495)	(0.0505)	(0.0520)	(0.0489)	(0.0496)
$Mktshare_{fct,s}$	0.132			0.161		
	(0.101)			(0.103)		
$ShareImp_{ct,s}$	-4.948			-3.636		
	(3.784)			(3.734)		
$ShareExp_{c,s}$	-4.715			-4.700		
	(9.604)			(9.386)		
$\log(Scope_{fct})$		-0.0435			-0.0408	
		(0.0461)			(0.0463)	
$Mktshare_{gfct}$		0.105			0.108	
		(0.0720)			(0.0746)	
$ShareProfessionals_{ft}$			-0.544			-0.595
			(0.737)			(0.752)
$\log(Nfirms_{gct})$			-0.0173			-0.0120
			(0.0201)			(0.0201)
$ShareHighEduc_{ft}$			-0.141			-0.192
			(0.498)			(0.519)
$\log(Wages_{ft})$			-0.0319			-0.0277
			(0.0476)			(0.0444)
Period FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Firm-product-country FE	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Constant	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Observations	37,234	37,234	37,234	4,209	4,209	4,209
R-squared	0.106	0.110	0.106	0.106	0.110	0.106

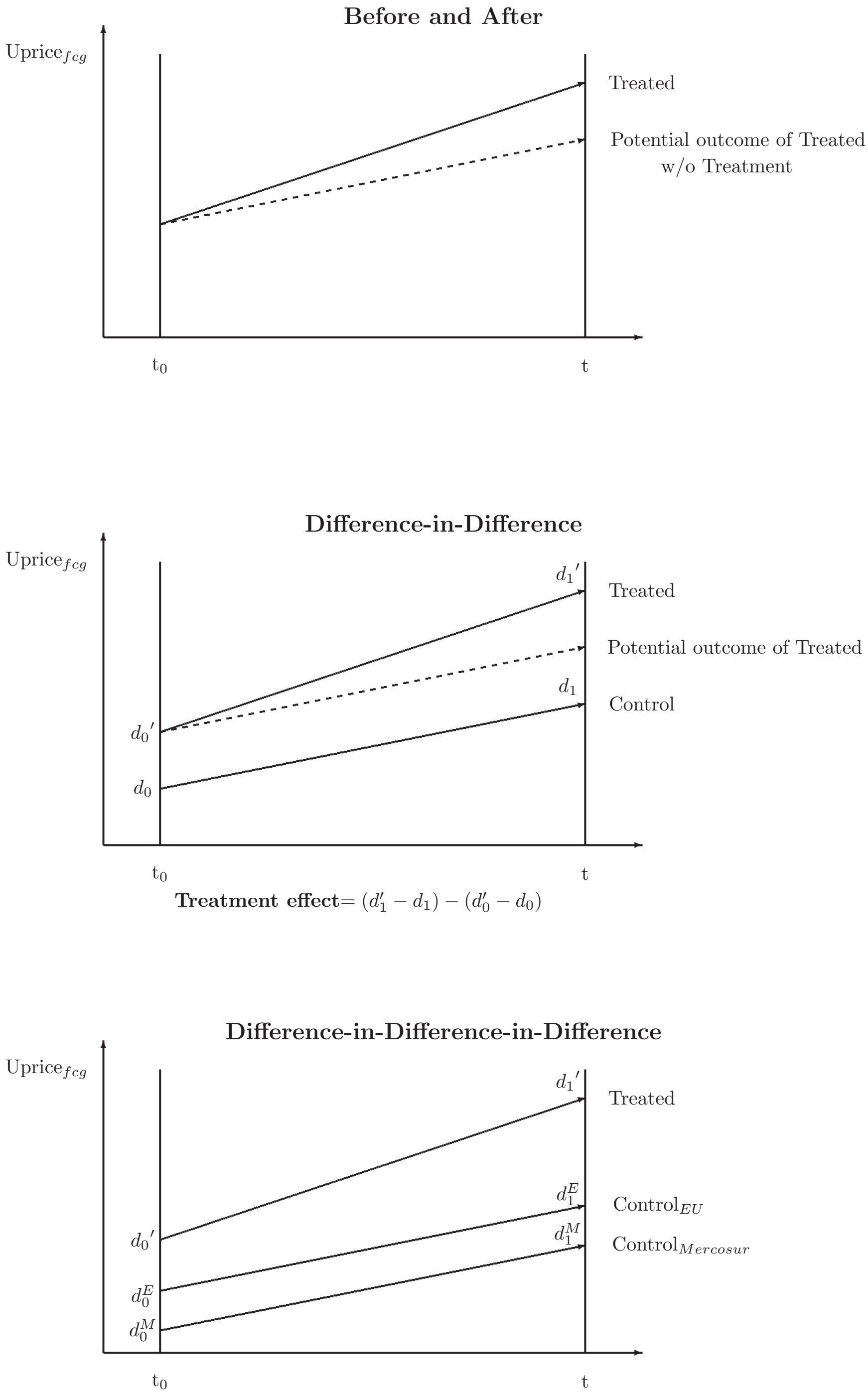
Notes: Products are classified according to the Rauch (1999) classification of goods.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Table 2.17: Effect of Quality Upgrading on Prices: Asymmetries across Products.

	Sample of firms for which the percentage of exports of the innovated product is higher than 50%				Sample of firms that export at most 2 HS8 products			
Upgrade$_{ft}$ $*$ **EU**			0.263***	0.241***			4.577**	5.271*
			(0.0600)	(0.0550)			(1.978)	(2.749)
Upgrade$_{ft}$	0.205*	0.288***	0.249**	0.335***	0.581***	0.708***	0.314**	0.649
	(0.117)	(0.0893)	(0.111)	(0.0845)	(0.0949)	(0.1023)	(0.117)	(0.409)
log($Nworkers_ft$)	0.134*	0.144*	0.139*	0.149**	-1.823***	-1.512	-2.946***	-1.957**
	(0.0742)	(0.0747)	(0.0695)	(0.0708)	(0.180)	(1.044)	(0.585)	(0.823)
log($CGDP_{ct}$)	0.992**	0.896**	-0.485	-0.455	0.624	1.554	-16.09**	-19.55
	(0.437)	(0.431)	(0.465)	(0.448)	(0.577)	(3.167)	(7.194)	(11.66)
log($Gini_{ct}$)	-0.562	-0.509	-0.402	-0.359	9.672***	6.092	27.54***	27.85**
	(0.525)	(0.503)	(0.468)	(0.454)	(1.839)	(4.932)	(8.427)	(10.97)
log($Ndestinations_{gft}$)	-0.0794	-0.0607	-0.0825	-0.0629	1.552***	0.304	1.767***	0.196
	(0.0699)	(0.0658)	(0.0714)	(0.0672)	(0.257)	(0.429)	(0.364)	(0.405)
$Mktshare_{fct,s}$	0.134		0.149		-3.518***		-4.795***	
	(0.126)		(0.129)		(0.516)		(1.118)	
$ShareImp_{ct,s}$	-7.139**		-8.178**		62.62**		102.3*	
	(2.976)		(3.230)		(29.78)		(51.39)	
$ShareExp_{c,s}$	-1.860		-2.214		424.6***		178.8*	
	(8.402)		(8.490)		(100.7)		(103.8)	
log($Scope_{fct}$)		-0.0441		-0.0451				
		(0.0471)		(0.0467)				
$Mktshare_{gfct}$		0.0869		0.0818		0.945***		0.724
		(0.0671)		(0.0640)		(0.335)		(0.584)
Period FE	yes	yes	yes	yes	yes	yes	yes	yes
Firm-product-country FE	yes	yes	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes	yes	yes
Observations	23,996	23,996	23,996	23,996	2,214	2,214	2,214	2,214
R-squared	0.062	0.063	0.064	0.065	0.937	0.524	0.967	0.660

Notes: Differentiated goods are classified according to the Rauch (1999) classification of goods.
The R-squared reported in columns (5) to (8) refer to the LSDV estimator, which includes the firm-product FE.
Robust t-statistics in absolute value within parentheses, based on standard errors clustered at the firm level.
Clustering at the firm-product or at the industry CNAE level do not change the robustness of the results.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable $ln(uprice)_{fcgt}$ is the (log) free on board export price by firm, product and destination.

Figure 2.3: Difference-in-Difference-in-Differences: Quality upgrading in the EU and Mercosur



Chapter 3

Income Inequality and Export Prices across Countries

3.1 Introduction

The relation between income distribution and the demand for high quality products has attracted a lot of attention in the trade literature.[1] Fajgelbaum, Grossman, and Helpman (2011) have derived conditions under which a richer, or more unequal, country has a larger demand for high quality goods. They provide a demand-based explanation for the patterns of trade in goods of different quality. Empirically, virtually every paper studying firm-level export prices predicts a positive relation between a country's income per capita and the consumption of high quality products. Although, preferences for quality vary not only across countries, but also within a country: wealthier consumers have a lower marginal utility of income and are willing to pay more for high quality products. This channel, i.e. the role of the second moment of the income distribution (income inequality), has been neglected by the empirical literature.

This Chapter provides first firm-level evidence of the links between income inequality and the patterns of trade and export prices, and identifies a theoretical mechanism behind these links. In our model, a country has a continuum of individuals, who differ in their skill/ability. Individuals have preferences over a homogeneous and a differentiated good,

[1] See, for instance, Fajgelbaum, Grossman, and Helpman (2011), Dalgin, Trindade, and Mitra (2008), Rauch and Trindade (2002).

which comes in two varieties, with high and low quality. We consider three income levels (poor, middle income, and rich), and show that the aggregate demand depends on the distribution of skills and income in a country. We also discuss the importance of markups for the distribution of prices. Because preferences over different types of goods depend on the individual income, a more unequal income distribution leads to higher average prices. We test this theoretical prediction using detailed data for Brazilian manufacturing exporters, with information at the firm and product level by destination country. We establish new stylized facts. In particular, we find that not only the first moment, but also the second moment of the income distribution in the destination country is an important determinant of export prices. Export prices are sistematically higher in high income destinations and, controlling for income, prices are higher in destinations with a more dispersed income distribution. These results hold only for differentiated goods, and in particular for varieties with high vertical differentiation. Results suggest that both mark-ups and product quality are adjusted to market conditions, and in particular to serve more distant, richer, and more unequal markets. We interpret the results in terms of the existing literature of trade with quality differentiation, and discuss competing hypotheses. In particular, Simonovska (2010) and Verhoogen (2008) present theoretical predictions consistent with our main findings, that exporters may adjust product quality and markups depending on the market conditions.

Moreover, we show that the strongest effect of income inequality on prices is driven by income inequality among middle income economies. As discussed in Dalgin, Trindade, and Mitra (2008), when the income expansion path is curved, income distribution becomes a determinant of aggregate demand. Anecdotal evidence suggests that many middle-income economies experienced a sharp increase in the number of rich, which are willing to devote a higher share of income to brands, luxury, and positional goods. With curved income-expansion paths, the *new rich* will buy proportionately more high quality goods. Moreover, firms may charge even higher markups for those goods: as individuals get wealthier, they are willing to pay more for high quality goods.

Of course, using product prices to explain non-homothetic preferences and product quality is not novel in the literature. Our contribution is to show for the first time empirical evidence at the firm level of the importance of the second moment of the income distribution for demand patterns, and to find a theoretical link that explains this fact. Using firm-level

data, we are able to use a high level of product disaggregation, to track firm behavior, and to control for supply-side unobserved heterogeneity.[2]
A large literature has documented the relation between export prices and destination country characteristics. Many of those studies find a strong positive relationship between the price of the good and the country's level of income and income per-capita (Hallak (2006, 2010), Hummels and Klenow (2005) and Fieler (2011)), and attribute higher prices to higher quality. However, these papers focus on income per capita, and do not discuss the role of income distribution within the country.
Bekkers, Francois, and Manchin (2012) study the effect of importer income per capita on traded prices, and test the predictions of three different theories using the effect of income inequality on prices. Using aggregate data on import prices, they find support for the hierarchic demand model, and contradict the quality and ideal variety theories. As individuals become richer, more goods become indispensable, wich decreases the price elasticity of these goods and raises markups. Thus, through the reduction in the price elasticity, they find that an increase in income inequality increases market prices. These empirical results are inconsistent with models incorporating demand for quality, such as Fajgelbaum, Grossman, and Helpman (2011). Fajgelbaum, Grossman, and Helpman (2011) show that, under certain conditions, richer, or more unequal, countries have a larger demand for high quality goods. Bekkers, Francois, and Manchin (2012) suggest that their results do not fasify the quality theory, but that the markup effect explains great part of the variation in prices. We discuss the role of markups in determining the price variation across importing countries, and show that both quality and markups explain our results. We show that, when prices are endogenous and average costs are decreasing in inputs, the effect of income inequality on prices is reinforced by the markup effect: both higher quality and higher markups explain higher prices in more unequal destinations.[3]
The results from this Chapter are also related to a new and rapidly growing literature on

[2]Even though empirical evidence at the aggregate level is robust, prices aggregated to the country level might fog some important unobserved characteristics related to the firm, product, and market, not related to the quality of the good.

[3]When prices are endogenous, the effect of income inequality on prices can go in either way, since it depends on how prices change when the middle class shrinks and the number of rich increases. Although, following standard monopolistic competition models with average costs decreasing in inputs, more inequality leads to higher prices.

the firm-level sources of price variation across destination markets.[4] Some relevant contributions are Bastos and Silva (2010b), Manova and Zhang (2012), Kugler and Verhoogen (2011) and Martin and Méjean (2010), which study the sources of price variation across and within firms. Bastos and Silva (2010b) show evidence of quality differentiation due to distance to the destination country, while Manova and Zhang (2012) test empirically different models from the literature. Manova and Zhang (2012) find within-firm effects that cannot be reconciled with heterogeneous firms models and suggest that firms adjust not only markups but also product quality for richer and more distant destination markets. Kugler and Verhoogen (2011) use data for Colombian firms and show convincing evidence that input quality and plant productivity are complementary in generating output quality. Martin and Méjean (2010) use French firm-level data and show that quality upgrading of french firms may be a result of low-wage countries competition (in particular of Chinese competition). Our empirical results confirm the predicions from the empirical literature regarding distance and income per capita for differentiated goods and show novel predictions for income inequality. Moreover, our results hold for differentiated goods, while non-differentiated goods follow a different pattern, which can be explained by a cost-competence versus quality-competenc model, as in Eckel, Iacovone, Javorcik, and Neary (2011).

The remainder of the Chapter is organized as follows. Section 2 presents the theoretical framework. Section 3 describes the data and shows descriptive statistics. Section 4 presents the main empirical results. Section 5 concludes.

3.2 Theory

Consider a small open economy with a continuum of individuals. There are two goods: a homogenous good and a differentiated good, which comes in two varieties/qualities $i =$

[4]Even though firm heterogeneity is a stylized fact, the empirical analysis of firm-level price variation across destination markets is a new and rapidly growing literature. Theoretically, two main types of models explain exporters' performance: (i) Efficiency sorting models, such as Melitz (2003) and Melitz and Ottaviano (2008), which attribute better export performance to firms with higher productivity and lower marginal costs; (ii) Quality sorting models, such as Baldwin and Harrigan (2011), Antoniades (2008), and Fajgelbaum, Grossman, and Helpman (2011)., which add the quality dimension to models with heterogeneous firms and explain why large productive exporters pay higher wages, use better inputs and have marginal costs increasing in quality.

L, H, called low L and high H. The homogenous good is the numeraire whose price is normalized to one. The prices of the differentiated good are q_H and q_L, with $q_H > q_L > 0$, and for now we assume that these prices are set in the world market. We later discuss how changes in demand for differentiated goods affect pricing decisions of firms when prices are endogenously determined. To simplify matters assume that the economy produces only the numeraire good, which is exported, and imports the differentiated good (although this is not essential for the argument below). The homogenous good is produced under constant returns to scale with labor as only input. All markets are perfectly competitive.

The society consists of a continuum of individuals (whose size is normalized to one) who share identical preferences but differ in their skill/ability. The latter is described in more detail below. An individual has preferences over the numeraire good and the differentiated good. We assume that the individual buys at most one unit of each quality, but may purchase any number of the homogenous good. We postulate the following utility function

$$u = c(1 + v), \tag{3.1}$$

where c is the number of units of the homogenous good and $v = (1 - \delta_H)\delta_L v_L + (1 - \delta_L)\delta_H v_H \geq 0$ is an utility index of consuming the differentiated good.[5] $v_i > 0$ is the benefit of consuming the differentiated good of quality i, and δ_i is a dummy variable taking the value of one if the individual buys quality i, and zero if quality i is not bought.

Letting y refer to income, the budget constraint of a consumer can be written as

$$c + \sum_i \delta_i q_i \leq y. \tag{3.2}$$

Conditions (1) and (2) have immediate implications: i) A consumer never buys both types of the differentiated good at the same time, as the purchase of each is costly, but the joint purchase does not give any additional utility over consuming only the numeraire good.[6] ii) Individuals with incomes less or equal to q_L do not buy the differentiated good. Utility is positive if and only if $c > 0$. We can therefore focus on the following cases: i) no purchase of the differentiated good is made, and utility is simply $u(c) = y$, and ii) one unit of one of

[5]The utility function could be generalized to assuming $u = h(c)(1 + v)$, with the function $h(c)$ being increasing, concave and $h(0) = 0$.

[6]We could allow for some positive benefit when consuming both qualities, as long as the benefit is sufficiently small relative to the prices of quality.

the differentiated goods is purchased, leading to utility $u(c) = (y - q_i)(1 + v_i)$ when quality $i = H, L$ is consumed. The optimal consumer choice can now be derived by comparison of these three utility levels.

To characterize optimal consumer behaviour let us introduce the following two income thresholds

$$\begin{aligned} y^* &= \frac{q_L(1+v_L)}{v_L} \\ y^{**} &= \frac{q_H(1+v_H) - q_L(1+v_L)}{v_H - v_L}. \end{aligned} \tag{3.3}$$

It is straightforward to show that the optimal consumption decision regarding the differentiated good is given by:

$$\begin{array}{lll} \delta_L = \delta_H = 0 & \text{if} & y < y^* \\ \delta_L = 1, \delta_H = 0 & \text{if} & y^* \leq y < y^{**} \\ \delta_L = 0, \delta_H = 1 & \text{if} & y^{**} \leq y, \end{array} \tag{3.4}$$

We simply refer to the three cases as no purchase, low quality, and high quality purchase. The three income ranges shown in (4) are called poor, middle income, and rich.

We see it as an advantage of our model that the quality good (either high or low) is not always purchased, but rather the purchase depends on income. In poor societies, many households will be restricted to purchases of absolute necessities. As income per capita grows, more individuals will be able to afford the low quality good, and some even the most expensive variety.

We assume in the following that the condition

$$\frac{q_H}{q_L} > \frac{v_H}{1+v_H}\frac{1+v_L}{v_L} \tag{3.5}$$

holds, which implies $y^{**} > y^*$. When a consumer with income between y^* and y^{**} exists, the low quality good is purchased in equilibrium.

The production of the numeraire good is using labor only and exhibits constant returns to scale. This implies that the wage per unit of labor is unity. Individuals differ in the effective units of labor x they own and supply, where x can be interpreted as productivity

or skill. Let $F(x)$ be the cumulative distribution function of skills with support $[\underline{x},\overline{x}]$. With a unit wage the distribution of incomes is the same as the distribution of skills, and thus the maximum and minimum incomes are identical to the maximum and minimum of skills.
We are now in a position to state aggregate demand for the differentiated good in terms of the distribution of skills and income. As shown in (4), there are three types of consumers regarding the purchase of the differentiated good, which are ordered by income. Let n_j be the fraction of society that corresponds to the three income classes in (4)

$$\begin{aligned} n_P &= F(y^*) \\ n_M &= F(y^{**}) - F(y^*) \\ n_R &= 1 - F(y^{**}), \end{aligned} \tag{3.6}$$

where $j = P, M, R$ refers to poor, middle class, and rich. Poor individuals consume only the homogenous good, the middle class buys the low quality good, and only the rich buy the high quality good.
We will from now on assume that the average income y_j in each of the three classes j is independent of the distribution of the class strength n_j.[7] This holds trivially if there are only three skill levels, one each in the three segments or classes. The assumption may also hold when the density is stritly positive for all possible values of x. For example, when the density of skills $f^j(x) = k^j$ is constant within each segment j, the class strength is $n_j = k^j(y^u - y^l)$, where y^u and y^l refer to the upper and lower bound of income in each class. In this case average income in each income group can be stated as

$$y_p = \frac{\underline{y} + y^*}{2}, \quad y_M = \frac{y^* + y^{**}}{2}, \quad y_R = \frac{\overline{y} + y^{**}}{2}.$$

The independence of average income in each class y_j and size of each class n_j allows us to compare economies which differ only in the distribution of class sizes without making an analysis of of average incomes per class necessary.
The purpose of our analysis is now to establish a link between income inequality and average price of the differentiated good, holding overall average income constant. Recall

[7] To see the role of this assumption, consider, for example, the case of poor individuals. Average income of a poor person is given by $y_P = \int_{\underline{y}}^{y^*} f(y)ydy/n_P$, and thus in general depends on n_P.

that we assume for now that prices of the quality goods are set in world markets and thus our result is completely driven by the composition of households in the three income brackets.

We define three variables to prove our main result. First, we denote average (and total) income as

$$Y = \sum_j n_j y_j \in [y_P, y_R], \tag{3.7}$$

recalling $\sum_j n_j = n = 1$. Second, the average price of the differentiated good is determined by the purchases of the two groups that consume the differentiated good and equals

$$q = \frac{n_M q_L + n_R q_H}{n_M + n_R} \in [q_L, q_H]. \tag{3.8}$$

Finally, we need a concept of income inequality. Society consists of three groups. Let p_k be the cumulative fraction of households up to group k, and z_k its cumulative income share. The Gini coefficient G for this economy[8] takes the value

$$\begin{aligned} G &= 1 - 2\sum_{k=1}^{3}\left(\int_{p_{k-1}}^{p_k}\left[\left(\frac{z_k - z_{k-1}}{p_k - p_{k-1}}\right)(p - p_{k-1}) + z_{k-1}\right] dp\right) \\ &= (n_P + n_M)\left(1 - \frac{n_P y_P}{Y}\right) - (1 - n_P)\left(\frac{n_p y_P + n_M y_M}{Y}\right) \in [0, 1], \end{aligned} \tag{3.9}$$

where $p_0 = 0, p_1 = n_P, p_2 = n_P + n_M, p_3 = 1$ and $z_0 = 0, z_1 = n_P y_P/Y, z_2 = (n_P y_P + n_M y_M)/Y$ and $z_3 = 1$.

We now establish the main result of our model by comparing two different countries that differ only in the Gini coefficient due to a different distribution of class sizes.

Proposition 1. Consider two countries A and B that are identical in all respects including the overall average income ($Y^A = Y^B$) and the average income in each class ($y_j^A = y_j^B$), except for the distribution of class sizes n_j^c, $c = A, B$. If country A has the more unequal distribution of incomes compared to country B, that is $G^A > G^B$, then the average price of the differentiated good in A is higher than in B: $q^A > q^B$.

Proof: We prove the result in two steps. Our proof exploits the proporty that G and q

[8] The Gini coefficient equals the area between the diagonal in a Lorenz diagramm and the Lorenz curve relative to the area under the diagonal. In the case of three groups the Lorenz curve is piecewise linear with three segments. The slope of the Lorenz curve changes at two values: the cumulative fraction of the population of n_P and $n_P + n_M$. The corresponding income shares are $n_P y_P/y$ and $(n_P y_P + n_M y_M)/y$.

are monotonic in n_R and hence we can rely on differentiation. Our first result establishes a link between the changes in the number of rich individuals and average price.

Lemma 1. $sign(dq) = sign(dn_R)$.

Proof of Lemma 1: Constant average income together with the adding up constraint $\sum_j n_j = 1$ imply via differentiation of (7)

$$dn_M = \frac{(y_P - y_R)}{y_M - y_P} dn_R =: kdn_R, \tag{3.10}$$

where $k = \frac{y_P - y_R}{y_M - y_P} < -1$. Hence, the number of rich and middle class cannot move in the same direction without affecting average income.
The change in the average price follows from differentiation of (8) to give

$$dq = \frac{(q_H - q_L)(n_M dn_R - n_R dn_M)}{(n_M + n_R)^2}. \tag{3.11}$$

Condition (11) implies that the average price increases when the relative change of rich individuals dn_R/n_R is larger than the relative change of middle income individuals dn_M/n_M. Plugging (10) into (11) to eliminate $dn_M$and collecting terms gives

$$dq = \frac{(q_H - q_L)(n_M - kn_R)}{(n_M + n_R)^2} dn_R, \tag{3.12}$$

which proves the Lemma because $q_H > q_L$ and $k < 0$.
Lemma 1 demonstrates the positive correlation between the number of rich and the average price. The result is established by making use of constant average income.
Our second step establishes a positive correlation between the changes of the size of the rich class and the Gini coefficient.

Lemma 2. $sign(dG) = sign(dn_R)$.

Proof of Lemma 2. Differentiating (9), substituting $dn_P = -d(n_M + n_R)$ and (10), and then collecting terms gives

$$
\begin{aligned}
dG &= \left[\left(1-\frac{2n_P y_P}{Y}\right)+\left(1-\frac{n_R y_R}{Y}\right)\right]dn_P+\left(1-\frac{n_P y_P}{Y}\right)dn_M+(1-n_P)dn_R \\
&= \frac{[y_R-(2+k)y_M]n_M}{y}dn_R,
\end{aligned}
$$

which proves the Lemma because $k < -1$ and $y_M < y_R$.

Together Lemmas 1 and 2 imply that a simultaneous increase in the number of rich leads to an increase in inequality and the average price of the differentiated good, that is $sign(dG) = sign(dq)$. This completes the proof of our main result.

Proposition 1 is silent about the causal relationship between the three variables of interest. In our view the natural way of thinking about the relationship, however, is that a change in the composition of households by income is the cause of observed adjustments in average price and income inequality.

So far we assumed that the prices of quality goods are exogenously given in order to emphasize the demand composition effect. In practice prices may vary with demand, as firms adjust to a new environment. It is therefore important to elaborate on endogenous price adjustments, as markups will play a role in the empirical part of this Chapter.

To analyze the role of endogenous prices, recall that we established a positive correlation beween inequality, average price and the number of rich. Suppose that the size of the rich class increases indeed. Then, condition (10) shows that the number of middle class households must fall to keep average income constant. The total change in average price can be represented by the sum of i) the change in the number of individuals (the composition effect), as shown in (11), and ii) the additional effect from endogenous pricing. The latter can be written as

$$
\frac{dq}{dn_R} = \frac{n_M \frac{dq_L}{dn_M}\frac{dn_M}{dn_R} + n_R \frac{dq_H}{dn_R}}{n_M + n_R}, \tag{3.13}
$$

where $dn_M/dn_R = k < 0$ is derived via (10). We implicitly assume that the number of rich and middle class households affect prices of quality goods only directly, that is, the pricing decision of high quality producing firms depends only on the number of high quality consumers but not on those consuming low quality (and analogously for low quality producing firms). This assumption keeps the analysis tractable.

Rather than fully specifying the supply side and thus the pricing decision of firms, we offer some general insights based on (13). Note that the two effects in the numerator of (13) are likely to go in opposite direction, as $sign(dq_L/dn_M) = sign(dq_H/dn_R)$ seems a natural assumption and $dn_M/dn_R < 0$. The sign (i.e., upward or downward sloping supply curves) and magnitude (i.e. slope) of the two individual price changes are thus critical.
We now wish to establish a sufficient condition for (13) to be positive, thus reinforcing the positive price effect, as shown in (11): $n_M \geq n_R$ and $0 > dq_H/dn_R \geq dq_L/dn_M$. In this case, we can simplify the numerator in (13) as follows:

$$n_M \frac{dq_L}{dn_M}\frac{dn_M}{dn_R} + n_R \frac{dq_H}{dn_R} \geq \frac{dq_L}{dn_M}(kn_M + n_R) > 0.$$

The condition that prices fall with the quantity consumed is consistent with results from models of monopolistic competition and models with external economies of scale, where average cost are falling with output.
By contrast, when the supply curve is upward sloping, as in standard models with decreasing returns to scale, the reduction in the middle class would tend to lower the average price when the middle class is larger than the number of rich. This would not necessarily overturn our general conclusion, as the composition effect pushes in the opposite direction, but it would reduce its strength.

3.3 Data and descriptive statistics

3.3.1 Brazilian firm-level data

We use a three-dimensional firm-level data for all Brazilian manufacturing exporters in the year 2000. The data comes from the Foreign Trade Secretariat (SECEX), and contains information by firm, product, and destination country on export values and quantities.
The data comes from the Brazilian customs declarations for merchandize exports that is collected for every exporting firm by the SECEX. All export values are reported in U.S. dollars (USD) free on board (f.o.b.). For the purposes of this Chapter, we use only manufacturing exporters. The precise steps to build the SECEX exports data are described in the Appendix.

Firms in the *SECEX export data* are identifyed by the unique CNPJ tax number. Brazilian products are coded according to the 8-digit NCM classification of goods (NCM-SH *Nomenclatura Comum do Mercosul*, Sistema Harmonizado). The first 6 digits of the NCM correspond to the HS (international Harmonized System), which is the international standard for the classification of goods.[9]

The variable average unit prices ($Uprice_{fcg}$) is generated using sales ($Value_{fcg}$) and quantities ($Quant_{fcg}$): the new variable $Uprice_{fcg}$ represents the average price of good g exported by firm f to country c. $Uprice_{fcg}$ is defined as $Uprice_{fcg} = \frac{Value_{fcg}}{Quant_{fcg}}$, where $Value$ represents total sales of f with good g in country c and $Quant$ is the total quantity exported of g by firm f to country c.

Firm-level 8-digit products are classified according to the Rauch (1999) classification of goods.[10]

Table 3.1 shows the variation in prices ($Uprice_{fcg}$) in terms of standard deviations. The standard deviation of log prices across destinations is on average 0.10 for a firm-product pair (fg). For comparison, the second part of Table 3.1 presents the deviation of prices within product-country pairs across firms. The variation across firms is higher, as one would expect from the trade literature with firm heterogeneity previously discussed. As expected, the price variation comes mostly from differentiated goods [11], and the variation is smaller within the European Union.

As an illustration for the price variation, Figure 3.1 shows the Kernel density of firm-product price variation across destinations computed in 1997 and 2000. The example in Figure 3.1 is of the leather industry [12]. Two important facts should be noticed in Figure

[9]Since the first six digits coincide with the 6-digit HS classification, it is possible to match the HS and NCM classification with the SITC classification (Standard International Trade Classification). Thus, the data can be matched with the Rauch (1999) classification of goods and the NBER-UN World trade data. Moreover, the similarity in classification between NCM and HS allows better comparison to the literature.

[10]Rauch (1999) uses the 4-digit SITC classification (issued by the United Nations) to aggregate the trade data in three groups of commodities: (i.) w, homogeneous (organized exchange) goods: goods traded in an organized exchange; (ii.) r, reference priced: goods not traded in an organized exchange, but which have some quoted reference price, as industry publications; and (iii.) n differentiated: goods without any quoted price. With this classification, goods are divided in 349 reference priced goods, 146 homogeneous goods and 694 differentiated goods. As shown in Bastos and Silva (2010a), the Rauch (1999) classification of goods is well suited for capturing quality differentiation.

[11]Those values in Table 3.1 are smaller than the ones reported in Manova and Zhang (2012), respectively, 0.46 and 0.90 for the variation across destinations and across firms.

[12]Price deviation is calculated as $Pd_{cfg} = \frac{P_{cfg}}{\frac{1}{n}\sum_{i=1}^{n} P_{ifg}}$ and represents the price gap of good g exported by firm f to country c with respect to the mean price of fg to all countries. All prices are free on board

3.1: (i) the within firm-product price dispersion across countries is non neglectable (shown in the Figure as the deviations from mean value x) and represents 0.107 in terms of average standard deviation for a firm-product pair; (ii) price dispersion varies over the years that follow trade liberalization. This variation in prices is only conditional on firm-product pairs and does not (necessarily) mean quality variation. We are interested in the causes of this price variation, studied throughout the Chapter.

Table 3.1: Variation in export prices - standard deviation

	Obs	**Mean**	**Std. Dev.**	**Min**	**Max**
Variation in export prices across destinations within firm-product pairs					
Standard deviation of prices across destinations:					
Total trade	54619	**0.1073**	0.2180	0	1.5677
Differentiated goods	45271	0.1099	0.2201	0	1.5677
Reference priced goods	4623	0.0754	0.1814	0	1.4623
Homogeneous goods	1203	0.0607	0.1331	0	1.0653
Only european countries *(total trade)*	9562	0.0614	0.1642	0	1.5159
Variation in export prices across firms within country-product pairs					
Standard deviation of prices across firms:					
Total trade	43525	**0.2106**	0.3211	0	1.5955
Differentiated goods	34314	0.2268	0.3282	0	1.5955
Reference priced goods	5304	0.1097	0.2476	0	1.5301
Homogeneous goods	924	0.1048	0.2089	0	1.5032
Only european countries *(total trade)*	6419	0.1527	0.2835	0	1.5052

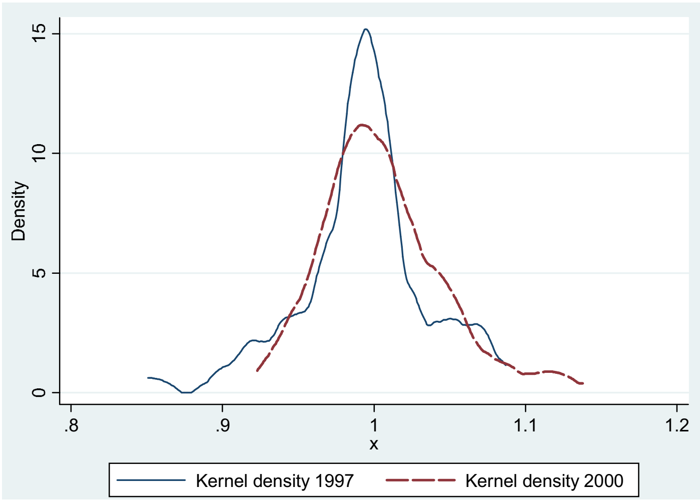
3.3.2 Country-level variables and world trade data

Income inequality data: Data on income inequality (Gini coefficient and income deciles) comes from the UNO-WIDER (United Nations World Institute for Development Economics Research)[13]. The main variable of interest is the Gini coefficient, $Gini_c$, measured on a scale of 0 to 100. For the purposes of this Chapter, information on disposable income was preferred, when available. According to a recent study by Aguiar and Bils (2011), consumption inequality has largely tracked income inequality in the last years and may thus explain variation in income inequality. Detailed information on the construction of

(f.o.b.).

[13]Data available at `http://www.wider.unu.edu/research/Database/en_GB/wiid/` .

Figure 3.1: Kernel density: firm-product price variation across countries. Comparison 1997-2000 for the leather industry.



the index is available in the Appendix to this Chapter.

Spatial data and country codes: The bilateral gravity regressors come from the CEPII - Centre d'Etudes Prospectives et d'Informations Internationales. The main variable of interest is distance to Brazil, $Dist_c$. The same source gives the international *cty* country codes.

World trade elasticities: Data on import demand elasticities ($Sigma_{c,s}$) from Broda, Greenfield, and Weinstein (2010). The elasticities are estimated at the 3-digit HS for 73 countries in the world.

World export and import data, bilateral flows: Data on bilateral imports and exports come from NBER-UN yearly bilateral trade data (`www.nber.org/data`), documented by Feenstra, Lipsey, Deng, Ma, and Mo (2005). The NBER-UN trade data gives an accurate measure of trade flows by sector SITC2 (defined as sector s)[14], since the values are mainly reported by the importing country - which is a better measure due to the differences between c.i.f. and f.o.b. prices (s.Feenstra, Lipsey, Deng, Ma, and Mo (2005)). The world trade data allows to calculate different measures of market power of Brazilian firms, as well as a proxy for production in the destination country and a measure of the importance of each sector in each country. All variables are described in Table 3.7.

Income per capita: Data on GDP per capita ($CGDP_c$) comes from the Penn World Table

[14]The NBER-UN data uses the Standard International Trade Classification (SITC 2 - Division), 4 digits.

(PWT 6.2 for 188 countries. The version 6.2 uses the year 2000 as the base year).
The main explanatory country variables are described in Table 3.2. Countries are divided according to the tertile of the income distribution.
Figure 3.2 shows the correlation between income per capita and the Gini coefficient. One could argue that the Gini coefficient does not provide much additional information to prices when controlling for income per capita. Although, for the sample of countries used in this Chapter[15], the correlation between the Gini coefficient and the income per capita is -0.193 for rich countries, and 0.149 for poor countries. This result is not surprising: according to the Kuznets curve (see Kuznets (1955)), there is a natural cycle of inequality and income per capita, leading to an inverted u-shaped curve (with Gini on the Y axis and income per capita on the X axis).

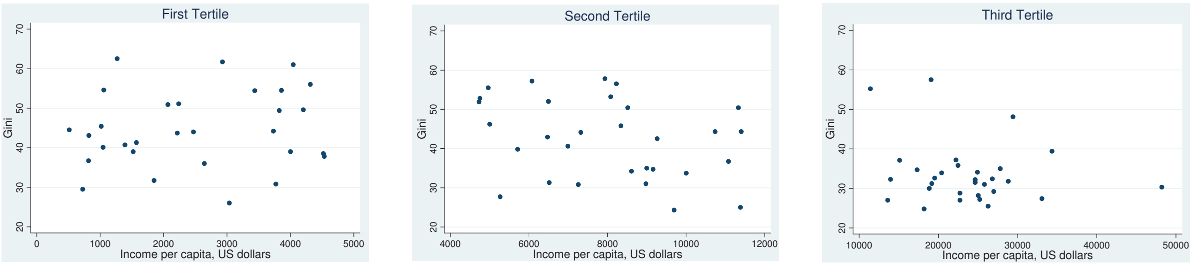
Table 3.2: Main explanatory variables, according to the tertile of the income distribution

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
First tertile of the distribution of $CGDP_c$					
GDP_c	329,513,308	1,003,365,021	2,606,171	5,052,199,936	31
$CGDP_c$	2,635.498	1,383.968	513.906	4,732.128	31
$Dist_c$	8,881.426	4,478.001	2,380.92	18,396.479	31
$Gini_c$	44.687	9.625	26	62.5	31
Second tertile of the distribution of $CGDP_c$					
GDP_c	198,419,970	283,274,398	2,040,752	1,352,476,032	30
$CGDP_c$	8,201.286	2,102.586	4,753.42	11,430.188	30
$Dist_c$	8,400.192	4,163.122	1,134.65	16,409.975	30
$Gini_c$	42.53	10.179	24.3	57.8	30
Third tertile of the distribution of $CGDP_c$					
GDP_c	714,360,206	1,786,852,465	5,536,964	9764,800,512	30
$CGDP_c$	24,095.87	6,835.66	13,616.582	48,217.272	30
$Dist_c$	10,338.795	2,393.837	6,343.316	18,821.258	29
$Gini_c$	32.767	6.627	24.8	57.5	30

The Appendix to descriptive statistics contains a thorough description of the main variables and the prediction according to the literature. Table 3.7 in the Appendix presents a brief summary of the variables.

[15]The sample used in this Chapter includes all destination countries of Brazilian exports, for which there is available information on the Gini coefficient. A detailed description is found in the Appendix.

Figure 3.2: Gini and income per capita for different tertiles of income per capita



3.4 Empirical Analysis

This section presents the econometric approach and empirical predictions of the theoretical model. We show that prices are sistematically higher in high income and more unequal destination countries. These results hold only for differentiated goods, and are magnified for products with higher scope for quality differentiation.

The econometric specification is similar to Manova and Zhang (2012) and Bastos and Silva (2010b). Bastos and Silva (2010b) use a cross-section of Portuguese firms and find convincing evidence that f.o.b. prices increase in distance; Manova and Zhang (2012) test different trade theories at the firm level and suggest quality differentiation as an explanation for differences in prices of differentiated goods.[16]

3.4.1 Econometric specification for cross-section analysis

We use *fixed effects transformation* as the methodology to study the determinants of f.o.b. prices across destination countries by firm-product pairs. From the linear unobserved

[16] Many studies have found that price variations across countries are related to non-homothetic preferences. Hallak (2006, 2010) and Hummels and Klenow (2005) find that prices are positivelly correlated to exporter per capita income, which suggests that countries with higher income have a comparative advantage in producing goods of higher quality. Fieler (2011) studies both demand and supply side and find that unit prices increase both with importer and exporter income per capita, i.e., *for the same commodity category, unit prices increase with importer income per capita.* This result indicates that countries with higher income produce and consume goods of higher quality Fieler (2011). Although, all those studies are at the country level; new studies as the ones mentioned from Manova and Zhang (2012) and Bastos and Silva (2010b) are the new attempts to study price variation using firm-level data.

effects model $Y_{cgf} = \mathbf{X}_{cgf}\beta + \delta_{gf} + u_{cgf}$, the averages of firm f and product g over C countries follow:

$$\underbrace{C^{-1}\sum_{c=1}^{C} Y_{cgf}}_{\bar{Y}_{gf}} = \underbrace{C^{-1}\sum_{c=1}^{C} \mathbf{X}_{cgf}}_{\bar{X}_{gf}}\beta + \delta_{gf} + \underbrace{C^{-1}\sum_{c=1}^{C} u_{cgf}}_{\bar{u}_{gf}} \tag{3.14}$$

where $Y_{cgf} = uprice_{cgf}$ represent unit values $(\frac{Value_{fcgt}}{Quant_{fcgt}})$ and $\mathbf{X}_{cgf}$ is the vector of control variables described in Table 3.7.
In terms of deviations from the mean, $\ddot{Y}_{cgf} = Y_{cgf} - \bar{Y}_{gf}$, it follows:

$$\ddot{Y}_{c(gf)} = \ddot{X}_{c(gf)}\beta + \ddot{u}_{c(gf)} \tag{3.15}$$

For linear models, the within estimator from equation 3.15 is equivalent to the least-squares dummy-variable estimator (LSDV) and allows to control for all firm-product unobserved heterogeneity. Thus, the LSDV and the fixed effects transformation may be used interchangeably once the standard errors are clustered in the correct way, given the sample dimensions.[17] Errors are clustered by destination country.

3.4.2 Price variation across destination countries: homogeneous versus differentiated goods

This section presents the results for the main proposition of the theoretical model. We expect that countries with a more unequal income distribution pay higher average prices for differentiated goods. The results follow the within estimator from equation 3.15, in logs if applicable. We confirm the predictions from our model in Tables 3.3 and 3.4.
We show that differentiated goods (Table 3.3) follow different patterns if compared to homogeneous goods (Table 3.4). In particular, the second moment of the income distribution

[17] The only difference between the two estimators refers to the cluster-robust standard errors because of different small-sample correction. Consider the LSDV model: $Y_{cgf} = \left(\sum_{n=1}^{N} \alpha_{cgf}\mathbf{d}_{n,cgf}\right) + \mathbf{X}_{cgf}\beta + u_{cgf}$, where $n = 1, ..., N$ are N $firm * product$ specific indicator variables, $\mathbf{d}_{n,cgf}$, with $\mathbf{d}_{n,cgf} = 1$ for the nth $firm * product$ pair observation, and $zero$ otherwise.
The inference in the least-squares dummy-variable estimator is designed for N fixed and $C \to \infty$, while in the within estimator C is fixed and $N \to \infty$. See Cameron and Trivedi (2010).

($Gini_c$) is positive and significant in all specifications shown in Table 3.3, for differentiated goods. Firm-product average prices are higher in richer countries (measured by the income per capita) and, controlling for income per capita, the effect of income inequality on prices is positive and significant. In the benchmark specification in Column (2), the magnitude of the Gini coefficient, measured from 1 to 100, means that 1 percentage increase in the income inequality leads to an increase in prices of differentiated goods by 0.44%. For income per capita, results mean that a 1% increase in the income per capita leads to an increase in export prices of 4.56%. Thus, prices are systematically higher not only in richer destinations, but also in more unequal destinations. As expected, there is no effect of income or income inequality on prices for homogeneous goods (Table 3.4).

Assuming for a moment that the results from Table 3.3 reflect quality variation across destinations, results could be interpreted as a market-specific quality differentiation. If country A has a higher share of wealthy individuals (given in the model by n_R) than country B, with a high willingness to pay for quality, the demand for high quality products in country A will be higher. Thus, average prices in country A (shown in equation 8) will be higher, which confirms the predictions from our model.[18] Our model also adds an interpretation for variable markups. With downward sloping supply curves (which is consistent with monopolistic competition and external economies of scale), markups are adjusted such that more unequal countries pay higher prices. Thus, firms may adjust markups and quality to more unequal destinations, as predicted in Simonovska (2010) and Verhoogen (2008).

In the next section, we discuss whether this result holds for all countries, and discuss which countries are driving the results of income inequality on prices. We also discuss competing hypotheses to the product quality and markup hypotheses.

For the first moment of the income distribution (income per capita), our results are in line with trade models with non-homothetic preferences. If preferences are non-homothetic, consumers in wealthier countries have a lower marginal utility of income and are willing to pay more for high quality products. Thus, the income level will determine the choice for quality, which will be embodied in the price charged by firms. This result has been shown, e.g., by Manova and Zhang (2012) and Bastos and Silva (2010b).

At the aggregate level, Bekkers, Francois, and Manchin (2012) confirm the result that

[18] Note that, in our model, the poor individuals (low income) can not afford the differentiated good, while the middle income and the rich individuals will consume the low and high quality varieties of the differentiated good.

higher income leads to higher average prices. They use the second moment of the income distribution (income inequality) to differentiate three competing models and find empirical support for a hierarchic demand model: as individuals become richer, more goods become indispensable, which decreases the price elasticity of these goods and raises markups. Thus, they find support for market prices decreasing with income inequality, which is opposite to the results found in our empirical analysis. Bekkers, Francois, and Manchin (2012) suggest that their results do not fasify the quality theory, but rather stress the importance of markups. Fajgelbaum, Grossman, and Helpman (2011) build a model with different quality levels and variable markups and discuss that prices are unambiguously higher for higher quality products, but that the effect of markups on prices can go in either way. According to their predictions, more income inequality leads to more demand for high quality products, which is inline with our results. In our model, when prices are endogenous, the effect of markups on prices can go in either way, depending on the shape of the supply curve, but prices are, by assumption, higher for products with higher quality. Empirically, we find that higher income inequality leads to higher prices. We interpret this finding as a result both of demand for high quality (once inequality increases) and of higher markups if firms have decreasing average costs (downward sloping supply curve).[19] The advantages of the firm-level approach, used in this Chapter, are to have a higher level of product disaggregation (8-digit product), to be able to track firm behavior, and to control for the supply-side unobserved heterogeneity.

At the aggregate level for trade flows, Francois and Kaplan (1996) have shown that income distribution, and in particular income inequality, has an important effect on trade flows. They find that, in developing countries, the share of imports of manufactured goods from developed countries increases with the inequality of the developing country. Dalgin, Trindade, and Mitra (2008) use a gravity approach and show that income distribution helps explaining import demand. They construct a classification of luxury goods and show that the difference in import demand of luxuries versus necessities varies with income inequality. This results are inline with our quality interpretation.

Distance to destination and the market size confirm the predictions from the literature (a similar interpretation is found in Manova and Zhang (2012) and Bastos and Silva (2010b)).

[19] If firms have upward sloping supply curves, our empirical results for income inequality would mean that the quality effect outweighs the markup effect.

Consider first the predictions for differentiated goods. For distance $Dist_c$: with per unit transaction costs, the relative price of the high quality products decreases with distance (Alchian and Allen (1964) effect). Thus, the highest quality is shipped to distant countries.[20] The prediction for market size (GDP_c) may be related to the toughness of the market: as the market grows large, competition gets tougher and leads to lower prices (i.e., firms may adjust markups). As shown below, competition and market power are considered in different ways.[21]

Empirically, the predicted income effect for differentiated goods can not be explained only by higher markups because of greater market power, since the variable $Mktshare_{fcg}$ (Column (3), Table 3.3) controls for the firm's market share, as also shown in Manova and Zhang (2012). Controlling for the firm-product market share in a specific country, the results for GDP per capita remain robust. One important concern with this measure of market share is the high correlation between prices and $Mktshare_{fcg}$. Thus, we use alternative measures to control for market power, shown in columns (4) and (5).

Column (4) adds $ShareImp_{c,s}$ a proxy for production in country c using the NBER-UN World Trade data. It controls for the importance of sector s_i in the total imports from country c. Column (5) adds $ShareExp_{c,s}$, which controls for the importance of sector s_i in total exports of destination country c, as a proxy for production in country c. Moreover, $ln(Nfirms)_{cg}$ controls for the number of firms selling the same product in each market as a proxy for competition. The coefficients for income per capita and income inequality remain significant in all specifications.

The results are also robust controlling for the *elasticity of substitution* measured by Broda, Greenfield, and Weinstein (2010), as shown in column (7).

For homogeneous goods, the patterns of distance and market size are the opposite compared to the results for differentiated goods, as we show in Table 3.4. For $Dist_c$, higher distances imply lower prices. This prediction could be a result of more productive firms being the only ones that make it to export to more distant markets. Since more productive firms have lower marginal costs for non vertically differentiated products, they also charge

[20] In the literature of price variation *across firms*, the argument of the quality sorting literature is that more productive firms sell higher quality, and high observed prices indicate high competitiveness; thus, marginal costs increase in distance, as argued in Verhoogen (2008) and Baldwin and Harrigan (2011).

[21] Heterogeneous firms models with linear demand (see Melitz and Ottaviano (2008)) predict that markups decrease as the market sizes increases, since competition gets tougher.

lower prices for the homogeneous product. For GDP_c, the positive effect may be a result of economies of scale, as long as firms have higher revenues in those markets.

Table 3.3: Variation in export prices within firm-product pairs across countries for Differentiated goods

Dependent variable: $ln(uprice)_{fcg}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Gini_c$	0.00175**	0.00444***	0.00507***	0.00354***	0.00346***	0.00399***	0.00444***
	(0.000804)	(0.00112)	(0.00112)	(0.00113)	(0.00113)	(0.00111)	(0.00112)
$ln(CGDP)_c$		0.0456***	0.0482***	0.0316*	0.0310*	0.0426***	0.0452***
		(0.0161)	(0.0161)	(0.0164)	(0.0164)	(0.0162)	(0.0161)
$ln(Dist)_c$		0.0478***	0.0275*	0.0466***	0.0477***	0.0764***	0.0473***
		(0.0135)	(0.0141)	(0.0139)	(0.0139)	(0.0168)	(0.0135)
$ln(GDP)_c$		-0.0218***	-0.0169***	-0.0278***	-0.0288***	-0.0282***	-0.0216***
		(0.00595)	(0.00601)	(0.00667)	(0.00663)	(0.00621)	(0.00596)
$Mktshare_{fcg}$			0.122***				
			(0.0262)				
$ShareImp_{c,s}$				-1.680			
				(1.094)			
$ShareExp_{c,s}$					-0.544		
					(1.025)		
$ln(Nfirms)_{cg}$						0.0275***	
						(0.0106)	
$Sigma_{c,s}$							0.000129
							(0.000218)
Constant	2.911***	2.387***	2.375***	2.637***	2.648***	2.264***	2.391***
	(0.0371)	(0.206)	(0.206)	(0.223)	(0.223)	(0.212)	(0.206)
Firm-product FE	Y	Y	Y	Y	Y	Y	Y
Observations	82,716	82,716	82,716	82,716	82,716	82,716	62,055
R-squared	0.924	0.926	0.926	0.928	0.928	0.926	0.926
Number of countries	90	90	90	90	90	90	62
Number of products	3226	3226	3226	3226	3226	3226	2780
Number of firms	6186	6186	6186	6186	6186	6186	4560

NOTES:

1. The standard errors are clustered at the country level.
2. The R-squared reported refer to the LSDV estimator, which includes the firm-product FE.
The within effect of the estimations using fixed effects transformation is, on average, 0.03 and, thus, similar to (although strictly greater than) the within effect reported in Bastos and Silva (2010b) in their working paper.
3. Since the focus of the paper is the variation across countries for a firm-product pair, all observations for which the number of destinations is less than 2 are dropped.

Table 3.4: Variation in export prices within firm-product pairs across countries for Homogeneous goods

Dependent variable: $ln(uprice)_{fcg}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Gini_c$	0.000149		0.000149	0.000165	0.000208	0.000321	-0.000260
	(0.00185)		(0.00185)	(0.00187)	(0.00197)	(0.00196)	(0.00195)
$ln(CGDP)_c$			0.00591	0.00566	-0.00481	-0.00303	0.00828
			(0.0159)	(0.0155)	(0.0171)	(0.0167)	(0.0158)
$ln(Dist)_c$		-0.0723**	-0.0718**	-0.0711**	-0.0613*	-0.0615*	-0.0798**
		(0.0314)	(0.0341)	(0.0343)	(0.0346)	(0.0346)	(0.0346)
$ln(GDP)_c$		0.0185***	0.0175***	0.0172***	0.00803	0.00818	0.0208***
		(0.00613)	(0.00600)	(0.00653)	(0.00600)	(0.00586)	(0.00714)
$Mktshare_{fcg}$				-0.00724			
				(0.0514)			
$ShareImp_{c,s}$					-0.428		
					(1.285)		
$ShareExp_{c,s}$						-1.062**	
						(0.536)	
$ln(Nfirms)_{cg}$							-0.0169
							(0.0129)
Constant		5.343***	5.298***	5.300***	5.514***	5.491***	5.332***
		(0.277)	(0.374)	(0.374)	(0.383)	(0.385)	(0.377)
Firm-product FE	Y	Y	Y	Y	Y	Y	Y
Observations	2,107	2,107	2,107	2,107	1,872	1,872	2,107
R-squared	0.983	0.983	0.983	0.983	0.984	0.984	0.983
Number of countries	74	74	74	74	74	74	74
Number of products	158	158	158	158	158	158	158
Number of firms	521	521	521	521	521	521	521

NOTES:

1. The standard errors are clustered at the country level.
2. The R-squared reported refer to the LSDV estimator, which includes the firm-product FE.
The within effect of the estimations using fixed effects transformation is, on average, 0.03 and, thus, similar to (although strictly greater than) the within effect reported in Bastos and Silva (2010b) in their working paper.
3. Since the focus of the paper is the variation across countries for a firm-product pair, all observations for which the number of destinations is less than 2 are dropped.

3.4.3 Are the effects asymmetric across groups of countries?

Table 3.3 has presented a positive and robust effect of income inequality of the destination country on export prices. To facilitate the analysis of the effect of income inequality on export prices, we divide the destination countries according to the tertiles of the distribution of the income per capita. As shown in Table 3.2, average income for the first, second, and third tertiles are, respectively, 2,635, 8,201, and 24,096 US dollars.

Results for the different tertiles of income are shown in Table 3.5. Results give further support to our quality hypothesis. We find the strongest effect for the middle income group.

The fact that results are not significant for the first tertile of income (poor countries) is not contradictory: for those countries, what matters is the income per capita (shown in the results with significant $CGDP_c$, and not income inequality), as shown in Table 3.5. As our theoretical model predicts, poor individuals will not buy the differentiated good. If very poor countries (with average income of 2,635 dollars in our sample, in the first tertile of the income distribution) have a high enough share of low income individuals, the effect of the middle income and rich individuals in those countries might be too small to generate enough consumption of the differentiated good. For the third tertile, results are similar to the results for the second tertile, but less robust. The reason why results are not significant is probably the fact that, for economies in the third tertile, there is very little variation in the Gini coefficient, as shown in Figure 3.2. Thus, the effect is less precisely estimated.

Similar results hold dividing the sample in three groups: developing with income below the median, developing with income above the median, and developed (all with income above the median). In this case, results are positive and significant only for the group of developing countries with income above the median. See the results in Table 3.11 in the Appendix.

Many facts may explain our results. As discussed in Dalgin, Trindade, and Mitra (2008), when the income expansion path is curved, income distribution becomes a determinant of aggregate demand. Many middle-income economies experienced a sharp increase in the number of rich. With curved income-expansion paths, the *new rich* will buy proportionately more high quality goods than before. Moreover, firms may charge even higher markups for those goods: as individuals get wealthier, they tend to devote a higher share of income to brands, luxury, and positional goods, and will be willing to pay more for those goods.

For middle income and rich countries, anecdotal evidence supports the fact that increase in inequality is driven by the rich. In most rich economies, increases in income inequality have been associated with the rise in income of the 20% wealthiest, as is the case of the United States (i.e., the rich are getting richer). In most middle income countries, income inequality has been associated with the increase in the number of rich.[22]

[22]This fact may be a further reason why results are not significant for rich countries: instead of having more rich individuals, there is an increase in the wealth for the already rich individuals, for which the increase in comsumption of high quality may not be enough to generate variations in demand.

Table 3.5: Variation in export prices within firm-product pairs across countries for the tertiles of the income per capita

Dependent variable:	**First Tertile**		**Second Tertile**		**Third Tertile**	
$ln(uprice)_{fcg}$	(1)	(2)	(3)	(4)	(5)	(6)
$Gini_c$	-0.00215	-0.00128	0.00431**	0.00457**	0.000762	0.00121
	(0.00473)	(0.00481)	(0.00209)	(0.00209)	(0.00556)	(0.00553)
$ln(CGDP)_c$	0.165**	0.165**	0.00812	0.00480	0.201	0.192
	(0.0745)	(0.0743)	(0.0649)	(0.0650)	(0.122)	(0.122)
$ln(Dist)_c$	0.0990*	0.0741	0.0648**	0.0550*	-0.0965	-0.103
	(0.0530)	(0.0545)	(0.0273)	(0.0286)	(0.152)	(0.153)
$ln(GDP)_c$	-0.0907***	-0.0847***	-0.0450***	-0.0440***	-0.0206	-0.0143
	(0.0260)	(0.0262)	(0.0120)	(0.0121)	(0.0227)	(0.0228)
$Mktshare_{fcg}$		0.112*		0.0641		0.0867
		(0.0665)		(0.0526)		(0.0729)
Constant	2.488***	2.509***	2.945***	3.009***	2.505	2.473
	(0.944)	(0.943)	(0.731)	(0.733)	(1.655)	(1.655)
Firm-product FE	Y	Y	Y	Y	Y	Y
Observations	18,290	18,290	43,328	43,328	21,098	21,098
R-squared	0.953	0.953	0.947	0.947	0.959	0.959

NOTES:
1. The standard errors are clustered at the country level.
2. The R-squared reported refer to the LSDV estimator, which includes the firm-product FE.

3.4.4 Are the effects asymmetric across groups of products?

We have shown that our results for the first and second moment of the income distribution hold only for differentiated goods. Among differentiated goods, we are also interested in asymmetric effects across products with lower or higher scope for vertical differentiation. Khandelwal (2010) characterizes industries according to the scope for quality differentiation. Industries are classified as long and short quality ladders, i.e., with long and short scope for quality differentiation. We use this classification of industries to analyse whether the effect of income inequality on prices is higher for sectors classified as long quality ladders. Thus, we expect that the effect of $Gini_c$ on prices is magnified for sectors classified as long quality ladders, associated with higher vertical differentiation. Results are shown in Table 3.6.

Using the interaction term $Gini_c * Ladders$, we show that the effect of income inequality on prices is captured by sectors with high scope for quality differentiation. This result provides further support to the quality hypothesis: for long quality ladders, prices are higher in more unequal countries.

Table 3.6: Variation in export prices within firm-product pairs across countries for different quality ladders

Dependent variable: $ln(uprice)_{fcg}$	(1)	(2)	(3)
$Ladders * Gini_c$	**0.00129***	**0.00124***	**0.00130***
	(0.000665)	(0.000667)	(0.000668)
$Gini_c$	-0.00199	-0.00120	-0.00115
	(0.00129)	(0.00142)	(0.00142)
$ln(CGDP)_c$		0.0150	0.0155
		(0.0113)	(0.0113)
$ln(Dist)_c$	0.0362***	0.0425***	0.0367***
	(0.00779)	(0.00902)	(0.00959)
$ln(GDP)_c$	-0.00902***	-0.0127***	-0.0113***
	(0.00309)	(0.00406)	(0.00414)
$Mktshare_{fcg}$			0.0345*
			(0.0179)
Constant	3.108***	2.957***	2.956***
	(0.0902)	(0.145)	(0.145)
Firm-product FE	Y	Y	Y
Observations	56,222	56,222	56,222
R-squared	0.970	0.970	0.970

NOTES:
1. The standard errors are clustered at the country level.
2. The R-squared reported refer to the LSDV estimator, which includes the firm-product FE.

3.4.5 Robustness checks:

Region/country effects: In order to rule out *region or country effects*, we exclude important trade partners from the sample at a time. Results are shown in Table 3.9 in the Appendix: results are significant exluding the United States, Argentina, Mercosur as well as the European Union. Thus, results are not specific to countries or regions in the sample.
Intra-firm trade: We show that results are not driven by intra-firm trade. Since information on final consumers is unobservable, we use information on foreign ownership status of firms in the period 1997-2000 as a rough proxy for intra-firm trade. The dummy FDI_f is one if the firm has foreign ownership status, and zero otherwise. More information is found in the data Appendix.
As shown in Table 3.10 in the Appendix, the effect of $Gini_c$ on prices is not completely captured by the dummy FDI_f, which means that results are not driven by intra firm trade.

Moreover, we show that the interaction term $FDI_f * Gini_c$ is positive and significant, which is not a surprising result: firms that receive FDI are in general larger, export to more markets, are more productive and produce higher quality products. As we show in Table 3.10, firms with foreign ownership do not drive the effects, but the effect is magnified for those firms.

Market share, endowment and production effects: As already shown in Table 3.3, the price variation across countries can not be explained only by the market share $Mktshare_{fcg}$ of Brazilian firms. Moreover, using information on World trade flows by SITC sector, the control variable $ShareImp_{c,s}$ in Table 3.3 implies that the results are not driven by sectors in which Brazil has a comparative advantage in comparison to other countries; and the control $ShareExp_{c,s}$ implies that the results are also not driven by sectors in which destination country c has a comparative advantage.

3.5 Conclusion

This Chapter shows first firm-level evidence of the links between income inequality and export prices. We provide a theoretical framework to explain why countries with higher income inequality demand products with higher average prices. The mechanism behind this result is the demand for different types of products: individuals have preferences over homogeneous and differentiated goods, with different levels of quality and different prices associated to them. An increase in the number of poor individuals, and/or in the number of rich individuals in a country lead to more income inequality, and to higher average prices. We also consider the role of markups for the pricing decision.

We show that the first and the second moment of income distribution have a positive and significant effect on prices. Countries with higher income per capita purchase products at higher prices and, given the income per capita, prices are systematically higher in more unequal countries. These results hold only for differentiated goods, and in particular for products with high scope for quality differentiation.

We address several issues not mentioned in the firm-price literature before and that might affect price variation across countries. In particular, results are robust to intra-firm trade, the quality ladder length, the elasticity of substitution in different markets, and different

measures of market power and the structure of industries in different markets.
Our empirical results suggest that the second moment of the income distribution is important to explain the patterns of trade, and that market-specific quality differerentiation, as well as market-specific markup pricing, are important margins of firm-level adjustment.

3.A Descriptive Statistics

Table 3.7: Main control variables x_{gfc}:

$\mathbf{x}_{gfc}$	**Variable description**
Country characteristics:	
GDP_c	GDP of country c (measure of country size)
$Dist_c$	Distance to country c
$CGDP_c$	GDP per capita of c
$Gini_c$	Gini coefficient in c
Firm and market characteristics:	
$Quant_{gfc}$	*Intensive margin*: quantity exported of good g to country c by firm f
$SumRev_f$	Total export revenues of f (measure of firm size)
$Mktshare_{gfc}$	Market share of fg in c with respect to the sum of firms exporting g to c
$ShareImp_{c,s}$	$\frac{Imp_{cs_i}}{\sum_{j \neq i} Imp_{cs_j}}$. Share of imports of c in sector s_i with respect to all sectors $j \neq i$
$ShareExp_{c,s}$	$\frac{Exp_{cs_i}}{\sum_{j \neq i} Exp_{cs_j}}$. Share of exports of c in sector s_i as *proxy for production in c*
$Mktshare_{fc,s}$	Share of imports in s_i from Brazilian firms with respect to total imports from the World
$Nfirms_{gc}$	Number of Brazilian firms selling g in country c (competition measure)
$Sigma_{c,s}$	Import demand elasticities at the 3-digit HS for each country c

3.B Data Appendix

3.B.1 SECEX firm-level data for the year 2000: data construction

The Brazilian SECEX exports data contains information on agricultural sector and observations without information on quantities. The procedure to construct the data for the cross-section 2000 follows:

1. If the observation relates to agricultural and mining sector, it was dropped from the sample. The same if the observation refers to commercial intermediates. Thus, only manufacturing firms are considered. This procedure removed 11,192 observations.

2. If the observation contains zero exporting value, it was removed from the sample. As described in Arkolakis and Mündler (2011), these observations correspond to reporting errors or shipments of commercial samples. As in Arkolakis and Mündler (2011), 484 observations are removed.

3. If the observation contains no information on export quantities, it was removed from the sample. This procedure removed 37,903 observations. Without information on quantities, it is not possible to construct unit values, defined as $p_{fcg} = \frac{Value_{fcg}}{Quantity_{fcg}}$, for f the firm, g the product and c the destination country of the f.o.b. exported value $Value_{fcg}$l and quantity $Quantity_{fcg}$. Importantly, the lack of information on quantities is not systematic by sector or type of product. Thus, there is no concern with sample selection. [23].

A product g is defined as a NCM 8-digit product. An example of such a product, in the textile industry, follows:

- 63090010 (8-digit NCM classification) Articles of apparel, clothing accessories and parts thereof.
- 630900 (6-digit NCM classification) Worn clothing and other worn articles.
- 63 (2-digit NCM classification) Other made up textile articles; sets; worn clothing and worn textile articles; rags..

Table 3.8 presents a brief summary of average number of destinations and number of products by firm. Column 2 shows that firms that export to more than 10 destinations export on average 26.29 different NCM 8-digit products. And, from Column 3, firms that export more than 10 products export to 8.77 destinations on average.

Table 3.8: Average number of destinations and number of products by firm

	Average number of products by number of destinations	**Average number of destinations by number of products exported**
1	2.83	1.70
2	3.40	2.84
3	4.25	3.84
4	5.04	4.62
5	6.21	5.57
10+	26.29	8.77
Average	4.69	1.70

[23] As a robustness check to the results, I reestimate the results after removing extreme unit values. The data trimming removes observations for which the unit value p_{fcg} is either 5 times above or 5 times below the median unit price by product g, as in Khandelwal (2010); Brambilla, Lederman, and Porto (2010). This second step drops 19,960 observations 5 times above and 18,184 observations 5 times below the median (for all types of goods). Results remain robust

3.B.2 Methodology for construction of the Gini coefficient:

I use the income inequality data from the WIID2 UNO-WIDER (United Nations World Institute for Development Economics Research). Although, the data contains many duplicate values and missing values for some countries. In case of duplicate values for a country, I keep the variables that satisfy the following criteria (in this order):

Step 1. Highest quality rating (variable $Quality = 1$, otherwise 2, 3 or 4). The quality rating in the WIID2 was evaluated according to the following criteria: (a) whether the concepts underlying the observations are known; (b) the coverage of the income/consumption concept; and (c) the survey quality. A observation receives quality rating 1 for observations that satisfy the criteria (a) and (b).

Step 2. Latest *Revision*. The WIID1 was updated to construct the new WIID2 database, which is the most recent and updated revision.

Step 3. Area covered refers to the whole country (variable $AreaCovr = All$).

Step 4. Basic statistical unit is the household (variable $IncSharU = household$, instead of tax unit, person or family).

Step 5. Unit of analysis is the person (variable $UofAnala = person$): in this case, the needs of different sized households have been taken into account [24].

Step 6. Equivalence scale has been adjusted (variable $Equivsc = householdpercapita$). Since the different sized households have been taken into account, in the equivalence scale the adjustment has been made for the different sized and composed households.

Step 7. Icome definition is *disposable income* (variable $IncDefn = Income, Disposable$). This classification is similar to the one from the Canberra Group on Household Income Statistics with the United Nations Statistics Division [25].

Step 8. Information on currency is available (variable $Curref$ with available information).

Step 9. Income definition is income (variable $IncDefn = Income, ..$).

Step 10. Income definition is gross income (variable $IncDefn = Income, Gross$).

Step 11. Equivalence scale used was the household (variable
$Equivsc = Householdeq, OECDmod$).

[24] In the case in which the unit of analysis is the household, the size of the households and the needs of different sized households have not been taken into account.

[25] The final report and recommendations from the Canberra Group on household income statistics can be found at `http://www.lisproject.org/links/canberra/finalreport.pdf`

This methodology leads to 72 unique Gini coefficients (72 countries) [26]. For countries with missing information for the year 2000, I follow the same steps described above for the years 1999 and 2001, respectively. In this way, the final methodology leads to 98 unique Gini coefficients (103 countries) [27]. When I combine the Gini coefficient with the firm-level data, I exclude destination countries with less than 3 observations in the sample[28].

3.B.3 Data on foreign ownership status

For the robustness checks conducted to control for intra-firm trade, we use information on the foreign ownership status of Brazilian firms, compiled by Poole (2009). All foreign investments are registered with Brazil's Central Bank (Banco Central do Brasil) and, thus, available in the dataset. Some assumptions were made to construct the dummy from the FDI information. As explained in Poole (2009), an establishment with positive foreign investment stock in t=2001 and positive flows in $t-3$ and $t-4$ is classiffied as a foreign-owned establishment through the whole period. If the establishment has no stock in t=2001 but positive inflows in other years, the establishment is classiffied as foreign-owned only for the years with positive flows. And, if the establishment has a positive stock in t=2001 but no flows in the years before, it is classified as foreign-owned for the whole period. Two dummies for the foreign ownership status were created, where the main difference is that one of the dummies refers only to the foreign ownership status of the firm, and the other assumes that also subsidiaries of firms receiving inflows are foreign-owned (even if the subsidiary is not classified as having received inflows or with a stock of foreign investment). Throughout this paper the dummy used is the second one. Both dummy variables were constructed using three main data sources from the Brazil's Central Bank: plant-level inflows information from 1996 to 2001, plant-level stock information in the year 2001, and (incomplete) information on the holding company corporate structure. If there was no information on FDI stocks by year, the data allowed for a procedure to infer which establishments were at least partially foreign-owned for each year; see Poole (2009).

[26] Only for Finnland there were still duplicate values for the year 2000 after all the steps. In this case, the observation was saved if the currency avaialble was in euros $curref == "EUR02/year"$

[27] The raw data available at `http://www.wider.unu.edu/research/Database/en_GB/wiid/`.

[28] Countries with less than three observations are Armenia, Azerbaijan, Laos, Lesotho, Moldova, Uzbekistan, and Georgia.

3.C Robustness checks

Table 3.9: Robustness checks: rule out *region effects*

Dependent variable:	Without US		Without Argentina		Without EU		Without Mercosur	
$ln(uprice)_{fcg}$	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
$Gini_c$	0.00352***	0.00409***	0.00351***	0.00409***	0.00360***	0.00425***	0.00336***	0.00360***
	(0.00113)	(0.00113)	(0.00116)	(0.00116)	(0.00121)	(0.00121)	(0.00120)	(0.00121)
$ln(CGDP)_c$	0.0328**	0.0339**	0.0458***	0.0461***	0.0703***	0.0744***	0.0458***	0.0460***
	(0.0164)	(0.0164)	(0.0171)	(0.0171)	(0.0179)	(0.0179)	(0.0175)	(0.0175)
$ln(Dist)_c$	0.0467***	0.0248*	0.0209	-0.0104	0.0713***	0.0507***	-0.00641	-0.0364
	(0.0138)	(0.0146)	(0.0171)	(0.0180)	(0.0147)	(0.0153)	(0.0238)	(0.0247)
$ln(GDP)_c$	-0.0291***	-0.0249***	-0.0182***	-0.0102	-0.0348***	-0.0303***	-0.0189***	-0.0112
	(0.00659)	(0.00662)	(0.00703)	(0.00714)	(0.00676)	(0.00680)	(0.00716)	(0.00727)
$Mktshare_{fcg}$		0.128***		0.142***		0.132***		0.137***
		(0.0277)		(0.0282)		(0.0296)		(0.0298)
Constant	2.642***	2.672***	2.603***	2.642***	2.237***	2.217***	2.982***	3.019***
	(0.222)	(0.222)	(0.223)	(0.222)	(0.219)	(0.220)	(0.303)	(0.303)
Firm-product FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	74,361	74,361	68,460	68,460	72,587	72,587	59,572	59,572
R-squared	0.928	0.928	0.929	0.929	0.931	0.931	0.931	0.931

Table 3.10: Robustness checks: foreign ownership status

Dependent variable: $ln(uprice)_{fcg}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Gini_c$		0.00350***	0.00409***	0.00278**	0.00268**	0.00305***	0.00350***
		(0.00116)	(0.00116)	(0.00117)	(0.00117)	(0.00115)	(0.00116)
$Gini_c * FDI_f$	0.00672***	0.00553***	0.00604***	0.00669***	0.00671***	0.00516***	0.00556***
	(0.00155)	(0.00176)	(0.00177)	(0.00185)	(0.00185)	(0.00177)	(0.00177)
$ln(CGDP)_c$	0.0277**	0.0413**	0.0436***	0.0261	0.0255	0.0390**	0.0408**
	(0.0128)	(0.0162)	(0.0162)	(0.0165)	(0.0165)	(0.0162)	(0.0162)
$ln(Dist)_c$	0.0371***	0.0472***	0.0258*	0.0461***	0.0471***	0.0711***	0.0466***
	(0.0119)	(0.0135)	(0.0142)	(0.0139)	(0.0139)	(0.0169)	(0.0135)
$ln(GDP)_c$	-0.0182***	-0.0206***	-0.0154**	-0.0265***	-0.0274***	-0.0261***	-0.0204***
	(0.00559)	(0.00596)	(0.00603)	(0.00667)	(0.00663)	(0.00624)	(0.00597)
$Mktshare_{fcg}$			0.129***				
			(0.0263)				
$ShareImp_{c,s}$				-1.611			
				(1.091)			
$ShareExp_{c,s}$					-0.447		
					(1.023)		
$ln(Nfirms)_{cg}$						0.0230**	
						(0.0106)	
$Sigma_{c,s}$							0.000148
							(0.000218)
Constant	2.665***	2.430***	2.422***	2.690***	2.703***	2.325***	2.435***
	(0.144)	(0.206)	(0.206)	(0.223)	(0.223)	(0.212)	(0.206)
Firm-product FE	Y	Y	Y	Y	Y	Y	Y
Observations	82,716	82,716	82,716	82,716	82,716	82,716	62,055
R-squared	0.926	0.926	0.926	0.928	0.928	0.926	0.926

NOTES:

1. The standard errors are clustered at the country level.
2. The R-squared reported refer to the LSDV estimator, which includes the firm-product FE.

Table 3.11: Variation in export prices within firm-product pairs across countries for the developed and developing countries

Dependent variable: $ln(uprice)_{fcg}$	**Developing country Below median** $CGDP_c$		**Developing country Above median** $CGDP_c$		**Developed country Above median** $CGDP_c$	
	(1)	(2)	(3)	(4)	(5)	(6)
$Gini_c$	-0.00140	-0.00120	0.00666**	0.00732***	4.90e-05	0.000448
	(0.00253)	(0.00254)	(0.00285)	(0.00281)	(0.00605)	(0.00602)
$ln(CGDP)_c$	0.199***	0.203***	0.0440	0.0222	0.200	0.191
	(0.0455)	(0.0457)	(0.0989)	(0.0981)	(0.124)	(0.123)
$ln(Dist)_c$	0.0512	0.0203	0.0657***	0.0501*	-0.111	-0.119
	(0.0386)	(0.0409)	(0.0253)	(0.0273)	(0.155)	(0.156)
$ln(GDP)_c$	-0.0761***	-0.0714***	-0.0472***	-0.0465***	-0.0192	-0.0121
	(0.0175)	(0.0175)	(0.0139)	(0.0140)	(0.0243)	(0.0244)
$Mktshare_{fcg}$		0.111**		0.102		0.0982
		(0.0502)		(0.0685)		(0.0750)
Constant	2.333***	2.431***	2.496**	2.757***	2.643	2.612
	(0.575)	(0.574)	(1.017)	(1.009)	(1.690)	(1.691)
Firm-product FE	Y	Y	Y	Y	Y	Y
Observations	26,075	26,075	35,789	35,789	20,852	20,852
R-squared	0.944	0.945	0.957	0.957	0.959	0.959

NOTES:

1. The standard errors are clustered at the country level.
2. The R-squared reported refer to the LSDV estimator, which includes the firm-product FE.

Chapter 4

The Effect of GATT/WTO on Export and Import Price Volatility

4.1 Introduction

Since the seminal paper by Rose (2004), many researchers have questioned the role of GATT/WTO for trade promotion and the advantages of adhering to the WTO principles.[1] [2] Besides trade promotion, membership in a multilateral trading system may act as a device for a more stability-oriented price setting behavior. Membership may constrain members from introducing new trade barriers and help for policy transparency and convergence in policy instruments in ways that promote stability.[3] Moreover, multilateral trade agreements may constrain firms from passing along their own production cost shocks, which inhibits a markup effect and reduces the volatility of prices.[4] A further firm-level channel for the reduction of price volatility is access to markets. When trade policy is

[1]While Rose (2004) has not found a positive effect of GATT/WTO membership on trade promotion, subsequent papers have readdressed the issue and found valuable effects of membership. See for instance, the asymmetric effects of membership across countries in Subramanian and Wei (2007) and Gowa and Kim (2005); the effects for the extensive and intensive margin of trade in Felbermayr and Kohler (2010a), Felbermayr and Kohler (2010b), and Helpman, Melitz, and Rubinstein (2008); and the effects for different classification of countries in Tomz, Goldstein, and Rivers (2005).

[2]According to the WTO rules, members are expected to follow several principles, as (i) lower barriers, (ii) non discrimination (with two treatments of most favored nation MFN and national treatment NT), (iii) transparency, (iv) certainty increase and (v) trade facilitation.

[3]See Mansfield and Reinhart (2008).

[4]De Blas and Russ (2012) study analytically the pro-competitive effects of trade and show that multilateral trade agreements reduce the volatility of prices.

more transparent and firms have better access to foreign markets, firms can better react to market-specific demand shocks by switching to alternative markets.[5] Thus, membership may play a risk-reducing role in economies exposed to external shocks. Even though the channels towards more stability-oriented prices are clear, still little is known about the empirical relationship between the stability of trade prices and multilateral trade agreements. This Chapter presents first empirical evidence on the effects of multilateral trade agreements, and in particular of GATT/WTO membership, on export and import price volatility. Using a large dataset covering annual bilateral trade flows and average prices by country pair, product and year, we establish new stylized facts. We find a robust and negative effect of GATT/WTO membership on price volatility for both import and export countries. Price volatility is measured as the standard deviation of the natural logarithm of price, and is computed over 4-year samples of data. The negative effect of membership on volatility is robust to several specifications, magnified for countries that increased the number of trade partners over time, and not driven by exchange rate shocks.

As an extension of our results, we also show the effects of GATT/WTO membership on import and export price levels. In this case, results indicate that membership leads to higher price levels for exporters (for importers, results are less robust, but negative). These results are inline with the interpretation of our findings for price volatility, and support a recent literature regarding prices in international trade.[6]

In a nutshell, we establish many new stylized facts: (i) GATT/WTO membership reduces price volatility of import and export countries. Similar results hold for Free Trade Agreemeents (FTAs). (ii) The effect is magnified for countries that increased the number of trade partners over time; (iii) GATT/WTO membership increases product price levels of exporters. For importers the effect is less robust, but negative; and (iv) The increase in export price levels is captured solely by differentiated goods. These effects are robust controlling for several time-varying characteristics[7] and are not driven by exchange rate shocks.

Our results can be interpreted along the lines of various models of international trade,

[5]See, for instance,Caselli, Koren, Lisicky, and Tenreyro (2011) and Vannoorenberghe (2011).

[6]For the results using price levels, our covariates follow the predictions from the price literature. See, e.g., Manova and Zhang (2012) and Hallak and Sivadasan (2011)

[7]We add several controls for market size (GDP), income per capita (CGDP), measures of comparative advantage, tariffs, openness, distance, common language, contiguity, income inequality, and further variables.

prices, and volatility. At the aggregate level, membership is coupled to the most favoured nation treatment, retaliation rights, and anti-dumping rules. As argued by Mansfield and Reinhart (2008), membership might constrain actions of members and, as a multilateral institution, the WTO helps to influence policy and to integrate markets. Moreover, membership may inhibit a price multiplier effect when the economy is subject to price shocks. As shown by Giordani, Rocha, and Ruta (2012), under inefficient trade policy, unilateral export restrictions in times of high prices create a multiplier effect that pushes prices even further up. This argument is inline with the results found by Anderson (2009). Using data for world food prices, he shows that most food price spikes are driven by major policy shifts, such as subsidies and tariffs. Thus, by enhancing transparency and convergence in trade policy instruments, membership might inhibit the multiplier effect and serve as an important mechanism device for more stable prices.

Our results have also a firm-level interpretation. De Blas and Russ (2012) study analytically the pro-competitive effects of trade in a model with heterogeneous firms and endogenous markups under Bertrand competition. They provide distributions of markups that are sensitive to the market structure and show that multilateral treaties reduce the volatility of import and export prices. Under multilateral trade agreements, firms can no longer pass along their own production cost shocks, which reduces their market power and inhibits a markup effect, reducing the volatility of prices. Thus, our empirical results for GATT/WTO and FTAs add to their theoretical predictions.

Moreover, we find that the effect of WTO membership on volatility is captured by countries that increased the number of trade partners over time. This result indicates that firms may react to shocks in one market by adjusting sales in the other, reducing the volatile of export prices. Vannoorenberghe (2011) shows firm-level evidence that an increase in the export share leads to lower volatility of exports, while leading to higher volatility of domestic sales. The explanation for this result is that, with market-specific demand shocks and convex production costs in the short run, exporters may react to shocks by substituting markets (Vannoorenberghe 2011). In this way, firms may absorb part of the external shocks. Thus, membership may play a risk-reducing role in economies exposed to external shocks, and this effect is driven by those economies that increase the number of trade partners over time.[8] In line with this argument, Buch, Döpke, and Strotmann (2009) find that sales of exporters are less volatile than those of non-exporters.As a further mechanism, at the firm level, membership may cause a selection effect and may shift the lower bound of productivity and the product quality range. This mechanism, in line with the Melitz (2003) model and the moving window effect from Sutton (2007), implies a reduction in the range of export prices and, thus, a reduction in price volatility over time.

Trade diversification is an important channel to explain reduction in volatility, which we find to be more important for countries that increase the number of trade partners over time. Caselli, Koren, Lisicky, and Tenreyro (2011) study the effect of openness on the volatiliy of a country's income. On the side of importers, Caselli, Koren, Lisicky, and Tenreyro (2011) argue that when final producers can source from suppliers from a variety of countries, shocks to domestic suppliers (or external country-specific shocks) are easily absorbed by switching to alternative partners. Through this mechanism countries can reduce the volatility of import prices. On the side of exporters, a similar mechanism may opperate. Caselli, Koren, Lisicky, and Tenreyro (2011) argue that, when exporters have multiple trade partners, an external demand shock has smaller effects on volatility when producers may ship their products to further trading partners. This mechanism could decrease the volatility of export prices.

Concerning price levels, our results are in line with the empirical evidence using price data. We find a positive and significant effect of membership on export price levels. This result can be interpreted along recent evidence on export prices, which attributes higher export prices to higher product quality and/or to higher markups.[9] GATT/WTO membership may facilitate access to better technologies and shift the product quality range, leading to an increase in export prices. Empirically, the effect we observe for price levels holds only for differentiated goods, which have scope for quality differentiation, and only for *export* prices. For import prices, the effect is not always significant, but negative. We discuss the results thoroughly in Section 4.

The remainder of the Chapter is organized as follows. Section 2 presents the data. Section

[8] Rodrik (1998) finds that more open economies have bigger governments. This empirical regularity is explained by the risk-reducing role of the government in economies exposed to more external shocks.

[9] Hummels and Klenow (2005) and Hallak (2006) find that exporters with higher income per capita sistematically export products at higher prices, and attribute the higher prices to higher product quality. A similar evidence and interpretation are found at the firm level by Manova and Zhang (2012) and Bastos and Silva (2010b).

3 discusses the empirical strategy for price volatility and for price levels. Section 4 shows the main results and robustness checks. Section 5 concludes.

4.2 Data

In this section we briefly describe the data used to construct our sample. Evaluating price volatility over time requires average price data with a sufficiently large time-series dimension, and a data that provides enough variation in prices and in membership status at GATT/WTO. We use 16 years of data and a period in which many countries joined WTO (between 1984 and 1999 40 countries joined WTO). The final sample has four dimensions: product k, exporter i, importer j and time t.

GATT/WTO membership: To construct the main explanatory variable, GATT/WTO membership, we use the official information from the WTO website. We construct two dummy variables WTO_{ct}, for countries $c = i, j$. The dummy has value one starting from the year t in which a country c signs its membership agreement[10], and zero otherwise.

Trade flows and average price data: We use the NBER-UN trade flows data constructed by Feenstra, Lipsey, Deng, Ma, and Mo (2005)[11] to construct a measure of average prices and price volatility. For the period 1984-1999, the trade data contains information not only on trade values, but also on quantities and unit of measurement by country pair, year and product (4 digit Standard International Trade Classification (SITC), revision 2)[12]. Whenever available, trade values are taken from importers and are, thus, import c.i.f. (cost, insurance and freight) prices (see Feenstra, Lipsey, Deng, Ma, and Mo (2005)). Adjustments in the original data are described in the Appendix A1.

Products are classified in homogeneous, differentiated and reference priced goods, according to the standard Rauch(1999) classification of goods, and identifyed through the 4-digit SITC. Countries are identifyed through the unique United Nations (UN) 3-digit classification of countries.

Sectors are classified according to the comparative advantage dummy (CA) proposed by

[10]The data comes from `http://www.wto.org/english/thewto_e/gattmem_e.htm`. As of 2008, there were 153 WTO members.

[11]See Feenstra, Lipsey, Deng, Ma, and Mo (2005) for a full description of the data.

[12]Although the data covers the period 1962-2000, the information on quantities, which is necessary to construct the measure of average prices, is available only from 1984 onwards.

Mayda and Rodrik (2005). The CA_{sct} dummy is 1 if sector s has a comparative advantage in country c in time t.[13]

Country characteristics: Yearly country c characteristics such as income per capita $CGDP_{ct}$, population Pop_{ct} and exchange rates $Xrat_{ct}$ come from the Penn World Table version 6.2.[14]

Time invariant bilateral data: Bilateral variables as distance $Distance_{ij}$, common language $Comlang_{ij}$ and contiguity $Contig_{ij}$ come from the Institute for Research on the International Economy CEPII (2005).[15]

Tariff data: The tariff data from 1988 to 1999 is supplied by UNCTAD-TRAINS, via the World Integrated Trade Solutions (WITS). The data is reported for two types of tariff, the Applied Effective Tariff (AHS) and the Most Favored Nation (MFN) tariff. The data provides the percentage of tariff imposed on a product k of an exporter i by an importer j across time t. Product codes are 4 digit SITC, the same used in the NBER-UN data. We make use of the AHS and conduct robustness checks using the MFN tariff data.[16]

Free Trade Agreement (FTA data): We use the FTA data from Baier and Bergstrand (2007) and construct a dummy variable FTA_{ijt} that is one if the country pair ij belong to the same FTA in year t.

Developing country status: The developing status information is provided by the International Monetary Fund (IMF), World Economic Outlook 1999[17]. We create a dummy

[13] Similar to Mayda and Rodrik (2005), the dummy CA_{sct} is constructed as follows:

$$CA_{sct} = \begin{cases} 1 & \text{if } M_{sct} - X_{sct} - \lambda_{ct} M_{sct} < 0 \\ 0 & \text{if } M_{sct} - X_{sct} - \lambda_{ct} M_{sct} > 0 \end{cases}$$

in which M_{sct} and X_{sct} are the corresponding import and export values of sector s of country c at time t, λ_{ct} is the adjustment factor (for country c at time t) which is used to adjust for the imbalance in trade (positive for trade deficit and negative for trade surplus). λ_{ct} is calculated as follows: $\lambda_{ct} = \frac{\sum_s (M_{sct} - X_{sct})}{\sum_s (M_{sct})}$. The sector s of country c at time t will have comparative advantage if $CA_{sct} = 1$, meaning that the import value doesn't exceed the sum of export and the adjustment from imbalance in trade.

[14] For further informaton about the data, see Heston, Summers, and Aten (2006).

[15] For further information, see Head, Mayer, and Ries (2010).

[16] Some tariff cases needed adjustment. For instance, for the observations of European Union (as importer), we need to expand the data, since all EU members apply the same tariff level provided by the Union (with exception of Sweden, that does not follow the European Union tariff schedule). Thus, observations will be expanded by 12 times for all years from 1988 to 1994, and 14 times from 1995 to 1999. The information on EU membership is taken from the official website of the European Union, available at http://europa.eu/about-eu/eu-history/index_en.htm.

[17] The data comes from `http://www.imf.org/external/pubs/ft/weo/1999/01/data`

$DEVING_{ct}$ which is one if country c is classified as a developing economy in year t. If information is not available from the IMF, we use the data from the Central Intelligence Agency (CIA) Fact Book.[18]

The United States' import data: As a robustness check for our results, we use the import data (for the period of 1989-1999) from the United States[19], which offers information by exporter i, importer j, time t at a highly disaggregated product level k. Products codes are classified at the 10 digit Hamonized System (HS). As a drawback of this data, it is unilateral and specific for the United States.

4.3 Empirical strategy

The volatility of prices over time is measured as the standard deviation of the log of prices, computed over 4 years of sample.[20] Using the NBER-UN trade data, we generate the yearly average prices as $P_{kijt} = \frac{V_{kijt}}{Q_{kijt}}$. V_{kijt} is the export value and Q_{kijt} the quantity exported of product k, by exporter i to importer j in year t. With information on yearly average prices P_{kijt}, we construct the volatility of export prices over 4 years of sample. The standard deviation of prices $\sigma_{kij\tau}$ is measured as the standard deviation of the log of P_{kijt}, and computed for every four years period τ, for each country pair ij and product k, as follows:

$$\sigma_{kij\tau} = \sqrt{E[log(P_{kijt}) - \mu]^2}$$

where, $\mu = E_\tau[log(P_{kijt})]$ is the expected value of log of P_{kijt}, for a four year period τ, for each country pair ij and product k.

The empirical strategy follows the adapted version of the gravity model, proposed by Rose (2005). Since we have 16 years of data (1984-1999) and compute the standard deviation $\sigma_{kij\tau}$ over 4-year periods, we generate 4 periods τ. Thus, for the explanatory variables, we calculate the expected value of every period of 4 years. The main empirical specification follows a fixed effects model (FE), shown in equation 5.1.

[18] This is the case of Andorra, Bermuda, Faroe Islands, Holy See, Liechtenstein and Monaco.

[19] This data is assembled by Feenstra under the grant from National Science Foundation to the NBER. The information used for value (import value) is the *customs value* information.

[20] The empirical strategy used is similar to Rose (2005). Rose (2005) examined the effects of GATT/WTO membership on the volatility of trade flows using an adapted version of the gravity model. We follow a similar methodology to estimate the effects for the volatility of trade prices.

$$\sigma_{kij\tau} = \alpha_i WTO_{i\tau} + \alpha_j WTO_{j\tau} + X_{kij\tau} + \delta_\tau + \omega_{kij} + \epsilon_{kij\tau} \quad (4.1)$$

where k denotes the product, i is the export country, j the import country and τ the 4-year period.

- ⋆ $\sigma_{kij\tau}$ is the standard deviation of prices over the period τ;
- ⋆ $WTO_{i\tau} = E_\tau[WTO_{it}]$, for WTO_{it} a dummy variable with value of 1 if country i is a GATT/WTO member at year t and 0 otherwise. The same for country j;
- ⋆ δ_τ is a time-specific fixed effect;
- ⋆ ω_{kij} is a product, importer, exporter fixed effect, which controls for all k, i, j time-invariant unobserved heterogeneity;
- ⋆ $\epsilon_{kij\tau}$ is a normally distributed error term;
- ⋆ $X_{kij\tau} = E_\tau[X_{kijt}]$ are 4 years average explanatory variables over period τ. This vector $X_{kij\tau}$ is composed by the following variables:

  $LogGDP_{i\tau}$ is the average log gross domestic product of country i in period τ. Same for j;

  $LogCGDP_{i\tau}$ is the average log gross domestic product per capita of country i in period τ. Same for j;

  $FTA_{ij\tau}$ is the average of FTA_{ijt} over period τ. FTA_{ijt} is 1 if both country i and j belong to the same free trade agreement at time t and 0 otherwise;

  $Tariff_{kij\tau}$ is the average of tariff rate (AHS tariff) imposed on product k of country i by country j at period τ;[21]

  $CA_{si\tau}$ is a the average over τ of dummy variable CA_{sit}, which is 1 if traded product k belongs to comparative advantage sector s of country i at time t. Same for j;

  $LogNpartner_{i\tau}$ is the average number of partners of country i in τ. Same for j;

  $LogXrat_{i\tau}$ is the average exchange rate of country i's currency against the US. Dollars at peirod τ. Same for j;

[21] We show the main analysis using the AHS tariff, and conduct robustness checks using the MFN tariff data.

$nopeg_{i\tau}$ is the average over τ of dummy variable $nopeg_{sit}$, which is 1 if country i did not have an exchange rate peg to the dollar at time t. Same for j;

$WTOnopeg_{i\tau} = E_\tau[WTO_{it} * nopeg_{it}]$. Same for j;

$WTOca_{i\tau} = E_\tau[WTO_{it} * CA_{sit}]$. Same for j;

$WTOdeving_{i\tau} = E_\tau[WTO_{it} * Deving_i]$, where $Deving_i$ is a dummy variable that is 1 if county i is developing (list of countries in Appendix A.1). Same for j;

$WTOnpartner_{i\tau} = E_\tau[WTO_{it} * Log(Nopartner_{it})]$. Same for j;

$WTOnsitc_{i\tau} = E_\tau[WTO_{it} * Log(Nositc_{it})]$. Same for j;

$WTOdist_{i\tau} = E_\tau[WTO_{it} * Log(Dist_{ij})]$. Same for j;

$WTOcomlang_{i\tau} = E_\tau[WTO_{it} * Comlang_{ij}]$. Same for j;

$WTOcontig_{i\tau} = E_\tau[WTO_{it} * Contig_{ij}]$. Same for j;

$WTOfta_{i\tau} = E_\tau[WTO_{it} * FTA_{ijt}]$. Same for j.

We also estimate a random effects model (RE) to account for time-invariant characteristics, as follows:

$$\sigma_{kij\tau} = \alpha_i WTO_{i\tau} + \alpha_j WTO_{j\tau} + X_{kij\tau} + \delta_\tau + LogDist_{ij} + Comlang_{ij} + Contig_{ij} + \epsilon_{kij\tau} \quad (4.2)$$

where

- ⋆ $LogDist_{ij}$ is the log of the distance between country i and j;
- ⋆ $Comlang_{ij}$ is a dummy varible that is 1 if two countries i and j share the common language and 0 otherwise;
- ⋆ $Contig_{ij}$ is a dummy varible that is 1 if two countries i and j share the common border and 0 otherwise.

For both (1) and (2), the coefficients of interest are α_i and α_j, which measure the effects of GATT/WTO membership of country i (export country) and country j (import country) on price volatility. If the GATT/WTO membership helps countries stablize their export and import prices (under the hypothesis), those coefficients are expected to be negative. In addition to the fixed and random effects models mentioned in equations (1) and (2), we also estimate the results using the non-linear pseudo-maximum likelihood estimator as a robustness check.

As an extension, we also estimate the effects of GATT/WTO membership on price levels. In this case, instead of the volatility of prices $\sigma_{kij\tau}$, we estimate the effect for 4-year price averages, computed as: $P_{kij\tau} = E_\tau[P_{kijt}]$.[22] The results for price levels are estimated as follows:

$$LogP_{kij\tau} = \alpha_i WTO_{i\tau} + \alpha_j WTO_{j\tau} + X_{kij\tau} + \delta_\tau + \omega_{kij} + \epsilon_{kij\tau} \tag{4.3}$$

$$LogP_{kij\tau} = \alpha_i WTO_{i\tau} + \alpha_j WTO_{j\tau} + X_{kij\tau} + \delta_\tau + LogDist_{ij} + Comlang_{ij} + Contig_{ij} + \epsilon_{kij\tau} \tag{4.4}$$

Equations 5.3 and 5.4 correspond to the fixed and random effects models. The control variables $X_{kij\tau}$ are the same used in equations 5.1 and 5.2.
Table 4.5 in the data Appendix A shows the summary statistics for the main variables of interest. Further variables are summarized in Table 4.6.

4.4 Results

4.4.1 Results for Price Volatility

The first results for the effect of GATT/WTO membership on price volatility are shown in Table 4.1. Since the tariff data contains many missing values, the baseline results are shown for two different samples. Sample 1 (Column (1) to (4)) contains all observations and Sample 2 (Column (5) to (8)) includes only observations with information on tariffs.[23] [24] For each sample, we present results following equation 1 (fixed effects) and equation 2 (random effects). In all estimations, the identifier Id reported in the bottom of the tables refers to the individual identifier i-j-k, for an exporter i, and importer j and product k.
The effect of GATT/WTO membership on price volatility is negative for both import and export country, and robust to all specifications. This is the main result of this Chapter. While highly significant, the link between membership and prices is not implausibly large quantitatively. A one standard deviation increase in WTO membership is associated with

[22] Note that, for price levels, we could also use yearly information. Although, taking 4-year averages of the data yields a sample of roughly 2 million observations, which is already computationally cumbersome. Thus, we use the 4-year averaged data as the preferred specification. For the main results with price levels, we confirm our findings using yearly data for samples of 10 years of data.

[23] Note that also for $FTA_{ij\tau}$ the information is not available for the complete sample. Columns (2), (4), (6) and (8) contain only the observations for which $FTA_{ij\tau}$ data was available.

[24] In all cases, the tariff reported is the Applied Effective Tariff (AHS).

a decrease in volatility of between 0.039 and 0.045 standard deviations for exporters (under the fixed effects model), and of between 0.036 and 0.142 standard deviations for importers (under the fixed effects model). Similar magnitudes are found for the effect of membership on free trade agreements (FTAs) on price volatility. Since the interpretation and channels that explain the effect of FTA and WTO membership on prices are similar, the results for FTA represent an important verification of our results.

We add several control variables that might affect price volatility, as countries' GDP, income per capita and FTA membership. In the random effects model, we also control for time-invariant country characteristics such as distance, common language and contiguity.

Table 4.2 shows the results for different groups of goods. Using the Rauch (1999) classification of goods, the results are shown for differentiated and homogeneous goods. In fact, despite for GDP and GDP per capita, the sign and significance of the variables do not change across groups of goods. Using our preferred specification, the fixed effects model in Columns (1), (2), (5) and (6), the significance and magnitude of the effect of membership on volatility is similar across groups of goods. Note that the estimations shown in Table 4.2 refer to the sample without tariffs. We check the robustness of the results using the sample with tariffs, as shown in Table 4.14 in Appendix B. Results do not vary relative to the results in Table 4.2.

Table 4.3 presents some extensions from the baseline estimations. The Hausman test suggests that the fixed effects specification is the preferred one in all cases from Tables 4.1 and 4.2. Thus, Table 4.3 shows only results controlling for product, importer, and exporter unobserved heterogeneity.

One of the arguments used to explain the effect of GATT/WTO membership on price volatility was that it helps reducing the impact of external shocks, as long as firms may react to shocks in one market by adjusting sales in the other. In Columns (1) and (2) of Table 4.3, we look at the number of trade partners of importers ($LogNpartners_{j\tau}$) and exporters ($LogNpartners_{i\tau}$). Column (1) shows that the effect of membership on the volatility of export prices is captured by countries that increased the number of export partners over time. This effect is shown by the interaction term $WTOnpartners_{i\tau}$. Following Caselli, Koren, Lisicky, and Tenreyro (2011), when a country has several trading partners and there is a recession in one of them causing a demand shock, exporters may switch to alternative destinations and absorb part of the shock, reducing volatility. For the import country, Column (2) shows that a similar argument holds for countries that increased the number of import trade partners over time: for those importers, it may be easier to hinder price spikes due to external or domestic shocks.

Column (5) shows results controlling for exchange rate shocks. Since WTO membership does not dismantle monetary protectionist measures, it is important to control for the exchange rate regime. Countries facing high fluctuations in exchange rates could be driving our results of price volatility. In Column (5) we show that WTO_i and WTO_j remain significant once we add a variable $nopeg_i\tau$. This variable is one if the country did not have an exchange rate peg with the dollar in period τ, and zero otherwise. If $WTOnopeg_i\tau$ would capture the whole effect of membership in prices, this would mean that countries that let currency fluctuate could be driving our results. Although, as shown in Column (5), WTO_i and WTO_j remain significant. Moreover, in Table 4.12 in the Appendix we show the robustness of the results for a sample of countries that had exchange rate pegs. In Table 4.12 Column (1) we estimate the effects only for a sample of exporters that had an exchange rate peg, and in Column (2) for a sample of importers that had an exchange rate peg. In both cases, WTO_i and WTO_j remain significant. These results confirm that exchange rate fluctuations are not driving the results.

Column (3) shows results for the interaction terms $WTOdeving_{i\tau}$ and $WTOdeving_{j\tau}$: for

Table 4.1: Baseline results for PRICE VOLATILITY

	Sample 1: Without tariff data				Sample 2: With tariff data			
	FE		RE		FE		RE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Wto_{i\tau}$	**-0.0389*****	**-0.0403*****	**-0.00409****	**-0.0103*****	**-0.0392*****	**-0.0447*****	**-0.00735*****	**-0.0142*****
	(0.00378)	(0.00470)	(0.00181)	(0.00214)	(0.00493)	(0.00618)	(0.00246)	(0.00311)
$Wto_{j\tau}$	**-0.0327*****	**-0.0362*****	**-0.00883*****	**-0.0117*****	**-0.142*****	**-0.142*****	**-0.0463*****	**-0.0466*****
	(0.00325)	(0.00342)	(0.00177)	(0.00280)	(0.0123)	(0.0123)	(0.00380)	(0.00593)
$Loggdp_{i\tau}$	0.00619	0.0233	0.00959***	0.00808***	-0.00774	0.0177	0.0100***	0.00779***
	(0.0290)	(0.0337)	(0.000616)	(0.000840)	(0.0377)	(0.0398)	(0.000865)	(0.00127)
$Loggdp_{j\tau}$	0.0614***	0.0876***	0.0131***	0.0124***	0.0971**	0.0930*	0.00976***	0.00861***
	(0.0123)	(0.0151)	(0.00105)	(0.00106)	(0.0471)	(0.0508)	(0.00143)	(0.00139)
$Logcgdp_{i\tau}$	-0.0610*	-0.0839**	0.0336***	0.0339***	-0.0576	-0.101**	0.0356***	0.0373***
	(0.0322)	(0.0360)	(0.00283)	(0.00319)	(0.0444)	(0.0468)	(0.00311)	(0.00320)
$Logcgdp_{j\tau}$	-0.0981***	-0.131***	-0.00839***	-0.0110***	-0.229***	-0.241***	-0.0331***	-0.0336***
	(0.0110)	(0.0134)	(0.00211)	(0.00217)	(0.0435)	(0.0457)	(0.00387)	(0.00375)
$Fta_{ij\tau}$		-0.0306***		-0.00460**		-0.0334***		-0.0131***
		(0.00339)		(0.00233)		(0.00443)		(0.00231)
$Logdist_{ij}$				-0.0125***				-0.00651***
				(0.000913)				(0.00143)
$Comlang_{ij}$				0.0108***				0.0109***
				(0.00216)				(0.00269)
$Contig_{ij}$				-0.0192***				-0.0137***
				(0.00204)				(0.00255)
$Tariff_{kij\tau}$					0.000136	0.000155*	-0.000518***	-0.000546***
					(8.16e-05)	(8.51e-05)	(0.000135)	(0.000139)
Const.	0.363	0.0336	-0.488***	-0.314***	1.317**	1.416**	-0.149***	-0.0306
	(0.298)	(0.357)	(0.0387)	(0.0401)	(0.635)	(0.700)	(0.0495)	(0.0491)
Period dum.	yes	yes	yes	yes	yes	yes	yes	yes
Id FE	yes	yes	no	no	yes	yes	no	no
Obs.	2,000,094	1,466,307	2,000,094	1,466,307	681,559	545,760	681,559	545,760
R^2	0.590	0.556			0.723	0.712		
Id	947,853	632,035	947,853	632,035	405,713	301,193	405,713	301,193

Notes: The dependent variable is $\sigma_{kij\tau}$, the standard deviation of logarithm of price (as a proxy for price volatility) of product p traded by exporter i and importer j at period τ. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/10%). The data is clustered at the sector level.

both i and j, the negative effect of WTO on price volatility is captured by developing countries. The list of countries defined as developing countries is shown in Appendix A.1. This result is no real surprise, given that the countries that joined WTO in the period under analysis are mostly developing economies.

Column (4) adds a measure of comparative advantage similar to Mayda and Rodrik (2005). For exporters, the effect of WTO membership is enlarged for sectors in which the exporter has a comparative advantage, as shown by the coefficient of the interaction term $WTOca_{i\tau}$. This effect could be a result of export countries diversifying the risk. For those products, it may be easier for producers and exporters to absorb external shocks.

In Table 4.13 in the Appendix, we show estimations only for the *intensive margin*, for homogeneous and differentiated gods, using information for *old partners*. An old partner refers to a country j with which country i was already trading before it enters the GATT/WTO. Hence, exluding new partners, results only reflect the impact of the intensive margin in the period 1984-1999. As shown in Table 4.13, the effect of WTO on price volatility is also significant for the intensive margin. Although, for homogeneous goods, the effect of WTO on volatility is not significant *for old partners*. This result suggests that the effect for homogeneous goods refers exclusively to the extensive margin of (new) partners. While for differentiated goods the intensive margin also helps explaining the effect of WTO on price volatility, for homogeneous goods the *extensive* margin is the relevant one.

Thus, we establish the following stylized facts: **(i)** WTO membership reduces price volatility; **(ii)** this effect is stronger for exporters and importers that increased the number of trade partners over time; **(iii)** the negative effect for differentiated goods comes both from the extensive and intensive margin of trade, while for homogeneous goods the effect is explained by the extensive margin of trade partners; **(iv)** for exporters, the effect of WTO is captured by the products in which the country has a comparative advantage; **(v)** not only WTO, but also membership in a FTA reduces the volatility of trade prices; **(vi)** results are not driven by exchange rate shocks.

Table 4.2: PRICE VOLATILITY for differentiated vs. homogeneous goods in the sample without tariff data

	Differentiated goods				Homogenous goods			
	FE		RE		FE		RE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Wto_{i\tau}$	**-0.0337*****	**-0.0349*****	**-0.00847*****	**-0.0162*****	**-0.0260*****	**-0.0285*****	**0.00392**	**0.00208**
	(0.00551)	**(0.00660)**	**(0.00208)**	**(0.00304)**	**(0.00637)**	**(0.00641)**	**(0.00351)**	**(0.00325)**
$Wto_{j\tau}$	**-0.0319*****	**-0.0357*****	**-0.0116*****	**-0.0173*****	**-0.0249*****	**-0.0266*****	**-0.000107**	**0.000414**
	(0.00402)	**(0.00477)**	**(0.00194)**	**(0.00356)**	**(0.00668)**	**(0.00682)**	**(0.00287)**	**(0.00345)**
$Loggdp_{i\tau}$	0.0855**	0.114***	0.00943***	0.00700***	-0.149***	-0.192***	0.00747***	0.00790***
	(0.0364)	(0.0423)	(0.000574)	(0.000754)	(0.0326)	(0.0359)	(0.00116)	(0.00133)
$Loggdp_{j\tau}$	0.0602***	0.0970***	0.0156***	0.0150***	0.00983	0.0353	0.00917***	0.00945***
	(0.0158)	(0.0191)	(0.00143)	(0.00148)	(0.0407)	(0.0468)	(0.00204)	(0.00232)
$Logcgdp_{i\tau}$	-0.162***	-0.196***	0.0383***	0.0394***	0.132***	0.158***	0.00937**	0.00773*
	(0.0384)	(0.0429)	(0.00301)	(0.00351)	(0.0290)	(0.0327)	(0.00413)	(0.00438)
$Logcgdp_{j\tau}$	-0.0984***	-0.139***	-0.0147***	-0.0174***	-0.0274	-0.0547	0.00794***	0.00569*
	(0.0146)	(0.0180)	(0.00198)	(0.00213)	(0.0330)	(0.0370)	(0.00298)	(0.00306)
$Fta_{ij\tau}$		-0.0281***		-0.00723*		-0.0229***		0.00153
		(0.00443)		(0.00378)		(0.00658)		(0.00394)
$Logdist_{ij}$				-0.0125***				-0.0110***
				(0.00116)				(0.00186)
$Comlang_{ij}$				0.0134***				0.0114***
				(0.00309)				(0.00260)
$Contig_{ij}$				-0.0196***				-0.00498
				(0.00188)				(0.00481)
$Tariff_{kij\tau}$								
Period dum.	yes	yes	yes	yes	yes	yes	yes	yes
Id FE	yes	yes	no	no	yes	yes	no	no
Obs.	1,134,976	825,281	1,134,976	825,281	200,333	146,312	200,333	146,312
R^2	0.592	0.579			0.575	0.545		
Id	535,626	353,100	535,626	353,100	99,651	66,898	99,651	66,898

Notes: The dependent variable is $\sigma_{kij\tau}$, the standard deviation of logarithm of price (as a proxy for price volatility) of product p traded by exporter i and importer j at period τ. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/10%). The data is clustered at the sector level.

Table 4.3: Extensions from the baseline estimations for PRICE VOLATILITY

	Full sample without tariff data				
	(1)	(2)	(3)	(4)	(5)
$Wto_{i\tau}$	0.0517	-0.0325***	0.0183	-0.0328***	**-0.0303*** **
	(0.0362)	(0.00461)	(0.0134)	(0.00418)	(0.00328)
$Wto_{j\tau}$	-0.140***	0.0198	0.0218**	-0.0330***	**-0.0233*** **
	(0.0116)	(0.0270)	(0.00854)	(0.00362)	(0.00251)
$WTOnpartner_{i\tau}$	**-0.0209** **				
	(0.00865)				
$LogNpartner_{i\tau}$	0.00674				
	(0.00749)				
$WTOnpartner_{j\tau}$		**-0.100*** **			
		(0.0240)			
$LogNpartner_{j\tau}$		0.119***			
		(0.0143)			
$WTOdeving_{i\tau}$			**-0.0680*** **		
			(0.0141)		
$WTOdeving_{j\tau}$			**-0.0587*** **		
			(0.00886)		
$WTOca_{si\tau}$				**-0.0109*** **	
				(0.00365)	
$WTOca_{sj\tau}$				0.00157	
				(0.00452)	
$CA_{si\tau}$				0.00820**	
				(0.00332)	
$CA_{si\tau}$				-0.00533	
				(0.00376)	
$WTO_{i\tau} * nopeg_{i\tau}$					**-0.0336*** **
					(0.00416)
$WTO_{j\tau} * nopeg_{j\tau}$					**-0.00107**
					(0.00375)
$Loggdp_{i\tau}$	yes	yes	yes	yes	yes
$Loggdp_{j\tau}$	yes	yes	yes	yes	yes
$Logcgdp_{i\tau}$	yes	yes	yes	yes	yes
$Logcgdp_{j\tau}$	yes	yes	yes	yes	yes
Period fixed effects	yes	yes	yes	yes	yes
Id fixed effects	yes	yes	yes	yes	yes
Obs.	2,000,094	2,000,094	2,000,094	2,000,094	2,000,094
R-squared	0.590	0.590	0.590	0.590	0.590
Id	947,853	947,853	947,853	947,853	947,853

Notes: The dependent variable is $\sigma_{kij\tau}$, the standard deviation of logarithm of price (as a proxy for price volatility) of product p traded by exporter i and importer j at period τ. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/10%). The data is clustered at the sector level.

4.4.2 Results for Price Levels

We extend the analysis to price levels. Following an increasingly growing literature on prices in international trade (e.g., Bastos and Silva (2010b) and **?**), we study the effect of WTO membership on price levels. We expect membership to increase the price level of *exporters*, if the channel is through export quality and better access to markets and technology. Results follow specifications shown in equations (3) and (4).[25]

The main results are shown in Table 4.4. The results for GDP, GDP per capita, distance and language are in line with the price literature (see Bastos and Silva (2010b), **?**, Hallak (2006), Hallak and Schott (2011)). For WTO, the results for the full sample are shown in Columns (1) and (2). We find that membership increases the price level of export country i, and this result is robust to several specifications. For importers, results are less robust, but negative using the fixed effects model. Thus, membership increases export prices, and decreases import prices.

One plausible explanation for the positive effect on export prices is better access to technology and quality upgrading. Through better access to markets and technology, membership may cause a change in the average product quality produced by the country and a shift in the lower bound of the product quality and productivity range. This implies a shift to higher quality products and, consequently, to higher prices (this quality-price relation is well explained in Baldwin and Harrigan (2011)). If the product quality interpretation is true, the WTO effect should be captured by differentiated goods, which have scope for quality differentiation. This hypothesis is confirmed in Columns (3) to (6): results of WTO on price levels are only observed for differentiated goods (Columns (3) and (4)), while for homogeneous goods the effect is not significant (Columns (5) and (6)). This result supports the hypothesis of shifts in the range of quality varieties after membership.

From the analysis on price levels, we establish the following stylized facts: (i) WTO membership increases product prices of exporters. For importers the effect is less robust, but negative; (ii) the effect is captured solely by differentiated goods.

[25] The analysis is shown for the 4 years average data. Besides allowing for a direct comparison to the periods used for the analysis of price volatility, other reasons for using the averaged data are: sample size and few time variation for the main variables of interest (WTO and FTA). Although, using the yearly data gives very similar results.

4.4.3 Robustness checks

This section presents several robustness checks using different controls and estimation strategies. Results are reported in Appendix B.

First, we estimate the main results using a non-linear pseudo-maximum likelihood estimator. Table 4.15 confirms that the results are robust to the use of a non-linear estimator.

Second, we use a highly disaggregated product data from the United States. The data used throughout this Chapter has information at the 4-digit product level. The United States import data is available at the 10 HS-digit, which allows a richer analysis at the product level. Although, this dataset is only available to the US as the importing country. Thus, results for WTO membership are shown only for trade with the United States. The results are shown in Table 4.16 in Appendix B. The negative effect of WTO on price volatility is confirmed in our preferred specification (fixed effects model controlling for FTA membership) for both samples (with and without tariff data). But the result is not robust to all specifications.

Finally, we also control for different measures of tariffs. In the tables shown before, results were reported using the Applied Effective Tariff (AHS). As a robustness check, we report results in Table 4.17 using the Most Favored Nation Tariff (MFN). Comparing columns (1) and (2) to columns (3) and (4) from Table 4.17, we see that there is very little variation in the magnitude of the coefficients across the two measures of tariffs. Moreover, in all cases, the tariff measurement choice does not affect the sign and the significance of the variables.

Table 4.4: PRICE LEVELS for differentiated vs. homogeneous goods (sample without tariff data)

	Full sample				**Differentiated goods**		**Homogeneous goods**	
	FE		RE		FE		FE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Wto_{i\tau}$	**0.0303****	**0.0355*****	0.174***	0.121***	**0.0519*****	**0.0551*****	0.00612	0.0134
	(0.0133)	(0.0128)	(0.0210)	(0.0223)	(0.0130)	(0.0137)	(0.0255)	(0.0238)
$Wto_{j\tau}$	-0.0143*	-0.0258***	-0.00292	0.00263	-0.0200*	-0.0341***	0.00172	-0.0243
	(0.00840)	(0.00953)	(0.0110)	(0.0127)	(0.0115)	(0.0122)	(0.0168)	(0.0177)
$Loggdp_{i\tau}$	-0.531***	-0.511***	-0.0198	-0.0517***	-0.503***	-0.455***	-0.297*	-0.313*
	(0.0612)	(0.0634)	(0.0179)	(0.0155)	(0.0630)	(0.0607)	(0.158)	(0.170)
$Loggdp_{j\tau}$	-0.0686	-0.177***	-0.00455	-0.0248	-0.157**	-0.297***	0.0747	0.0700
	(0.0543)	(0.0657)	(0.0160)	(0.0205)	(0.0633)	(0.0806)	(0.0735)	(0.0653)
$Logcgdp_{i\tau}$	**0.634*****	**0.614*****	0.368***	0.348***	**0.604*****	**0.550*****	0.343*	0.360*
	(0.0651)	(0.0672)	(0.0382)	(0.0340)	(0.0609)	(0.0632)	(0.175)	(0.182)
$Logcgdp_{j\tau}$	**0.105***	**0.223*****	0.112***	0.119***	**0.198*****	**0.351*****	-0.0364	-0.0623
	(0.0528)	(0.0627)	(0.0357)	(0.0274)	(0.0608)	(0.0739)	(0.0658)	(0.0627)
$Fta_{ij\tau}$		-0.0117		0.0561***		-0.00698		0.00662
		(0.00913)		(0.0110)		(0.0123)		(0.0210)
$Logdist_{ij}$				**0.0742****				
				(0.0344)				
$Comlang_{ij}$				**-0.248*****				
				(0.0543)				
$Contig_{ij}$				**-0.232*****				
				(0.0290)				
Const.	6.045***	6.970***	-2.817***	-2.196***	7.076***	8.086***	1.417	1.966
	(0.807)	(0.920)	(0.521)	(0.560)	(0.995)	(1.154)	(1.261)	(1.586)
Period dum.	yes	yes	yes	yes	yes	yes	yes	yes
Id FE	yes	yes	yes	yes	yes	yes	yes	yes
Obs.	2,000,094	1,466,307	2,000,094	1,466,307	1,134,976	825,281	200,333	146,312
R_squared	0.967	0.963			0.966	0.962	0.956	0.950
Id	947,853	632,035	947,853	632,035	535,626	353,100	99,651	66,898

Notes: The dependent variable is $LogP_{kij\tau}$, the logarithm of price (as a proxy for price level) of product p traded by exporter i and importer j at period τ. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/10%). The data is clustered at the sector level.

4.5 Conclusion

This Chapter examines the effect of the multilateral trading system, and in particular of GATT/WTO membership, on the price volatility and price levels of import and export countries. Using bilateral trade flows from 1984 to 1999 for 190 countries (listed in Appendix A), we establish many new stylized facts. As our main result, we find a robust and negative effect of GATT/WTO membership on price volatility for both importers and exporters and similar results for FTAs. This result has important policy implications.

De Blas and Russ (2012) build a model on the pro-competitive effects of trade and show that, under multilateral trade agreements, firms can no longer pass along their own production cost shocks. Thus, by reducing their market power and inhibiting a markup effect, multilateral trade agreements may reduce the volatility of prices. Moreover, with trade diversification, multilateral trade agreements may play a risk-reducing role in economies exposed to external shocks. This argument is confirmed by our result that volatility decreases more in countries that increase the number of trade partners over time.

Empirically, the question relating the effect of multilateral trade agreements on price behavior has been neglected by the literature. We fill this gap and show several new stylized facts: **(i)** WTO membership reduces price volatility. Similar results are found for FTAs; **(ii)** the effect of membership is stronger for exporters and importers that increased the number of trade partners over time; **(iii)** the negative effect for differentiated goods comes both from the extensive and intensive margin of trade, while for homogeneous goods the effect is explained by the extensive margin of trade partners; **(iv)** for exporters, the effect of WTO is captured by the products in which the country has a comparative advantage; **(v)** results are not driven by exchange rate shocks.

For price levels, we find that **(i)** WTO membership increases product prices of exporters. For importers the effect is less robust, but negative; **(ii)** the effect is captured solely by differentiated goods.

We discuss several channels that explain our results and conduct various robustness checks that confirm our findings. Results suggest that multilateral trade agreements may minimize the adverse effects of demand and supply shocks on trade prices.

4.A Data Construction

4.A.1 Summary Statistics

Table 4.5: Summary statistics - main variables (4 years average data)

Variable	Mean	Std. Dev.	Min.	Max.	N
$P_{kij\tau}$	31.105	664.417	0	537798.5	2462590
$\log(P_{kij\tau})$	1.356	2.045	-17.507	13.194	2462579
$\sigma_{kij\tau}$	0.173	0.258	0	6.954	2462579
$WTO_{i\tau}$	0.858	0.347	0	1	2462590
$WTO_{j\tau}$	0.778	0.412	0	1	2462590
$Loggdp_{i\tau}$	19.695	1.504	10.898	22.944	2350701
$Loggdp_{j\tau}$	18.841	1.771	10.898	22.944	2337748
$Logcgdp_{i\tau}$	9.367	0.78	5.044	10.48	2350701
$Logcgdp_{j\tau}$	8.994	0.974	5.044	10.48	2337748
$FTA_{ij\tau}$	0.192	0.389	0	1	1590892
$Logdist_{ij}$	8.154	1.069	4.088	9.891	2311657
$Comlang_{ij}$	0.165	0.371	0	1	2311657
$Contig_{ij}$	0.089	0.285	0	1	2311657
$SimpleAHS_{kij\tau}$	9.281	14.175	0	1650	742709
$SimpleMFN_{kij\tau}$	10.514	14.083	0	1650	729521

Table 4.6: Summary statistics - additional control variables

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
$CA_{si\tau}$	0.557	0.471	0	1	2355126
$CA_{sj\tau}$	0.406	0.463	0	1	2279642
$WTOca_{si\tau}$	0.49	0.476	0	1	2355126
$WTOca_{sj\tau}$	0.347	0.451	0	1	2279642
$Deving_{i\tau}$	0.31	0.462	0	1	2462590
$Deving_{j\tau}$	0.524	0.499	0	1	2462590
$WTOdeving_{i\tau}$	0.219	0.412	0	1	2462590
$WTOdeving_{j\tau}$	0.338	0.47	0	1	2462590
$WTOnpartner_{i\tau}$	4.167	1.721	0	5.142	2462590
$WTOnpartner_{j\tau}$	3.586	1.957	0	5.147	2462590
$WTOnsitc_{i\tau}$	5.492	2.258	0	6.7	2462590
$WTOnsitc_{j\tau}$	4.936	2.632	0	6.617	2462590
$LogXrat_{i\tau}$	2.173	3.198	-22.84	12.945	2356642
$LogXrat_{j\tau}$	2.347	3.327	-22.84	12.945	2371883
$WTOdist_{i\tau}$	7.273	2.705	0	9.891	2311657
$WTOdist_{j\tau}$	6.502	3.399	0	9.891	2311657
$WTOcomlang_{i\tau}$	0.15	0.357	0	1	2311657
$WTOcomlang_{j\tau}$	0.134	0.34	0	1	2311657
$WTOcontig_{i\tau}$	0.076	0.264	0	1	2311657
$WTOcontig_{j\tau}$	0.071	0.256	0	1	2311657
$WTOfta_{i\tau}$	0.192	0.389	0	1	1590892
$WTOfta_{j\tau}$	0.192	0.389	0	1	1590892
$LogOpen_{i\tau}$	68.607	53.103	0.847	391.565	2350701
$LogOpen_{j\tau}$	71.5	51.211	0.847	391.565	2337748
$LogGini_{i\tau}$	3.5	0.234	2.934	4.352	1998084
$LogGini_{j\tau}$	3.551	0.263	2.934	4.352	1684468
Diff.good	0.569	0.495	0	1	2462590
Homog.good	0.102	0.303	0	1	2462590
$WTOdiff_{ki\tau}$	0.49	0.499	0	1	2462590
$WTOdiff_{kj\tau}$	0.437	0.494	0	1	2462590
$LogNpartner_{i\tau}$	4.774	0.456	0.693	5.142	2462590
$LogNpartner_{j\tau}$	4.477	0.596	0	5.147	2462590
$LogNsitc_{i\tau}$	6.355	0.502	1.04	6.7	2462590
$LogNsitc_{j\tau}$	6.295	0.344	0	6.625	2462590

4.A.2 List of developed and developing countries

Table 4.7: List of developed countries

AUSTRALIA	GREECE	NEW ZEALAND	UNITED STATES
AUSTRIA	ICELAND	NORWAY	ANDORRA
BELGIUM	IRELAND	PORTUGAL	BERMUDA
CANADA	ISRAEL	SINGAPORE	FAROE ISLANDS
CHINA,P.R.:HONG KONG	ITALY	SPAIN	HOLY SEE
DENMARK	JAPAN	SWEDEN	LIECHTENSTEIN
FINLAND	KOREA	SWITZERLAND	MONACO
FRANCE	LUXEMBOURG	TAIWAN PROV.OF CHINA	
GERMANY	NETHERLANDS	UNITED KINGDOM	

Table 4.8: List of developing countries

AFGHANISTAN	DJIBOUTI	LITHUANIA	SENEGAL
ALBANIA	DOMINICA	MACEDONIA, FYR	SEYCHELLES
ALGERIA	DOMINICAN REP.	MADAGASCAR	SIERRA LEONE
ANGOLA	ECUADOR	MALAWI	SLOVAK REPUBLIC
ANTIGUA & BARBUDA	EGYPT	MALAYSIA	SLOVENIA
ARGENTINA	EL SALVADOR	MALDIVES	SOLOMON ISLANDS
ARMENIA	EQUATORIAL GUINEA	MALI	SOMALIA
AZERBAIJAN	ERITREA	MALTA	SOUTH AFRICA
BAHAMAS, THE	ESTONIA	MARSHALL ISLANDS	SRI LANKA
BAHRAIN	ETHIOPIA	MAURITANIA	ST. KITTS AND NEVIS
BANGLADESH	FIJI	MAURITIUS	ST. LUCIA
BARBADOS	GABON	MEXICO	ST. VINCENT & GRENS.
BELARUS	GAMBIA, THE	MICRONESIA, FED.STS.	SUDAN
BELIZE	GEORGIA	MOLDOVA	SURINAME
BENIN	GHANA	MONGOLIA	SWAZILAND
BHUTAN	GRENADA	MOROCCO	SYRIAN ARAB REP.
BOLIVIA	GUATEMALA	MOZAMBIQUE	TAJIKISTAN
BOTSWANA	GUINEA	MYANMAR	TANZANIA
BRAZIL	GUINEA-BISSAU	NAMIBIA	THAILAND
BULGARIA	GUYANA	NEPAL	TOGO
BURKINA FASO	HAITI	NETHER. ANTILLES	TONGA
BURUNDI	HONDURAS	NICARAGUA	TRINIDAD & TOBAGO
CAMBODIA	HUNGARY	NIGER	TUNISIA
CAMEROON	INDIA	NIGERIA	TURKEY

CAPE VERDE	INDONESIA	OMAN	TURKMENISTAN
CEN. AFRICAN REP.	IRAN, I.R.	PAKISTAN	UGANDA
CHAD	JAMAICA	PANAMA	UKRAINE
CHILE	JORDAN	PAPUA NEW GUINEA	UNITED ARAB E.
CHINA	KAZAKHSTAN	PARAGUAY	URUGUAY
COLOMBIA	KENYA	PERU	UZBEKISTAN
COMOROS	KIRIBATI	PHILIPPINES	VANUATU
CONGO, DEM. REP.	KUWAIT	POLAND	VENEZUELA
CONGO, REP.	KYRGYZ REP.	QATAR	VIETNAM
COSTA RICA	LAO	ROMANIA	YEMEN REP.
COTE D IVOIRE	LATVIA	RUSSIA	YUGOSLAVIA, SFR
CROATIA	LEBANON	RWANDA	ZAMBIA
CYPRUS	LESOTHO	SAMOA	ZIMBABWE
CZECH REP.	LIBERIA	SAO TOME & PRINCIPE	
CZECHOSLOVAKIA	LIBYA	SAUDI ARABIA	

4.A.3 List of countries that are not in Sample 2 (sample with tariff data)

The UNCTAD-TRAINS data contains a detailed tariff data at the product and country level. Although, for some countries there is no information on tariffs. We list these countries in Table 4.9. Importantly, the countries from Table 4.9 are all developing economies, which implies that the sample with tariff data might be biased towards developed economies. Therefore, we present the most important results for both samples, with and without tariff data.

Table 4.9: List of importers not in Sample 2 with tariff data

Afghanistan	Fiji	Lao P.Dem.R	Sierra Leone
Azerbaijan	Djibouti	Liberia	Slovakia
Armenia	Gambia	China MC SAR	Somalia
Bermuda	Kiribati	Mauritania	Syria
Bosnia Herzg	Guinea	Mongolia	Tajikistan
Bulgaria	Haiti	Neth.Ant.Aru	Togo
Burundi	Iran	Niger	Untd Arab Em
Cambodia	Iraq	GuineaBissau	TFYR Macedna
Dem.Rp.Congo	Israel	Qatar	Uzbekistan
Croatia	Jordan	Senegal	Samoa
Cyprus	Korea D P Rp	Seychelles	Yemen
Benin	Kuwait		

Notes: These above importers are available in Sample 1, but not in Sample 2 with tariff data. Sample 1 covers observations with available data for GATT/WTO membership, GDP, CGDP, time-invariant variables, exchange rate and openness.

4.A.4 Adjustment for United States import data

The 10 digit import data from the United States is subject to unit measurements correction. In this data, many different unit types are used, what could bias average prices. For instance, the unit type of Liter has the abbreviations L or LTR. The adjustments are done based on Automated Export System Trade Interface Requirements (AESTIR) (2004), Appendix K - Unit of measurements (version1.0). Adjustments are listed in Table 4.10. Finally, observations for which the country-product unit of measurement changed over time are eliminated from the sample, to avoid bias in units.

Moreover, the data is corrected for country code discrepancies, according to the UN country codes. The list of changes is shown in Table 4.11.

Table 4.10: Adjustment for unit of measurements

Units	**Abbreviation**	**Final (used) abbreviation**
Cubic Meters	M3 or CBM	M3
Hundred	HUN or HND	HUN
Liters	L or LTR	L
Meters	M, MTR or LNM	M
Packs	PK or PKS	PK
Square Centimeters	CM2 or SCM	CM2
Thousand Cubic Meters	TCM or KM3	KM3
Ton	T or TON	T

Table 4.11: Adjustment for country codes in the United States' import data

Country name	**Initial code**	**Adjusted code**
ARMENIA	31 and 051	51
AZERBIJ	31 and 051	31
GERMANY	280	276
ETHIOPIA	230	231
N_ANTIL	532	530
SAMOA	888	882
ST_K_NEV	658	659
TAIWAN	896	158

4.B Additional results and robustness checks

Table 4.12: PRICE VOLATILITY and exchange rate shocks: Countries with exchange rate pegs

	Exporters with peg	Importers with peg
	(1)	(2)
$Wto_{i\tau}$	**-0.0330*** **	**-0.0493*** **
	(0.00793)	(0.0159)
$Wto_{j\tau}$	**-0.0565*** **	**-0.0390*** **
	(0.0109)	(0.00520)
$Loggdp_{i\tau}$, $Loggdp_{j\tau}$	yes	yes
$Logcgdp_{i\tau}$, $Logcgdp_{j\tau}$	yes	yes
Period fixed effects	yes	yes
Id fixed effects	yes	yes
Observations	164,879	207,614
R-squared	0.750	0.68
Number of id	87,279	105,465

The dependent variable is $\sigma_{kij\tau}$. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/ 10%). The data is clustered at the sector level.

Table 4.13: PRICE VOLATILITY for the intensive margin: Old Partners

	Exporter		Importer	
	Diff goods	Hom goods	Diff goods	Hom goods
	(1)	(2)	(3)	(4)
$Wto_{i\tau}$	-0.0493***	-0.0119	0.00162	-0.0320
	(0.00671)	(0.0103)	(0.0116)	(0.0259)
$Wto_{j\tau}$	-0.0288**	-0.0421	-0.0451***	-0.0137
	(0.0118)	(0.0310)	(0.00686)	(0.00900)
$Loggdp_{i\tau}$	-0.0652*	-0.0555	0.0613	-0.0729
	(0.0388)	(0.0563)	(0.0428)	(0.0697)
$Loggdp_{j\tau}$	0.125**	0.0750	-0.174***	-0.182***
	(0.0536)	(0.0807)	(0.0296)	(0.0511)
$Logcgdp_{i\tau}$	0.0261	0.0781	-0.0830*	0.0704
	(0.0469)	(0.0634)	(0.0449)	(0.0742)
$Logcgdp_{j\tau}$	-0.163**	-0.136	0.0913**	0.150***
	(0.0609)	(0.0862)	(0.0352)	(0.0462)
Const.	0.124	0.228	1.841***	2.731***
	(0.470)	(0.881)	(0.496)	(0.797)
Period dum.	yes	yes	yes	yes
Id FE	yes	yes	yes	yes
Obs.	62,487	15,294	124,407	17,852
R-squared	0.608	0.614	0.606	0.627
Id	33,923	8,240	64,872	9,803

Notes: The dependent variable is $\sigma_{kij\tau}$, the standard deviation of logarithm of price (as a proxy for price volatility) of product p traded by exporter i and importer j at period τ. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/ 10%).
The data is clustered at the sector level.

Table 4.14: PRICE VOLATILITY for differentiated vs. homogeneous goods in the sample with tariff data

	Differentiated goods				Homogeneous goods			
	FE		RE		FE		RE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Wto_{i\tau}$	-0.0329***	-0.0357***	-0.0124***	-0.0214***	-0.0157	-0.0275*	0.00459	0.00310
	(0.00663)	(0.00930)	(0.00273)	(0.00438)	(0.0136)	(0.0151)	(0.00539)	(0.00508)
$Wto_{j\tau}$	-0.146***	-0.145***	-0.0523***	-0.0627***	-0.113**	-0.115**	-0.0211**	-0.00650
	(0.0129)	(0.0131)	(0.00400)	(0.00622)	(0.0479)	(0.0482)	(0.00976)	(0.0103)
$Loggdp_{i\tau}$	0.0761*	0.100**	0.00906***	0.00571***	-0.183**	-0.220**	0.00881***	0.00902***
	(0.0399)	(0.0388)	(0.000842)	(0.00136)	(0.0839)	(0.0869)	(0.00189)	(0.00210)
$Loggdp_{j\tau}$	0.0586	0.0451	0.0137***	0.0122***	0.338*	0.381*	0.00439***	0.00452***
	(0.0451)	(0.0481)	(0.00190)	(0.00195)	(0.169)	(0.190)	(0.00162)	(0.00170)
$Logcgdp_{i\tau}$	-0.166***	-0.204***	0.0396***	0.0415***	0.169**	0.180**	0.0101	0.0125*
	(0.0469)	(0.0450)	(0.00356)	(0.00366)	(0.0809)	(0.0855)	(0.00671)	(0.00698)
$Logcgdp_{j\tau}$	-0.211***	-0.223***	-0.0461***	-0.0460***	-0.415***	-0.445***	-0.00818**	-0.00849**
	(0.0483)	(0.0506)	(0.00299)	(0.00287)	(0.140)	(0.149)	(0.00399)	(0.00377)
$Fta_{ij\tau}$		-0.0356***		-0.0147***		-0.0247*		-0.0165***
		(0.00575)		(0.00339)		(0.0128)		(0.00555)
$Logdist_{ij}$				-0.00568***				-0.00618**
				(0.00162)				(0.00283)
$Comlang_{ij}$				0.0130***				0.0115***
				(0.00368)				(0.00372)
$Contig_{ij}$				-0.00922***				-0.00158
				(0.00265)				(0.00746)
$Tariff_{pij}$	0.000198	0.000203	-0.000856***	-0.000885***	2.70e-05	5.42e-05	-0.000106	-0.000102
	(0.000152)	(0.000159)	(0.000185)	(0.000195)	(0.000125)	(0.000133)	(0.000142)	(0.000135)
Const.	1.272**	1.533**	-0.0989	0.0466	-0.579	-0.521	-0.111	-0.0992
	(0.590)	(0.628)	(0.0605)	(0.0585)	(1.936)	(2.133)	(0.108)	(0.101)
Period dum.	yes	yes	yes	yes	yes	yes	yes	yes
Id FE	yes	yes	no	no	yes	yes	no	no
Obs.	396,133	317,130	396,133	317,130	60,154	46,536	60,154	46,536
R^2	0.731	0.699			0.684	0.652		
Id	236,011	174,810	236,011	174,810	36,195	26,223	36,195	26,223

Notes: The dependent variable is $\sigma_{kij\tau}$, the standard deviation of logarithm of price (as a proxy for price volatility) of product p traded by exporter i and importer j at period τ. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/10%). The data is clustered at the sector level.

Table 4.15: PRICE VOLATILITY using pseudo-maximum likelihood estimation

	(1)	(2)
$Wto_{i\tau}$	-0.207***	-0.206***
	(0.0176)	(0.0207)
$Wto_{j\tau}$	-0.159***	-0.172***
	(0.00974)	(0.0111)
$Loggdp_{i\tau}$	0.397***	0.498***
	(0.0393)	(0.0443)
$Loggdp_{j\tau}$	0.0738***	0.0970***
	(0.0252)	(0.0305)
$Logcgdp_{i\tau}$	-0.725***	-0.842***
	(0.0442)	(0.0502)
$Logcgdp_{j\tau}$	-0.333***	-0.388***
	(0.0255)	(0.0317)
$Fta_{ij\tau}$		-0.167***
		(0.00922)
Period dummies	yes	yes
Id fixed effects	yes	yes
Obs.	1,520,195	1,183,599
R^2	519,041	385,749

Notes: The dependent variable is the standard deviation of prices (as a proxy for price volatility) of product p traded exporter i and importer j at period τ. Robust standard by errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/ 10%). The data is clustered at the sector level.

Table 4.16: PRICE VOLATILITY using the United States' import data

	Sample 1: Without tariff		Sample 2: With tariff	
	(1)	(2)	(3)	(4)
Wto	0.000187	-0.0190**	-0.00489	-0.0205**
	(0.00692)	(0.00950)	(0.00758)	(0.00985)
$Loggdp$	-0.00827	-0.00225	-0.0110	0.00356
	(0.0363)	(0.0376)	(0.0385)	(0.0401)
$Logcgdp$	-0.123***	-0.101***	-0.135***	-0.126***
	(0.0343)	(0.0377)	(0.0362)	(0.0397)
FTA		0.0321***		0.0180*
		(0.00898)		(0.00947)
$Logdistance$				
$Comlang$				
$Contig$				
$Tariff$			-0.000697	-0.000696
			(0.000502)	(0.000516)
Const.	1.603***	1.325***	1.786***	1.456***
	(0.430)	(0.445)	(0.460)	(0.478)
Period dum.	yes	yes	yes	yes
Id FE	yes	yes	yes	yes
Obs.	856,106	742,188	781,244	691,623
R-squared	0.661	0.656	0.673	0.664
Id	473,908	401,968	437,997	378,542

Notes: The dependent variable is $\sigma_{kij\tau}$, the standard deviation of logarithm of price (as a proxy for price volatility) of product p traded by importer j and the United States in period τ. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/ 10%). The data is clustered at the sector level.

Table 4.17: PRICE VOLATILILTY for Applied Effective Tariff vs. Most Favored Nation (using fixed effects)

	Applied Effective Tariff (AHS)		Most Favored Nation Tariff (MFN)	
	(1)	(2)	(3)	(4)
$Wto_{i\tau}$	-0.0392***	-0.0447***	-0.0409***	-0.0469***
	(0.00493)	(0.00618)	(0.00504)	(0.00628)
$Wto_{j\tau}$	-0.142***	-0.142***	-0.143***	-0.143***
	(0.0123)	(0.0123)	(0.0123)	(0.0122)
$Loggdp_{i\tau}$	-0.00774	0.0177	-0.0222	0.000648
	(0.0377)	(0.0398)	(0.0378)	(0.0396)
$Loggdp_{j\tau}$	0.0971**	0.0930*	0.0845*	0.0760
	(0.0471)	(0.0508)	(0.0486)	(0.0522)
$Logcgdp_{i\tau}$	-0.0576	-0.101**	-0.0442	-0.0847*
	(0.0444)	(0.0468)	(0.0444)	(0.0464)
$Logcgdp_{j\tau}$	-0.229***	-0.241***	-0.223***	-0.232***
	(0.0435)	(0.0457)	(0.0449)	(0.0470)
$Fta_{ij\tau}$		-0.0334***		-0.0332***
		(0.00443)		(0.00442)
$SimpleAHS_{kij\tau}$	0.000136	0.000155*		
	(8.16e-05)	(8.51e-05)		
$SimpleMFN_{kij\tau}$			8.56e-05	0.000106
			(9.16e-05)	(9.37e-05)
Const.	1.317**	1.416**	1.671**	1.861**
	(0.635)	(0.700)	(0.651)	(0.715)
Period dum.	yes	yes	yes	yes
Id FE	yes	yes	yes	yes
Obs.	681,559	545,760	668,572	533,984
R^2	0.723	0.013	0.7228	0.6889
Id	405,713	301,193	399,262	295,779

Notes: The dependent variable is standard deviation of logarithm of price (as a proxy for price volatility) of product p traded by exporter i and importer j at period τ. Regressions are implemented for two types of tariff (AHS and MFN) using fixed effects. Robust standard errors are in parentheses. ***(**/*) is significance level of t-statistics at 1% (5%/ 10%). data is clustered at the sector level. Period dummies are included in all regressions.

Chapter 5

Networks and Trade: Evidence from the Jewish Diaspora

5.1 Introduction

Social networks operating across national borders might help to overcome the informal barriers to trade and help to explain the "mystery of the missing trade " (Rauch 2001) [1]. The effect of cultural proximity and networks on trade might be even higher due to the diffusion of preferences across borders, as, for instance, when a group has a home bias or particular preferences and disseminates its consumption habits overseas, as discussed in Combes, Lafourcade, and Mayer (2005).

We study the effects of informal networks on trade in the Jewish community, a group that exhibits a deep and abiding commitment to life in community and is known by its high investment in human capital and high skills related to international exchange. The analysis of the Jewish Diaspora is particularly interesting since: (i) We build and uncover the Jewish population data from publications of the American Jewish Committee from 1899 to 2005, allowing a rich analysis both in panel and cross-section; (ii) The creation of the State of Israel establishes unique characteristics for the Jewish population and provides us the opportunity to evaluate the effects of the migration and redistribution of Jews on trade flows. Our results suggest a robust trade-creation effect of networks: in our bench-

[1] The mystery of missing trade refers specially to the results found by Trefler (1995), which shows some mysteries (rejection by the data) related to the patterns of trade and the volume of trade predicted by the theoretical models.

mark specification for the period 1951-2000, the jewish networks lead to a trade creation of 0.85%, compared to 23.6% of trade creation due to free trade agreements.

We follow the Dixit-Stiglitz monopolistic competition model to derive the gravity equation and address theoretically two additional issues: **1.** The preference parameter a_{ij}, in order to account for home bias in consumers' preferences; **2.** Along with the standard Anderson and van Wincoop (2003) model, we compute the tariff equivalent using the Novy (2008) model, recently applied in Jacks, Meissner, and Novy (2010).[2] The network among Jews is measured by the product of the share of Jews in a country pair i j and is fully consistent with the state of the art gravity literature (e.g., Anderson and van Wincoop (2003), Combes, Lafourcade, and Mayer (2005) and Novy (2008)). As an outcome of the modifyed gravity model, the proximity measure affects trade in two ways: through the reduction of trade costs, τ_{ij}, and the diffusion of preferences, a_{ij}.

Using the Pseudo Maximum Likelihood (PML) estimation as our main empirical specification, we find robust trade-creation effects of networks. Moreover, our results suggest that the omission of controls for multilateral resistance terms in the Anderson and van Wincoop (2003) gravity equation leads to overestimation of the network effect. When we divide the sample into direct and indirect networks, we show that the direct networks capture most of the trade creation effects of networks. Finally, we find no evidence of a decreasing effect of networks over time.

The Chapter is divided as follows. Section 2 presents some stylized facts on Jewish history and provides a closer look at the data. Section 3 discusses the gravity model and the empirical approach. Section 4 shows the main results. Section 5 offers concluding remarks.

5.2 Stylized facts and data

5.2.1 Jewish Networks and Trade

Social interactions and informal barriers to trade have been recently used to explain trade flows (see Guiso, Pistaferri, and Schivardi (2005) and Combes, Lafourcade, and Mayer (2005)). Within informal barriers, ethnic proximity is one of the most tractable to be

[2] The Novy (2008) approach allows part of the goods to be *non-tradable* and also corrects for multilateral resistance terms in a tractable way.

theoretically modeled and empirically tested: Rauch and Trindade (2002) showed for a cross-section analysis that Chinese networks can be easily proxied by the product of the share of the Chinese population in two countries.

We study networks within a religious and cultural group which is particularly interesting due to its characteristics. Jews exhibit a deep and abiding commitment to life in community and build strong networks. In one of the most cited Jewish texts, the "Pirkei Avot" [3], Rabbi Hillel set a one line dicta that has characterized Jewish community for the past 2000 years: "*Al tifrosh min hatzibur* - Do not separate yourself from the community" .

The value to life in community and the membership in the same cultural and religious group created a network externality and the possibility to impose sanctions, which, according to Greif (1993), made it profitable for Jewish merchants not to leave their religious network [4]. As shown in Temin (1997), Mokyr (2002) and Botticini and Eckstein (2007), cultural values within the Jewish community and international exchange are closely related.

Jews also have a long tradition in high skilled activities and have long sought occupations in crafts and trade (Botticini and Eckstein (2007)). Ayal and Chiswick (1983) raise the discussion concerning the overinvestment on human capital by the Jews in the Diaspora, which is reinforced by Botticini and Eckstein (2007): as merchants, the Jews invested more in education, "a pre-condition for the extensive mailing network and common court system that endowed them with trading skills demanded all over the world" [5].

Botticini and Eckstein (2005) also argue that jewish migration was "motivated by increasing trade opportunities that enabled the Jews to reach standards of living comparable to the upper classes in all countries where they settled" .

Figure 5.1 shows the distribution of the Jewish population through the twentieth century

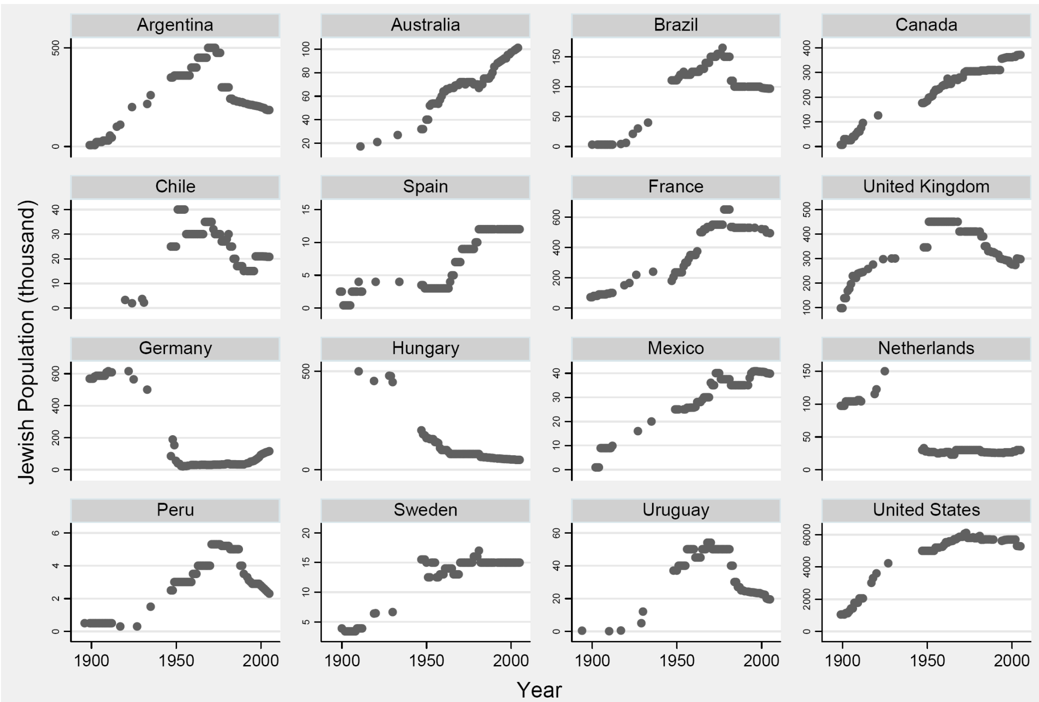
[3] The Pirkei Avot means literally "Ethics of Our Fathers" and is composed of ethical maxims of the Rabbis of the Mishnaic period. It is part of the Mishna, a major work of Rabbinic Judaism and the first major redaction into written form of Jewish oral traditions.

[4] Greif (1993) reports that a Jewish trader, known as the Maghribi trader, "was associated with many Maghribi traders residing in different trade centers, and it was customary to reciprocate in the supply of trade-related information that was so crucial to business success. (...) These information flows within the Maghribis traders group, as well as a merchant's experience, circumvented to some extent the asymmetric information between merchants and agents and enabled the former to monitor the later."

[5] "The Jews who where engaged in long-distance trade had the highest human capital. (...), they were envolved in complicated transactions (...) that required a sophisticated understanding of trade and partnership rules with both Jews and non-Jews, and trade over many commodities in many languagues in different countries. Some of these traders were also the religious leaders of the Jewish communities " (Botticini and Eckstein (2005))

for some countries, selected according to the (highest) number of the Jews in absolute numbers in 2006 [6]. Three structural breaks are worth mentioning: 1. The events of the Second World War, which caused a massive redistribution of the Jewish population in the world (and for which data for most countries is not available); 2. The event of the creation of the state of Israel in 1948 and its particular migration inflow, not observed in other countries in the world (see Figure 5.4 in Appendix A, for the Jewish population in Israel since the creation of the state); and 3. The second wave of migration from developing countries to Israel at the beginning of the 1980's. The large migration flows and the specific characteristics of the Jewish community make the analysis of Jews living in Diaspora and in Israel an interesting question in the trade literature.

Figure 5.1: Jews in the World (1899-2005)



[6] The two countries with a large Jewish population missing in this figure are Israel and Russia. Both cases are plotted separately in the Appendix for their particular characteristics. There is data available for 110 countries, but many missing values before 1950 for most of the countries.

5.2.2 The creation of the State of Israel

The dreadful events of the Second World War and the creation of the State of Israel establish unique characteristics for the Jewish population in the years after War and provide us the opportunity to evaluate the effects of the redistribution of Jews on trade flows.
The creation of the State of Israel is an important event not expoited in the economics literature yet. There is no counterpart in the literature of such an abrupt and high inflow of an ethnic and religious group to a country as is the case of the Jews to Israel. Our dataset shows that, in the first decade after the creation of the State of Israel (1948-1958), the Jewish population in Israel rose from 750 thousand to almost two million Jews. The Jewish population data in Israel is found in Figure 5.4 Appendix A.2 (s. also Appendix A.2 for further details on the data). Section 4.2 studies the effects of networks with Israel on trade.
Since we have many missing values for the period before the Second World War, we investigate in particular the period after the creation of the state of Israel.

5.2.3 The Jewish population data

Jewish population data comes from the publications of the American Jewish Committee - AJC (`www.ajc.org`). We build this dataset, available in the yearly volumes from the "American Jewish Year Book " from 1899 to 2005 for 110 countries, leading to a rich panel data.[7]
The data yields an unbalanced panel: in each of the reports there are some missing values. For our subsample from 1951 to 2004 (the most used in the estimations), we observe for each year at least 75 countries, and on average 83 countries. When we take the share of the Jewish population, this average shrinks to 76, since for some countries there was no available information on the total population[8]. The descriptive statistics with yearly values of Jewish population mean, median and number of observations for the monadic data is

[7]Note that the information observed in the data is the number of Jews in each country by year, regardless the country of birth of the Jew.

[8]Countries (and cty code number) for which we could not match the Jewish population data with the available total population data from IMF: Yugoslavia (cty 188), Afghanistan (cty 512), Gibraltar (cty 823), Turmekistan (cty 795), Uzbekistan (cty 927), Cuba (cty 928), Czechoslovakia (cty 934), Serbia and Montenegro (cty 965).

found in Appendix A.
An important concern is who is a Jew in the dataset. The AJC considers as Jews in their data what they call the *core* Jewish population, which means, the numbers exclude non-Jewish members of Jewish households and other non-Jews of Jewish ancestry. Appendix A provides a full description of who is a Jew.
Historical estimates from AJC are based on several censuses and surveys, partly made available by the source country and in some cases with duplicated values. Always when feasible, the AJC provides a cross-matching of the different sources of data for the same Jewish population, which increases the reliability of the data. The data for the period of intra-wars (First and Second World War) is imprecise and in most cases was not reported. Thus, we focus our analysis from 1948 on, when data was again reliable. Since the data until 1948 is interesting to understand the migration flows and the links to social and cultural networks, we still perform simple analysis in cross-section for this period, but do not use it to infer our main results.[9]
See Appendix A for a complete description on the Jewish data and its collection.

5.2.4 Gravity data and descriptive statistics

We use trade data from the Direction of Trade Statistics - DOTS/IMF (`www.imfstatistics.org/dot`) for the period 1951-2005. In the Appendix we also do a robustness check to the Rauch and Trindade (2002) paper using the NBER-UN data coded by Feenstra, Lipsey, Deng, Ma, and Mo (2005) (see Appendix C).
Data on GDP for the recent periods is taken from the World Development Indicators WDI/IMF; for the population, we use the IFS/IMF data. Our dummies proxies for information and trade costs come from CEPII - Centre d'Etudes Prospectives et d'Informations Internationales. Finally, data for the existance of FTA (Free Trade Agreement) is taken from the IMF's Direction of Trade Statistics for the years 1960, 1965, 1970,..., 2000 - the same data source used by Baier and Bergstrand (2007). Since in the panel data analysis we take 5 years average of the trade data, i.e. 1966-70, 71-75, ..., 1996-2000, we always

[9]The arquives from the AJC deliver yearly reports containing information on the Jewish population in the world. Although, the reports from the Second World War represent only estimates of the real data. It became feasible for the AJC to compute data on the Jewish population again by the end of the 1940's.

include the FTA data from the former period, which means, 1965 for the period 66-70, 1970 for 71-75 and so on.

We report the summary statistics of the yearly data in Table 5.1 and the correlation matrix at 1% significance level in Table 2.

Table 5.1: DOTS trade data and regressors, yearly data (1951-2000)

Variable	Obs	Mean	Std.Dev.	Min	Max
$Imports_{ij}$	183,706	4,45 e+08	4,43 e+09	0	3,36 e+11
Jewish population i	183,706	189243	842388	20	6115000
Jewish population j	183,706	181886	823740.1	20	6115000
Total population i	183,706	4,21 e+07	1,26 e+08	231000	1,31 e+09
Total population j	183,706	4,62 e+07	1,38 e+08	223000	1,31 e+09
JSH_i	183,706	0,0165861	0,1077659	2,24e-08	0,9064885
JSH_j	183,706	0,0157032	0,104471	2,24e-08	0,9064885
$JSH_i * JSH_j$	183,706	0,0000737	0,0008457	1,75e-14	0,0278173
GDP_i	183,706	3,23 e+11	1,12 e+12	1,76 e+08	1,25 e+13
GDP_j	183,706	3,15 e+11	1,11 e+12	1,04 e+08	1,25 e+13
$CGDP_i$	183,706	8,944,461	12778,73	6,643,237	81003,84
$CGDP_j$	183,706	8,747,356	12653,03	6,643,237	81003,84
Distance	183,706	7,751,093	4,755,023	5,961,723	19772,34
Contiguity	183,706	0,0334908	0,1799149	0	1
Common Language	183,706	0,1575364	0,3643068	0	1
Former colony	183,706	0,0271841	0,1626199	0	1
FTA	103,234	0,0608520	0,2390599	0	1

Table 5.2: Correlation matrix at 1% significance level

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. $Imports_{ij}$	1							
2. $Jewpop_i$	0.1184*	1						
3. Pop_i	0.0774*	0.1427*	1					
4. $(GDP_i * GDP_j)$	0.5614*	0.1683*	0.1016*	1				
5. Distance	-0.0628*	-0.0225*	0.0460*	-0.0069*	1			
6. Contiguity	0.1554*	-0.0019*	0.0136*	0.0231*	-0.2391*	1		
7. Language	0.0457*	0.1379*	0.0111*	0.0087	-0.1215*	0.1397*	1	
8. FTA	0.3238*	0.0160*	-0.0300*	0.1154*	-0.2765*	0.1907*	0.0213	1

*** Denotes significantly different from 0 at 1% level.

5.3 Model and Empirical Specification

5.3.1 Trade flows and trade costs: gravity revisited

We follow the Dixit-Stiglitz Krugman (Dixit and Stiglitz (1977); Krugman (1980)) monopolistic competition model, particularly the Anderson and van Wincoop (2003) gravity equation, with a slightly modified utility function to account for home bias in consumers' preferences a_{ij} [10] [11]. We omit time subscripts for simplicity.

Market clearing condition and the solution for the scaled prices (s. complete derivation in Anderson and van Wincoop (2003) and Feenstra (2004)) yield the maximization problem:

$$c_{ij} = \frac{y_i y_j}{y_w} \left(\frac{1+\tau_{ij}}{a_{ij}} \right)^{1-\sigma} (P_i P_j)^{\sigma-1} \tag{5.1}$$

where c_{ij} is the demand of country j of goods produced in country i (c.i.f. value of imports), σ the elasticity of substitution between varieties, a_{ij} the preference parameter, y_i and y_j income in countries i and j, y_w total world income, and τ_{ij} the standard ad valorem iceberg-type trade costs, with $\tau_{ij} > 0 \;\forall\; i \neq j$.[12] [13]

P_i and P_j account for the multilateral resistance terms depicted by Anderson and van Wincoop (2003), countries i and j "resistance to trade with all other countries " . This reflects the fact that trade is determined by *relative* trade barriers. For a given bilateral barrier τ_{ij}, an increase in barriers from i and other trade partners causes a reduction in relative prices of goods from j and an increase in imports from j [14], such that

[10]Due to the preference parameter a_{ij}, varieties do not enter symmetrically the CES-Utility function but are weighted by a_{ij}. Agents maximize $U_j = \left(\sum_{k=1}^{I} (a_{kj} c_{kj})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$ subject to the budget constraint $\sum_{k=1}^{I} p_{kj} c_{kj} = y_j$, where I is the number of countries.

[11]We also test our hypothesis using the Novy (2008) model in section 4.3.

[12]This implies that only a fraction $\frac{1}{1+\tau_{ij}}$ arrives at the destination. Without information on trade within regions in a country, we also assume that $\tau_{ii} = 0$ and $\tau_{ij} > 0 \;\forall\; i \neq j$.

[13]Crucial assumptions for utility maximization are, besides the market clearing condition and the budget constraint, the assumption that τ_{ij} and a_{ij} are symmetric, i.e., $\tau_{ij} = \tau_{ji}$ and $a_{ij} = a_{ji}$ (see Feenstra (2004)).

[14]In the monopolistic competition model, P_i represents a consumer index and depends on all bilateral resistances τ_{ij}. Although, as shown in Anderson and van Wincoop (2003), this is not a proper interpretation for P_i more generally. For instance, in the existance of different consumption preferences among countries, P_i no longer represents the consumer price index, since the border barrier includes a home bias. Thus, the authors refer to P_i as the "multilateral resistance terms " bilateral trade, after controlling for size, depends on τ_{ij} relative to the product of P_i and P_j. Note that $P_j = (\sum_i a_{ji}^{\sigma-1} y_i p_{ji}^{1-\sigma})^{\frac{1}{1-\sigma}}$.

$P_i^{1-\sigma} = \sum_j \frac{y_j}{y_w} a_{ij}^{\sigma-1} P_j^{\sigma-1} (1+\tau_{ij})^{1-\sigma}$.

5.3.2 Trade costs and the proximity channel

Transportation costs τ_{ij} are composed of physical and political transport costs T_{ij} and of information costs $INFO_{ij}$, as in Combes, Lafourcade, and Mayer (2005). The physical component of T_{ij} is composed of the distance between countries, D_{ij}, and their contiguity $CONT_{ij}$. As a political component of T_{ij} we use the existence of a free trade agreement (FTA) between countries i and j. Thus, $T_{ij} = e^{\bar{\delta}(1-FTA_{ij})+\gamma(1-CONT_{ij})} D_{ij}^{\bar{\lambda}}$.

We use the network channel as a proxy for informal trade barriers, which is in our specification a component of the information cost $INFO_{ij}$. There is no consensus regarding the way through which networks affect trade patterns; we follow Rauch and Trindade (2002) and use the product of the share of the Jewish population in a country pair, i.e., $JSH_{ij} = \frac{jewpop_i}{totalpop_i} * \frac{jewpop_j}{totalpop_j}$, as our proximity measure.

Information costs are given by $INFO_{ij} = e^{\bar{\vartheta}(1-LANG_{ij})} I(JSH_{ij})$, where the function $I(JSH_{ij})$ decreases the greater the magnitude of the network. Thus, trade costs are defined as: $\tau_{ij} = e^{\bar{\delta}(1-FTA_{ij})+\gamma(1-CONT_{ij})} D_{ij}^{\bar{\lambda}} e^{\bar{\vartheta}(1-LANG_{ij})} I(JSH_{ij})$.

The second channel through which networks affect trade is the preference parameter a_{ij}. For a representative agent, $a_{ij} = \bar{\varphi} I(JSH_{ij}) e^{u_{ij}}$, with $\varphi > 0$ and u_{ij} a random component [15]. The literature on trade and networks (e.g. Head and Ries (2001), and Rauch and Trindade (2002)) shows that the effect of migrants is not consistently higher for imports than for exports, as also argued by Combes, Lafourcade, and Mayer (2005). This implies that one should be cautious about the empirical relevance of the preference channel. Thus, we do not aim to disentanble the two channels (trade costs and preferences). Moreover, since our sample is large compared to the number of observations which include Israel as a trade partner, we can in some cases abstract from the preference channel;[16] Thus, we expect trade costs to capture most of the effect of networks on trade. The preference channel might be especially interesting when we analyse trade only with Israel and the *direct* networks to Israel.

[15]Consumers might have a home bias and prefere locally produced goods, which happens, for instance, due to persistence of consumption habits.

[16]It is less intuitive to think of similar preferences from Jews living in the US and in Germany, for instance. In those *indirect* networks, the information cost channel is expected to be more relevant.

5.3.3 Pseudo-maximum likelihood estimation

Our gravity model follows equation (5.1). A stochastic version of equation (5.1) can be written as:

$$c_{ij} = (y_i y_j)^{\bar{\psi}} a_{ij}^{\bar{\varphi}} e^{\bar{\delta}(1-FTA)+\gamma(1-CONT_{ij})} D_{ij}^{\bar{\lambda}} e^{\bar{\vartheta}(1-LANG_{ij})} I(JSH_{ij})^{\bar{\varsigma}} e^{\bar{\gamma}_i d_i + \bar{\gamma}_j d_j} \epsilon_{ij} \quad (5.2)$$

where d_i and d_j are the dummies representing P_i and P_j that control for multilateral resistance terms, $\bar{\gamma}_i$ and $\bar{\gamma}_j$ the respective parameters and ϵ_{ij} an iid error term s.t. $E[\epsilon_{ij}|c, P, y, a, \tau] = 1$.

We use different ways to control for multilateral resistance terms and use the pseudo-maximum likelihood (PML) estimation as our main econometric strategy. We assume that trade costs can be log linearized, as shown in Henderson and Millimet (2008). The equation to be estimated using quasi-maximum likelihood follows:

$$c_{ij} = exp\left\{\bar{\psi} ln(y_i y_j) + \xi \mathbf{X}_{ij} + (\bar{\varsigma} + \bar{\varphi}) I(JSH_{ij}) + \bar{\gamma}_i d_i + \bar{\gamma}_j d_j\right\} + \epsilon_{ij} \quad (5.3)$$

where $\mathbf{X}_{ij}$ is the vector of variables in τ_{ij} other than the network variable, ξ the vector of coefficients and $I(JSH_{ij})$ the measure of networks, which contains both the information and the preference channel. Note that $\bar{\varsigma} = (\sigma - 1)\varsigma$, for σ the elasticity of substitution.[17]

The correct specification of the conditional mean, i.e., $E[c_{ij}|Z] = expz_i'\hat{\beta}$ for z a set of regressors, is the only assumption required for consistent estimation of equation (5.3) (a result shown in Gourieroux, Monfort, and Trognon (1984) and Wooldridge (2002)). Note that c_{ij} does not need to have a Poisson distribution: the estimator is a Poisson PML estimator which solves $max_\beta \sum_{i=1}^{n} l_i(\beta)$. The unique solution of $max_\beta E[l_i(\beta)]$ is ensured by rulling out perfect multicollinearity.[18]

We also estimate equation (5.2) using OLS and Tobit and check the adequacy of the results (s. results in Appendix B and C). The Tobit model has an important advantage over OLS for trade data: if there exists many observations on the threshold b, OLS

[17] Rauch and Trindade (2002) divide trade flows in groups of goods using the Rauch (1999) classification of goods. Although, the interpretation of the coefficients of the network variable across groups of goods relies on a strong assumption of equal elasticities σ across those groups. We discuss their results in Appendix C.

[18] Note that the Hessian $H(\beta) = -\sum_{i=1}^{n} exp(x_i'\beta)x_i x_i'$ is negative definite for all x and β, what ensures the uniqueness of the maximum. Some of the parameters might be not identified, as discussed in Santos Silva and Tenreyro (2010). Thus, the parameters which cause perfect multicollinearities and complete separation are dropped to ensure identification of β.

would lead to inconsistent estimators. For X the set of regressors and $P(.)$ the conditional probability, OLS estimates only $E[c_{ij}|X, c_{ij} > b]$, while the Tobit model estimates $E[c_{ij}|X] = P(c_{ij} = b|c_{ij})b + P(c_{ij} > b|c_{ij})E[c_{ij}|X, c_{ij} > b]$. Thus, OLS estimates only the expected value of observations above the threshold b. Moreover, inconsistency of OLS might result from a $E[c_{ij}|X]$ non linear in X.

Despite this advantage over OLS for trade data, the Tobit model, used by Rauch and Trindade (2002) among others, has been highly criticized in the most recent literature dealing with the gravity model. In the presence of heteroskedasticity and nonnormal residuals, Tobit leads to inconsistent parameters, which we can suspect to be the case of trade data.[19]

Under heteroskedasticity, the Jensen's Inequality, i.e. $E(\log c_{ij}) \neq \log E(c_{ij})$, implies that the interpretation of the elasticities of the log-linearized model is incorrect and the model should be estimated using the multiplicative form (Santos Silva and Tenreyro (2006), Henderson and Millimet (2008)).[20] This is true since the nonlinear transformation of the dependent variable by log-linearization changes the properties of the error term: for X the set of regressors, $E[ln(\epsilon_{ij})|X]$ depends on the shape of $E[\epsilon_{ij}|X]$. Results of the log-linearized version using OLS are consistent estimates of $E[ln(c_{ij})|X]$ only if $E[ln(c_{ij})|X]$ is a linear function of the regressors.[21]

5.3.4 Trade Creation

More important than to evaluate the outcome coefficient of the JSH_{ij} variable is to measure the magnitude of the trade creation effects of the Jewish population. In the Rauch and Trindade (2002) study, a minority of countries capture most of the trade creation effects of networks. We follow their strategy and divide our observations in two groups, with high

[19]For trade flows c and a set of regressors x, as $E[c|x]$ reaches its lower bound, dispersion around the mean tends to be small. The variance $V[c_i|x]$ tends to vanish as $c \to 0$, while $V[c_i|x]$ is higher for higher values of c ($E[c|x]$ has greater dispersion). But there is also no reason to assume that $V[c_i|x]$ is proportional to c_i. Therefore, errors in trade data are generally heteroskedastic, as extensivelly discussed in Santos Silva and Tenreyro (2006).

[20]The Tobit model proposed by Eaton and Tamura (1994) and used in Rauch and Trindade (2002) solves the problem of observations on the threshold b. But, as in the OLS model, under heteroskedasticity it leads to inconsistent estimates of the parameters.

[21]Consider equation (5.2): the validity of the specification depends on whether ϵ_{ij} is statistically independent on all regressors.

and low share of Jews. We take the median of JSH_c, for $c = i, j$, and create a dummy called $DCORE$, that equals 1 if both countries are above the median, and 0 otherwise. Thus, we measure trade creation for two groups $JSHSmall_{ij} = JSH_{ij} * (1 - DCORE)$ and $JSHLarge_{ij} = JSH_{ij} * (DCORE)$, corresponding, respectively, to the countries with a large and a small share of Jews.[22]

The trade creation effect is measured as $100 \left[\exp(\overline{JEWSHARE} * \varpi_m) - 1\right]$, where $\overline{JEWSHARE}$ is the mean of the JSH_{ij} in the two different groups and ϖ is the corresponding coefficient estimated from the two variables $JSHSmall$ and $JSHlarge$. When we use the complete sample, we use the mean of JSH_{ij} to calculate the trade creation effects.

5.4 The effects of social networks on trade

5.4.1 Effects of JSH_{ij} on total trade flows

Results for world trade flows using the DOTS trade data and the PML estimations are reported on Table 5.3.[23] [24] Further results using the NBER-UN trade data with the Rauch (1999) classification of goods are reported in the Appendix C. We take 5 years average of the data to minimize the problem with missing values and data heterogeneity, which yields 10 periods: 1951-1955, ..., 1996-2000. It is computationaly cumbersome to estimate a panel over 50 years for 110 countries using PML, given the high number of dummies to control for time-varying importer and exporter fixed effects. Thus, besides missing values and data heterogeneity, there is a computational advantage of taking five years average of the data.

Table 5.3 shows the main results, using the PML estimation. The dependent variable in this model follows equation (5.3). Columns (1) and (2) report results for the proximity channel JSH_{ij}. We use the mean of the whole sample JSH_{ij} to calculate the trade creation

[22] Observations for the countries with small share of Jews are treated as an undifferentiated mass of zeroes. Thus, the coefficient from the regressor JSH_{ij} should be similar to the coefficient from $JSHLarge_{ij}$, as argued by Rauch and Trindade (2002).

[23] We also allow GDP per capita to enter our final model. With non-homothetic preferences, there would be a natual role for per capita income in gravity equations.

[24] We reproduce the main results using $SJEW_{ij}$, the sum of the ethnic population in the country pair. The information cost in this case yields $INFO_{ij} = e^{\bar{\vartheta}(1-LANG_{ij})} SJEW_{ij}^{\mu}$. Even though results are mainly statistically significant, the use of the sum of Jews is less intuitive.

effects attributable to the Jews (a comparison between the mean and the median for each year is available in Table 5.6 in Appendix A). For the complete panel, the mean is 0.000068 and the trade creation effect is 0.84% and 1.42%. Using FTA for comparison, we observe a trade creation effect of 23.6% by $FTAs$. FTA is always positive and significant, which is the expected effect. GDP has the expected sign and magnitude similar to the usually reported in the gravity models of trade. Period dummies are in most cases significant.

In columns (3) and (4), the countries are divided according to the criteria described in section 3.4. We show that large countries capture most of the effect in terms of trade creation.

The estimations with the fixed effects specification and period dummies reported in columns (1) and (3) represent our benchmark results. One could argue that the 0.84% of trade creation we find is rather small comparing to the at least 60% trade creation found in the Rauch and Trindade (2002) study for the Chinese group. Although, we argue that the values of trade creation in Table 5.3 are plausible for the relatively smaller group under study. Moreover, if we do not control for multilateral resistance terms, the trade creation effects of the Jewish networks approximately doubles. The results reported in Rauch and Trindade (2002) are subject to two concerns: 1. The estimators might be biased due to the omission of the multilateral resistance terms; 2. Their Tobit gravity equation may be subject to misspecification (see discussion in section 3.3.).

We report results for the log-linearized version of equation (5.2) in Table 5.8 (Appendix B) as well as for the Tobit model in Table 5.9 (Appendix B). Both models confirm the results from Table 5.3. The effect of networks on trade is higher with the log-linearized model and the Tobit model, in comparison to the PML estimation.

One important concern with our model is sequential moment restrictions: past values of JSH_{ij} might help to predict trade. If this is the case [25], we could solve the endogeneity problem including lags in the model. Our results show that JSH_{ijt-1} has a smaller effect on trade then JSH_{ijt}, but the significance of the results do not change.

[25] z_{ijt} would be correlated with ϵ_{ijt}.

Table 5.3: Trade creation effects. Panel using PML.
Period 1951-2000 (five years average).

Dep. variable: c_{ij}	(1)	(2)	(3)	(4)
JSH_{ij}	122.2**	207.5***		
	(18.20)	(55.66)		
$JSHLarge_{ij}$			86.06**	144.6***
			(42.74)	(0.00621)
$JSHSmall_{ij}$			483.1**	772.0***
			(190.8)	(258.1)
Log $(GDP_i * GDP_j)$	1.103***	1.990***	0.940***	0.940***
	(0.118)	(0.0442)	(0.0156)	(0.0156)
Log $(CGDP_i * CGDP_j)$	0.393***	1.233***	0.396***	
	(0.113)	(4.46e-06)	(0.113)	
FTA	0.236***	0.329***	0.239***	0.371***
	(0.0506)	(0.0205)	(0.0505)	(0.0588)
Trade creation (JSH_{ij})	**0.84%**	**1.42%**		
Trade creation $(JSHLarge_{ij})$			**3.16%**	**1.87%**
Trade creation $(JSHSmall_{ij})$			**0.23%**	**0.14%**
Trade creation FTA	**23.60%**	**23.60%**	**23.90%**	**37.10%**
Period dummies (P)	yes	no	yes	no
ij fixed effects	yes	yes	yes	yes
Observations	22159	22804	22159	22159
Country pairs	3175	3175	3175	3175
Log likelihood	-3.644e+11	-5.248e+11	-3.602e+11	-5.247e+11

Note: The trade creation effect in columns (1) and (2) are calculated with median (s. section 3.5.)
(ii) Mean of $JSHLarge_{ij}$ and $JSHSmall_{ij}$, respectively: 2.16e-04 and 2.95e-06.

5.4.2 Direct versus indirect networks and the creation of the State of Israel

We create an additional measure of *direct* and *indirect* links to study the relevance of networks with Israel. Direct links are defined as networks in which Israel is either the import or export country.[26] The hypothesis is that direct links have a high impact on trade, through both the preference channel and the information channel. The measure of *direct* networks is created in a similar fashion to the two groups of countries shown in 3.4. $JSHdir_{ij} = JSH_{ij} * (dir)$, for *dir* a dummy equal to 1 if i or j are Israel and

[26] As a robustness check, we also include the United States in the direct links, given the magnitude and importance of the Jewish population in this country. The coefficients are slightly higher, but the trade creation effect remains close to previous results.

$JSHindir_{ij} = JSH_{ij} * (1 - dir)$ otherwise.

Results for the direct and indirect links are reported in columns (1) and (2) in Table 5.4. In column (2) we control for multilateral resistance terms and results for the direct networks with Israel yield a trade creation effect of 24%. Column (1) reproduces the same regression model but with period dummies. In this case, the effect of the indirect networks vanishes: one possible way to interpret this last result is to think that direct vs. indirect links could help in a very crude way to disentangle the preference and the trade cost channels, and that the preference channel of the Jewish networks dominates the trade cost channel.

In columns (3), (4) and (5), we look only at the *direct links* to Israel: we keep only the observations for which one of the countries is Israel. As already mentioned in subsection 2.2., the creation of the state of Israel offers a quasi-natural experiment and, after its creation, the high inflow of Jews might be responsible for the high effects of the direct links found in columns (1) and (2).

Column (3) shows the trade creation effects of the direct links. In column (4), the network variable is divided between *strong* ($JSHLarge_{ij}$) and *weak* ($JSHSmall_{ij}$) networks. Even though the coefficient for $JSHSmall_{ij}$ is higher, its mean is much smaller and, thus, the trade creation effect of the group $JSHLarge_{ij}$ is higher, as expected. Finally, in column (5) we add a dummy to control for political relations with Israel. A closer look at the first two decades after the creation of the State of Israel reveals that results from columns (4) and (5) might be biased due to omitted variables: in particular in the first two decades after the creation of the State of Israel, many countries participated in a boycott to Israelian products. Thus, we include country votes at the United Nations as a proxy for political relations with Israel. This dataset from the United Nations is available for all countries in our sample and covers the complete period under study.[27] Results for the UN votes (5) are significant and positive, as expected, and the effect of the JSH_{ij} reduces with the inclusion of the dummy.

For the specification reported in (1) and (2), we have also included $[JSH_{ij} * (1 - dir)]^2$ as a quadratic term, along with $JSHdir_{ij}$ and $JSHindir_{ij}$, to capture diminishing returns. Although, we found no evidence of diminishing returns.

[27]We have also created a dummy for the Arab Liga, the countries which leaded the trade boycott with Israel. Although, using the UN votes offers a more complete analysis.

Table 5.4: Direct and indirect links and trade with Israel. Dep. variable: c_{ij}.

Dep. Variable: c_{ij}	World Trade		Trade with Israel		
	(1)	(2)	(3)	(4)	(5)
Log $(GDP_i * GDP_j)$	1.109***	2.009***	3.5721***	2.917***	2.881***
	(0.119)	(0.0441)	(0.118)	(0.131)	(0.118)
Log $(CGDP_i * CGDP_j)$	0.401***	1.252***	2.5794***	2.421***	2.310***
	(0.114)	(0.0511)	(0.113)	(0.132)	(0.113)
FTA	0.237***	0.330***	-0.1051***	-0.206***	-0.190***
	(0.0506)	(0.0172)	(5.74e-05)	(5.74e-05)	(5.74e-05)
UN votes					0.395***
					(0.0952)
$JSHdir_{ij}$	119.3**	195.1***			
	(56.41)	(35.40)			
$JSHindir_{ij}$	1437	5065***			
	(1622)	(1540)			
JSH_{ij}			104.34***		74.18***
			(55.66)		(46.43)
$JSHLarge_{ij}$				87.49***	
				(42.74)	
$JSHSmall_{ij}$				519.6***	
				(258.1)	
Obs.	22159	22159	723	723	723
Number of pairs	3175	3175	102	102	102
Log-likelihood	-3.604e+11	-4.775e+11	-1.703e+09	-1.646e+09	-1.703e+09

5.4.3 The Novy (2008) model and trade costs over time

Novy (2008) proposes a tractable way to control for time-varying multilateral resistance terms in a model that allows part of the goods to be non-tradable. The model was used in Jacks, Meissner, and Novy (2008). We use it as an alternative specification to Anderson and van Wincoop (2003).

Instead of the theoretical constructs P_i and P_j as in Anderson and van Wincoop (2003), Novy (2008) uses the tractable measure $y_i - x_i$ (output minus exports) for countries i and j to control for multilateral resistance terms, which is captured directly from the data. As a drawback of the model, we need to use export data instead of import data because of the measure $y_i - x_i$.

Details of the model are found in Appendix D.

We represent the Novy (2008) gravity equation in terms of the tariff equivalent, ψ, such that $\psi_{ij} = \frac{1}{1-\tau_{ij}} - 1$ (see equation (5.9) in Appendix D). Under symmetry, $\tau_{ij} = \tau_{ji} = \left(\frac{x_{ij}x_{ji}}{\theta_i(y_i-x_i)\theta_j(y_j-x_j)}\right)^{\frac{1}{2\sigma-2}}$, where θ_i is the share of tradable goods in country i.

We set the values for the parameters θ and σ suggested in Jacks, Meissner, and Novy (2008), i.e., $\theta = 0.8$ and $\sigma = 11$, and write the tariff equivalent ψ_{ij} as a function of all trade costs τ_{ij} :

$$\psi_{ijt} = exp\{\beta_0 + \beta_1 JSH_{ijt} + \beta_2 LANG_{ij} + \beta_3 CONT_{ij} + \beta_4 COL_{ij} + \beta_5 FTA_{ijt} + \beta_6 lnD_{ij}\} + \epsilon_{ijt} \quad (5.4)$$

where language $LANG_{ij}$, contiguity $CONT_{ij}$, colonial relationship COL_{ij} and distance D_{ij} are time-invariant regressors and ϵ_{ijt} an error term.

In our data, the correlation between ψ_{ij} and τ_{ij}, at 1% significance level, is nearly 0.95. Thus, using ψ_{ij} or τ_{ij} should leave the regressors unaffected, as is the case in Jacks, Meissner, and Novy (2008). Moreover, ψ_{ij} is more intuitive to interpret than τ_{ij}: the coefficients are percentage point changes in the tariff equivalent in response to changes in regressors. We show the results for the tariff equivalent following equation (5.4). The hypothesis is that, the higher the proximity channel JSH_{ij}, the lower the tariff equivalent ψ_{ij}.

We report results for World trade and trade with Israel in Tables 5.5 and 5.6, respectively. P1-P10 refers to the 10 cross-sections for the 5 years averaged data: P1=1951-55, P2= 1956-60, ..., P10= 1996-2000. All results are reported with time-invariant gravity regressors. We find significant results of the JSH_{ij} on trade over time, and find no evidence of a decreasing effect of networks on trade over time. For JSH_{ij}, the effect on ψ_{ij} is slightly increasing. For trade with Israel there is no clear pattern once we control for political relations.

Table 5.5 shows that the effects of the network channel persist over time and has always a negative and significant effect on the tariff equivalent, confirming our hypothesis. The control variables confirm the predictions from the gravity model: higher distance leads to a higher tariff equivalent, while contiguity, colony and FTA lead to a lower tariff equivalent.[28]

Table 5.6 reports the results for the fixed effects PML model for trade with Israel. Not controlling for political relations with Israel could lead to biased results, as already argued for Table 5.4. Thus, we check the robustness of the results adding UN votes. The pattern over time for JSH_{ij} in Table 5.6 is similar to the one observed in Table 5.5 when we do not control for political relations. Once we control for political relations, the pattern over

[28]The only variable that deviates from the predictions is language, which is positive in the period 1950-1970 and in two cases significant. From 1970 to 2000, the effect of language on trade costs has the expected sign.

time is unclear, even though one could argue that it has an inverted u-shape effect.[29]

Table 5.5: PML estimation for 10 periods (1951-2000). Dependent variable: ψ_{ij}. WORLD TRADE

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Dist	0.293***	0.313***	0.377***	0.378***	0.375***	0.359***	0.340***	0.288***	0.205***	0.229***
	(0.0195)	(0.0175)	(0.0203)	(0.0212)	(0.0191)	(0.0203)	(0.0207)	(0.0239)	(0.0274)	(0.0190)
Cont	-0.533***	-0.317***	-0.266***	-0.138**	-0.0359	0.0998	-0.222**	-0.269***	-0.400***	-0.211***
	(0.113)	(0.0919)	(0.0900)	(0.0676)	(0.102)	(0.122)	(0.0863)	(0.0587)	(0.0600)	(0.0455)
Lang	0.107***	0.0196	0.150***	0.00708	-0.106**	-0.0950*	-0.0175	-0.104*	-0.200***	-0.0849**
	(0.0406)	(0.0392)	(0.0455)	(0.0450)	(0.0467)	(0.0531)	(0.0544)	(0.0606)	(0.0511)	(0.0421)
Col	-0.803***	-0.763***	-0.838***	-0.683***	-0.619***	-0.485***	-0.618***	-0.489***	-0.403***	-0.298***
	(0.114)	(0.109)	(0.0756)	(0.0637)	(0.0551)	(0.104)	(0.0971)	(0.0606)	(0.0552)	(0.0479)
JSH	-35.32***	-28.91*	-53.39**	-69.02***	-69.20***	-93.78***	-102.9***	-88.65***	-120.6***	-77.65***
	(10.70)	(17.18)	(24.77)	(15.58)	(12.54)	(15.37)	(15.49)	(12.65)	(19.59)	(14.18)
FTA			-0.550***	-0.465***	-0.206	-0.400***	-0.478***	-0.497***	-0.687***	-0.298***
			(0.0485)	(0.0458)	(0.185)	(0.0932)	(0.0572)	(0.0546)	(0.0461)	(0.0387)
Const	-1.387***	-1.520***	-2.113***	-2.231***	-2.329***	-2.233***	-2.040***	-1.780***	-1.062***	-1.631***
	(0.174)	(0.158)	(0.183)	(0.189)	(0.167)	(0.178)	(0.184)	(0.211)	(0.243)	(0.164)
Obs	2277	2832	2522	2334	2516	2620	2908	2158	2332	2350

Estimations with robust standard errors. Cross-sections for the 5 years averaged data.

*, **, ***, indicate significance of the coefficient at the 1%, 5% and 10% level, respectively.

[29] Rauch and Trindade (2002) have already speculated on the effects of networks over time. They argued that better communication technology, the spread of English as the common business language, and stronger international institutions could be explanations for a decreasing effect of Chinese networks over time. Although, making use of only two cross-sections, they were not able to check the validity of this hypothesis.

Table 5.6: PML estimation for 10 periods (1951-2000). Dependent variable: ψ_{ij}. TRADE WITH ISRAEL

	P1		**P2**		**P3**		**P4**	
JSH_{ij}	-56.85***	-91.33***	-35.87*	-38.84**	-52.03**	-44.25*	-65.24***	-60.55***
	(15.43)	(12.81)	(19.36)	(16.38)	(26.23)	(25.38)	(18.86)	(17.87)
UN votes		-1.238***		-2.107***		-0.570		-1.189**
		(0.376)		(0.449)		(0.590)		(0.604)
Obs	91	63	102	86	96	88	92	88
	P5		**P6**		**P7**		**P8**	
JSH_{ij}	-72.03***	-59.11***	-127.8***	-89.58***	-151.4***	-82.28***	-117.3***	-42.79***
	(20.95)	(18.29)	(33.08)	(22.86)	(33.24)	(20.17)	(27.93)	(13.61)
UN votes		-3.103***		-2.337***		-2.023***		-1.744***
		(0.663)		(0.266)		(0.247)		(0.320)
Obs	96	94	98	96	106	104	90	88
	P9		**P10**					
JSH_{ij}	-122.7***	-25.32	-102.6***	-13.18				
	(28.06)	(20.88)	(39.04)	(22.77)				
UN votes		-1.571***		-1.719**				
		(0.278)		(0.744)				
Obs	94	92	96	92				

Estimations with robust standard errors. Cross-sections for the 5 years averaged data.

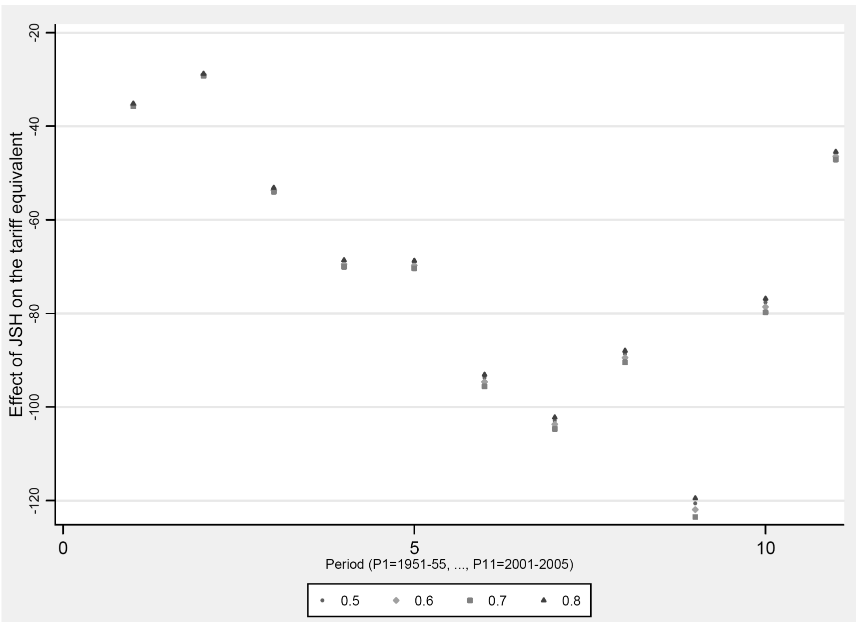
*, **, ***, indicate significance of the coefficient at the 1%, 5% and 10% level, respectively.

For the estimations shown in Tables 5.5 and 5.6, we have set values for the parameters θ (the share of tradable goods) and σ (the elasticity of substitution).[30] In Figures 5.2 and 5.3, we perform a sensitivity analysis for different values of θ and σ and show that the effect of the JSH_{ij} on ψ_{ij} for World Trade (Table 5.5) remains robust to different perturbations in the parameters.

In Figure 5.2, the effect of JSH_{ij} on ψ_{ij} is stable even to unrealistic values of θ.[31] In Figure 5.3, the effect of the networks on trade increases with the elasticity of substitution (the higher the σ, the higher the effect on trade).

Note that the effect of JSH_{ij} on ψ_{ij} is particularly high for the ninth period (1991-95). This abrupt growth of the network effect might be related to the facts reported in Gandal, Hanson, and Slaughter (2004). The authors exploit the sudden migration of high skilled Russian Jews from the former Soviet Union to Israel and the effects on factor endowments in Israel. Such an abrupt inflow to Israel due to policy changes might affect the structure of the Jewish networks and their effects on trade.

Figure 5.2: Sensitivity of the effect of JSH_{ij} on ψ_{ij} to changes in θ.



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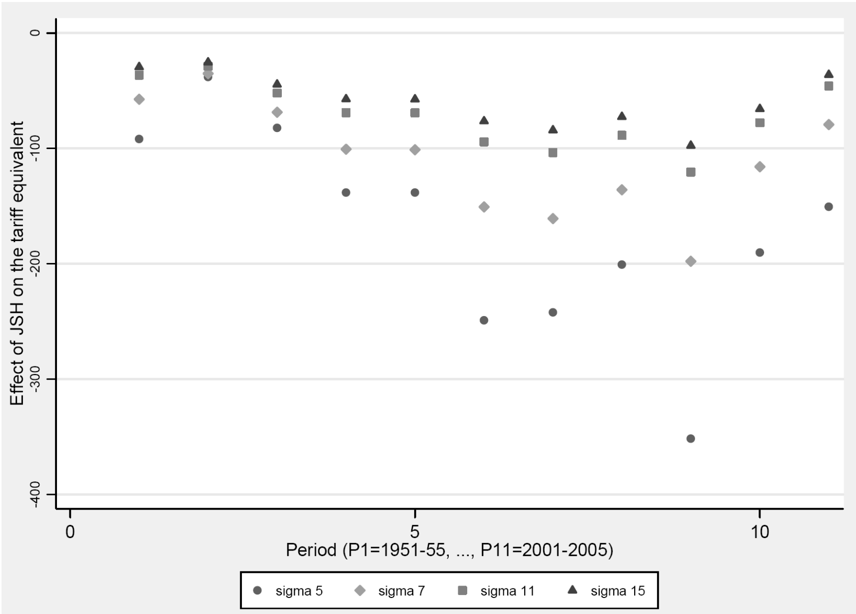
[30]We set the same values suggested in Jacks, Meissner, and Novy (2008). The authors also conduct a sensitivity analysis for these values.

[31]Note that θ is considered constant over time. Although, it is clear from the sensitivity analysis that changes in θ over time does not overestimate our results for the effects of JSH_{ij} on ψ_{ij}.

Figure 5.3: Sensitivity of the effect of JSH_{ij} on ψ_{ij} to changes in σ.



5.5 Final Remarks

This Chapter has shown the trade creation effects of a religious group using a theory-based gravity equation. Results reveal important trade-enhancing effects of networks. In our preferred specification, networks lead to a trade creation of 0.84%. We show that the non-linear PML estimation with robust standard errors is immune to misspecification, while the estimation using OLS and Tobit might lead to overestimation of the results.

We show that the countries with the majority of Jews capture most of the trade creation effects. Using information on UN votes, we show that our results are robust controlling for political relations. Finally, we find that, despite better communication technology and stronger international institutions, there is no evidence of a decreasing effect of the Jewish network on the tariff equivalent over time. Thus, our results show the importance of networks for the integration of the world economy.

5.A Jewish Population Data and Statistics

5.A.1 Who is a Jew in our dataset?

Despite ideologies, this is a crucial question in our study. As mentioned in the archives of the AJC [32], the clear definition of the Jewish group is an important concept to provide serious comparative foundations to the study of the Jewish demography. The three major concepts of a Jew are: (i) the *core* Jewish population; (ii) the *enlarged* Jewish population; and (iii) the *Law of Return* Jewish population.

The data from the American Jewish Committee considers in their numbers for the Jewish population in each country only the *core* Jewish population, what does not include non-Jewish members of Jewish households and other non-Jews of Jewish ancestry [33]. In what follows, we give a closer look at the definitions:

(i) The *core* Jewish population:

In most of the countries, the concept of the core Jewish population includes "all persons who, when asked, identify themselves as Jews; or, if the respondant is a different person in the same household, are identified by him/her as Jews" [34]. "The core Jewish population includes all converts to Judaism by any procedure, as well as other people who declare they are Jew". "Persons of Jewish parentage who adopted another religion are usually excluded, as are other individuals who in censuses or surveys explicitly identify with a non-Jewish group without having converted out of Judaism".

Until 2001, Jews who had other religious corporate identities were excluded from the definition of the *core*. Since 2001, Jews with multiple religious identities are, under certain circumstances, included as Jews [35].

(ii) The *enlarged* Jewish population:

[32] We refer here mainly to the notes on the most current book release on the Jewish data and methods: American Jewish Year Book Vol. 107 (2007) and the chapter World Jewish Population and Clarifications (2007)

[33] For instance, statistics from the AJC show that in 1980 there were 196 thousand Jews in Brazil, while in 2006 this number decreased to 96 thousand. The break out in the numbers from the census suggest considerable intermarriage with non-Jews, as suggests the AJC.

[34] This definition of a person as a Jew broadly overlaps with the Halakhah (the rabbinic law), but not necessarily coincide. Although, in Israel, the personal status is subject to the rulings of the Ministry of the Interior, which relies on the rabbinical authorities and thus relies on legal rules of the Halakhah.

[35] This change in the definition does not represent a problem to our sample, since we mainly use data from 1950 until 2000.

The enlarged Jewish population includes the core population and: a. all other persons of Jewish parentage who are not Jewish at the date of the investigation; b. all of the respective non-Jews with Jewish backgroud.

(iii) The *Law of Return* Jewish population:

According to this rule, a Jew is any person born to a Jewish mother or converted to Judaism, who does not have another religious identity. The Law of Return is significantly larger definition than (i) and (ii) and represents the distinctive legal framework for the acceptance and absorption of new immigrants; awards Jewish new immmigrants immediate citizenship and other civil rights.

The data collection for the definition (i) benefits from scholars and institutions in many countries. Some of the countries that have delivered national censuses information on Jewish population in the recent years are: Ireland, Czech Republic, India, Romania, Bulgaria, the Russian Republic, Macedonia, Israel, Canada, South Africa, Australia, New Zealand, Belarus, Azerbaijan, Kazakhstan, Kyrgyzstan, Brazil, Mexico, Switzerland, Estonia, Latvia, Tajikistan, United Kingdom, Hungary, Croatia, Lithuania, Ukraine, Georgia, Poland, Moldova. For some countries, for instance, the United States, the censuses do not provide infromation on religion. Although, other sociodemographic studies have provided the AJC information on the Jewish demography, as for instance in the countries: South Africa, Mexico, Lithuania, United Kingdom, Chile, Venezuela, Israel, Hungary, Netherlands, Guatemala, Moldova, Sweden, France, Turkey, Argentina and United States [36].

It is important to note that the AJC provides a cross-matching of the different sources of data for the same Jewish population always when feasible, what provides a check on the reliability of the data.

As we have already mentioned in the data description, the total population data comes from the IMF. We use this data along with the AJC data in order to create our proximity channel, the product of the share of Jews in the country pair $i\ j$, JSH_{ij}. A closer look on the monadic data follows:

[36]For the United States, current information was provided by the National Jewish Population Survey and the American Jewish Identity Survey.

Table 5.7: Mean values and median of the variable JSH_i (monadic data)

	Observations	**Mean**	**Std. Dev.**	**Min**	**Max**	**Median**
1951	70	.0163063	.0972918	8.79e-06	.8162518	.0013453
1952	72	.0167620	.1062832	6.89e-06	.9041469	.0013941
1953	71	.0168085	.1073130	6.77e-06	.9064885	.0014178
1954	76	.0153116	.1006274	6.67e-06	.8792067	.0013658
1955	76	.0148763	.0974630	6.57e-06	.8515275	.0009280
1956	76	.0148020	.0973268	1.62e-06	.8503059	.0009036
1957	75	.0146855	.0985630	1.60e-06	.855409	.0008604
1958	70	.0152756	.1043689	8.16e-06	.8751267	.0010100
1959	76	.0150118	.1000505	6.19e-07	.8742632	.0011368
1960	77	.0144498	.0988162	6.08e-07	.8689687	.0010555
1961	77	.0141523	.0971825	3.73e-07	.8545454	.0007930
1962	77	.0139416	.0960317	3.66e-07	.8444396	.0007710
1963	74	.0141892	.0988747	2.87e-07	.8521776	.0007937
1964	78	.0136506	.0976660	2.81e-07	.8641129	.0007425
1965	77	.0137998	.0986647	2.74e-07	.867304	.0006986
1966	77	.0137982	.0992608	2.67e-07	.8724858	.0006765
1967	76	.0137779	.0994817	1.30e-07	.8686551	.0006008
1968	76	.0136351	.0981350	1.27e-07	.8568841	.0005839
1969	76	.0136717	.0987637	2.47e-08	.8623009	.0005675
1970	76	.0136308	.0986880	2.41e-08	.8616287	.0004849
1971	76	.0134450	.0983716	2.35e-08	.8587722	.0004279
1972	76	.0134636	.0981087	2.29e-08	.856492	.0004147
1973	76	.0134616	.0984294	2.24e-08	.8592616	.0004241
1974	74	.0137462	.0997310	3.30e-08	.8591549	.0004187
1975	74	.0134064	.0969983	3.23e-08	.8356164	.0004135
1976	76	.0130885	.0959711	3.18e-08	.83783	.0004241
1977	76	.0129544	.0957970	3.13e-08	.836307	.0004221
1978	77	.0129268	.0963544	3.09e-08	.8466648	.0004107
1979	77	.0127422	.0948677	3.04e-08	.8336043	.0003976
1980	75	.0129392	.0960488	3.00e-08	.8328906	.0003854
1981	78	.0127110	.0959517	2.96e-08	.8485007	.0003051
1982	69	.0140821	.1010704	3.96e-06	.8408555	.0004648
1983	69	.0138582	.0993647	3.87e-06	.8266684	.0004474
1984	67	.0143060	.1019554	2.83e-06	.8358434	.0005055
1985	67	.0140873	.1003149	2.76e-06	.8223982	.0005033
1986	67	.0141917	.1016309	1.80e-06	.8331414	.0004502
1987	67	.0139805	.1000699	1.76e-06	.820345	.0004410
1988	66	.0142216	.1017126	1.72e-06	.8275262	.0004133
1989	66	.0139457	.0995832	1.68e-06	.8102115	.0004063
1990	67	.0137183	.0988885	1.64e-06	.8105893	.0003556
1991	67	.0135094	.0973296	1.60e-06	.7978321	.0003790
1992	77	.0124185	.0929673	1.56e-06	.8171222	.0004975
1993	79	.0122993	.0928278	1.53e-06	.8264407	.0005254
1994	84	.0113922	.0888870	1.49e-06	.8158654	.0004940
1995	87	.0108263	.0863713	9.62e-07	.8066989	.0004399
1996	87	.0107456	.0859414	9.38e-07	.8026568	.0003760
1997	87	.0106827	.0857637	9.14e-07	.8009683	.0003921
1998	87	.0104533	.0840670	7.98e-07	.7850980	.0003825
1999	87	.0104584	.0846017	7.91e-07	.7900521	.0003478
2000	87	.0105674	.0859308	7.85e-07	.8024326	.0003251
2001	74	.0122113	.0924907	7.79e-07	.7966859	.0004037
2002	87	.0104079	.0847981	7.74e-07	.7918373	.0002885
2003	86	.0100516	.0811707	7.69e-07	.7536454	.0003303
2004	85	.0100884	.0810761	7.65e-07	.7483866	.0003744

5.A.2 Jews in Israel - Migration Stock

Figure 5.4: Jewish Population (million) in Israel since the creation of the State (1948)

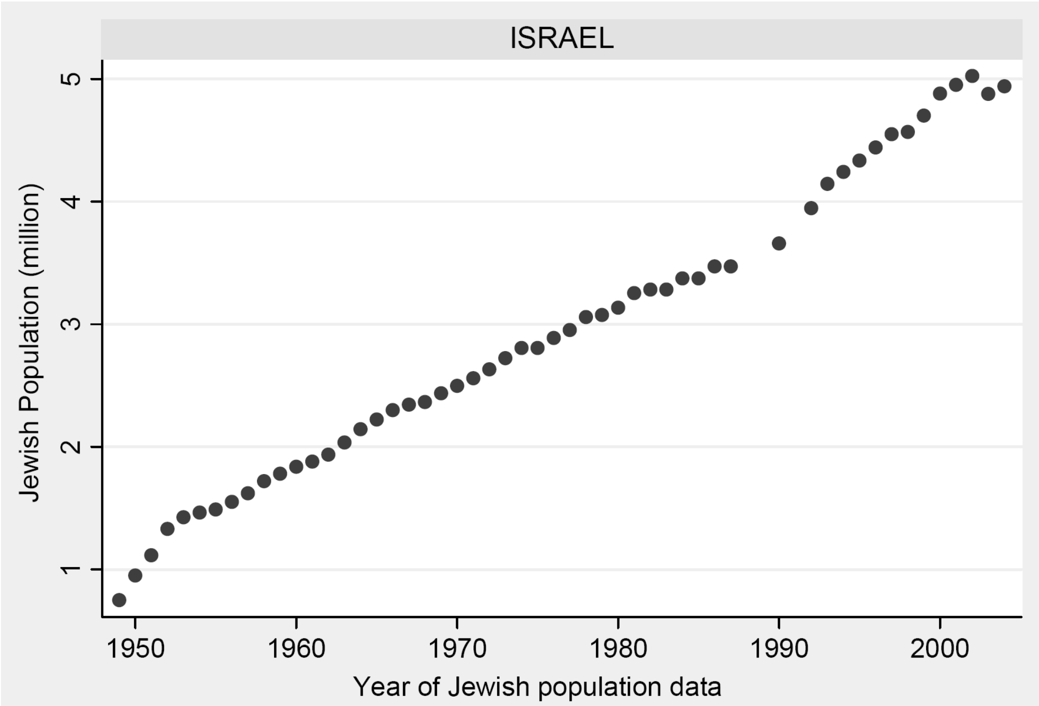


Figure 5.2 shows the increase in the Jewish population after the creation of the State of Israel. The increase in the number of Jews in Israel shown in the figure might be due to migration flows, population growth or Jews converted into Judaism (the dataset refers to the Jewish population in Israel regardless place of birth). We compare the total population in Israel (Jews and non-Jews) to the Jewish population and find that, with exception of the years 2000-2005 (for which the difference is higher), in the other years the increase in the Jewish population growth was appoximately proportional to the total population growth. This can also be confirmed in the column called Max in the table of means, representing Israel (which is the country with the maximum value of the JSH_i); the share of Jews in Israel does not change drastically. Thus, this confirms the litetarure, which argues that most of the Jewish population growth in Israel can be attributed to Jewish migration [37].

[37] The AJC also raises the concern on the decrease of the Jewish population growth due to low birth rates among Jews - they argue that the fertility rate of Jews is lower with respect to other religious groups (AJC (2007)).

5.B Results using OLS and the Tobit model

For the log-linearized OLS with fixed effects it follows:

$$lnc_{ij} = \gamma_i d_i + \gamma_j d_j + \varphi X + \eta_{ij} \tag{5.5}$$

for d_i and d_j the multilateral resistance terms, X the vector of regressors and η_{ij} is the log-linearized error term ϵ_{ij}, $ln\epsilon_{ij}$. We conduct the RESET test proposed by Ramsey (1969) [s. Santos Silva and Tenreyro (2006)] in order to check whether the OLS model is misspecified. In all cases reported in Table 5.8, the p-values of the RESET test are zero, what rejects the hypothesis that the coefficient is zero. The trade creation effect found using OLS at least doubles in comparison to the results using PML (compare OLS results with Table 5.3).

Table 5.8: Results using the OLS model. 5 years averaged data. World Trade

Dependent variable: log c_{ij}	(1)	(2)	(3)	(4)	(5)
JSH_{ij}	303.8***	434.3***	156.9*	19.54	224.3***
	(42.61)	(51.81)	(87.77)	(79.18)	(40.58)
Log $(GDP_i * GDP_j)$	1.438***	3.627***	1.370***	28.27***	1.372***
	(0.0182)	(0.109)	(0.0348)	(4.755)	(0.0213)
Log $(CGDP_i * CGDP_j)$	-0.300***	-2.819***	-0.0761*	-28.62***	0.0406
	(0.0237)	(0.0910)	(0.0457)	(4.805)	(0.0304)
Log distance	-1.857***	0	-1.610***	-1.759***	-1.956***
	(0.0498)	(0)	(0.0985)	(0.101)	(0.0483)
Contiguity	0.0711	0	0.360	0.752**	-0.164
	(0.273)	(0)	(0.479)	(0.377)	(0.243)
Language	1.272***	0	1.041***	1.451***	0.967***
	(0.139)	(0)	(0.252)	(0.223)	(0.129)
Colony	1.318***	0	0.612	-0.0338	1.467***
	(0.305)	(0)	(0.595)	(0.470)	(0.273)
Common colony	1.025***	0	0.202	0.667	1.888***
	(0.246)	(0)	(0.511)	(0.463)	(0.229)
FTA			-0.533***	-0.162	
			(0.174)	(0.231)	
Constant	-36.33***	-115.7***	-38.39***	-1009***	-35.94***
	(0.655)	(3.769)	(1.340)	(177.1)	(0.823)
Fixed effects estimation	*no*	*yes*	*no*	*no*	*no*
Country fixed effects Interacted with year	*no*	*no*	*no*	*no*	*yes*
Importer and exporter Fixed effects interacted with Year (i*year and j*year)	*no*	*no*	*no*	*yes*	*no*
Observations	40590	40590	11045	11045	40590
Number of pairs	6714	6714	1665	1665	6714

The Tobit model for equation (5.2) for a minimum threshold b follows:

$$ln(b+c_{ij}) = [\psi_l n(c_i * y_j) + \varpi JSH_{ij} + \vartheta LANG_{ij} + \gamma CONT_{ij} + \delta FTA_{ij} + \lambda lnD_{ij} + \pi_i + \nu_j + \eta_{ij}, lnb] \quad (5.6)$$

Results using the Tobit model are reported in Table 5.9. We report results with [columns (1) and (2)] and without [columns (3) and (4)] FTA, since data for FTA is missing for some countries and is available only from 1960 on. Clearly, the omission of the multilateral resistance terms overestimates the effect of networks on trade (compare columns (1) and (2)). This is also the case of the OLS model: compare columns (1) and (6) from Table 5.8. P-values of the RESET test are zero, which implies that the Tobit model is misspecified.

5.C A robustness check to Rauch and Trindade (2002)

For the main results of the paper, we have used information on aggregated world trade flows, which has a longer time variation. In this Appendix, we use the NBER-UN data with the Rauch (1999) classification of goods to compare our results to the literature. In a very influential paper, Rauch and Trindade (2002) study the effects of the Chinese networks on trade. They estimate a Tobit model in cross-sections for the years 1980 and 1990 and reveal a trade creation effect of the Chinese networks of at least 60%. As in Rauch and Trindade (2002), we expect that, more than the effect on trade costs, the existence of taste similarity within an ethnic group should lead to a higher effect of networks on differentiated goods in comparison to the effect on homogeneous goods. The empirical specification follows:

$$\begin{aligned} ln(b_m + c_{ijm}) &= [\psi_m ln(c_i * y_j) + \varpi_m JSH_{ij} + \vartheta_m LANG_{ij} + \gamma_m CONT_{ij} \\ &\quad + \delta_m FTA_{ij} + \lambda_m lnD_{ij} + \pi_i + \nu_j + \eta_{ijm}, lnb_m] \end{aligned} \quad (5.7)$$

where $m = w, r, n$:

w represents the homogeneous goods group;

n represents the differentiated goods group;

Table 5.9: Results using the Tobit model. 5 years averaged data. World Trade

Dependent variable: log $b + c_{ij}$	(1)	(2)	(3)	(4)
JSHij	345.4***	296.4***	239.6***	205.2***
	(40.21)	(38.98)	(64.02)	(63.47)
Log $(GDP_i * GDP_j)$	1.426***	1.331***	1.351***	1.411***
	(0.0184)	(0.0238)	(0.0256)	(0.0281)
Log $(CGDP_i * CGDP_j)$	0.279***	0.0948***	-0.0795**	-0.179***
	(0.0244)	(0.0321)	(0.0345)	(0.0353)
Log distance	-1.891***	-1.844***	-1.672***	-1.639***
	(0.0507)	(0.0507)	(0.0716)	(0.0704)
Contiguity	-0.0174	-0.214	0.244	0.273
	(0.277)	(0.248)	(0.348)	(0.341)
Language	1.172***	1.223***	1.299***	1.380***
	(0.137)	(0.131)	(0.182)	(0.179)
Colony	1.350***	1.303***	0.659	0.484
	(0.308)	(0.279)	(0.432)	(0.423)
Common colony	0.785***	1.902***	0.249	0.483
	(0.242)	(0.229)	(0.373)	(0.366)
FTA			-0.825***	-1.042***
			(0.131)	(0.132)
Period dummies	*no*	*yes*	*no*	*yes*
Country fixed effects	*no*	*yes*	*no*	*no*
Constant	-35.78***	-33.00***	-39.64***	-44.62***
	(0.663)	(1.063)	(0.977)	(1.289)
Log-likelihood	-111960.75	-110852.08	-59731.687	-59574.08
Observations	41207	41207	22804	22804
Country pairs	6618	6618	3344	3344

Period dummies were omitted in columns (2) and (4) for simplicity.
Except periods 6 and 10, they are significant at 1% level.

r represents the reference priced goods group.

Since, as already mentioned in section 3.3, the Tobit model is also subject to heteroskedastic errors,[38] we also show results using the PPML suggested by Santos Silva and Tenreyro (2006).

[38] The heteroskedasticity may lead to inconsistent estimators (s. discussion on Santos Silva and Tenreyro (2006) in section 3.6.).

5.C.1 Data and Descriptive statisticss: the Rauch (1999) classification of goods

Table 5.8 presents the summary statistics for the 5 years averaged data pos-1960. We use the NBER-UN yearly bilateral trade data (`www.nber.org/data`), documented by Feenstra, Lipsey, Deng, Ma, and Mo (2005), in order to compare our results to the ones found in Rauch and Trindade (2002). We aggregate the trade data in three groups of commodities according to the Rauch (1999) liberal classification of goods: (i.) w, homogeneous (organized exchange) goods: goods traded in an organized exchange; (ii.) r, reference priced: goods not traded in an organized exchange, but which have some quoted reference price, as industry publications; and (iii.) n differentiated: goods without any quoted price. The NBER-UN trade data gives a more accurate measure of trade flows, since the values are mainly reported by the importing country - which is a better measure due to the differences between c.i.f. and f.o.b. prices (s. Feenstra, Lipsey, Deng, Ma, and Mo (2005)).
Data on GDP for the recent periods is taken from the World Development Indicators WDI/IMF; for the population, we use the IFS/IMF data. Our dummies proxies for information and trade costs come from CEPII - Centre d'Etudes Prospectives et d'Informations Internationales. Finally, data for the existance of FTA (Free Trade Agreement) is taken from the IMF's Direction of Trade Statistics for the years 1960, 1965, 1970,..., 2000 - the same data source used by Baier and Bergstrand (2007). Since in the panel data analysis we take 5 years average of the trade data, i.e. 1966-70, 71-75, ..., 1996-2000, we always include the FTA data from the former period, which means, 1965 for the period 66-70, 1970 for 71-75 and so on.
Table 5.9 presents a simple correlation matrix among the 5 years averaged core variables of the model in the logarithmic form. Even if merely ilustrative, it is interesting to notice that our network channel is positively correlated to the trade variables in the three groups of commodities. GDP, GDP per capita, countries contiguity and existence of a free trade agreement between i and j are positively correlated to trade, as expected. Common language is negatively correlated to the product of GDP's and GDP's per capita. FTA and contiguity are not correlated at 1% significance level to the proximity measure $JSH_i * JSH_j$.

Table 5.10: NBER trade data and regressors, yearly data (1962-2000)

Variable	Obs	Mean	Std.Dev.	Min	Max
Reference priced goods	84.859	90661.73	543301.6	1	3.13e+07
Differentiated goods	96.023	289457.3	2496726	0	1.41e+08
Homogeneous goods	74.231	71267.17	433458.1	1	2.92e+07
Jewish population i	103.149	238277.4	949708.9	20	6115000
Jewish population j	103.149	228620.5	937812.8	20	6115000
Total population i	103.149	5.19 e+07	1.42 e+08	232000	1.27 e+09
Total population j	103.149	4.72 e+07	1.31 e+08	232000	1.27 e+09
JSH_i	103.149	.0190686	.1159091	2.24e-08	.8724858
JSH_j	103.149	.0167838	.1080378	2.24e-08	.8724858
$JSH_i * JSH_j$	103.149	.0000858	.0008809	1.75e-14	.0246964
GDP_i	103.149	4.16 e+11	1.25 e+12	2.33 e+08	1.25 e+13
GDP_j	103.149	4.13 e+11	1.26 e+12	2.33 e+08	1.25 e+13
$CGDP_i$	103.149	11178.1	12871.48	1.160.914	65134.23
$CGDP_j$	103.149	10849.05	12707.47	1.160.914	65134.23

Table 5.11: Correlation matrix at 1% significance level

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Ln (c_{ijR})	1								
2. Ln (c_{ijN})	0.8440*	1							
3. Ln (c_{ijW})	0.5913*	0.5321*	1						
4. $JSH_i * JSH_j$	0.0180*	0.0246*	0.0196*	1					
5. FTA	0.3139*	0.3109*	0.2720*	-0.0194	1				
6. Ln ($GDP_i * GDP_j$)	0.7403*	0.7639*	0.6322*	0.0142	0.2308*	1			
7. Ln ($CGDP_i * CGDP_j$)	0.5233*	0.6088*	0.4156*	0.1513*	0.3374*	0.6003*	1		
8. Contiguity	0.1733*	0.1581*	0.1596*	-0.0138	0.1917*	0.0296*	-0.0089	1	
9. Language	-0.0062	0.0043	0.0374*	0.0679*	0.0026	-0.1596*	-0.1212*	0.1478*	1

5.C.2 Results using the Rauch (1999) classification of goods: cross-section and panel data

First we show the results with the Tobit model used by Rauch and Trindade (2002) for the cross-sections 1970, 1980, and 1990. We use a micro founded gravity equation and control for multilateral resistance terms, omitted in the Rauch and Trindade (2002) gravity equation - many of our results that are not significant at 10% level turn to significant if we omit the multilateral resistance terms (P_i P_j), which reinforces the discussion from Anderson and van Wincoop (2003) on the bias caused by the omission of these terms. Table 5.10, 5.11 and 5.12 show the results for three cross sections using the proximity channel JSH_{ij}. The cross-section years, the data sources, and the classification of goods are the same used in Rauch and Trindade (2002).

The hypothesis raised for the three groups of goods was that the proximity channel JSH_{ij} would have a higher effect on trade for the group of differentiated goods, followed by the reference priced goods. Effects on the group of homogeneous goods would be smaller.

Surprisingly, in these cross-sections presented, the greater effect on the groups of differentiated goods can not be confirmed: except for the year 1970, we do not find significant results for this group once we add the FTA dummy. Even though the variable FTA is not significant in half of the cases, once we add it to control for the existence of free trade agreements, the effect of the JSH_{ij} on trade vanishes in some cases which were significant before. Again, results are more frequently significant (but misspecified) if we do not include the importer and exporter fixed effects. Once we add these controls and add the FTA dummy, there is no effect of JSH_{ij} on trade in most of the cases for the cross-sections shown [39]. Thus, results with these cross-sections are inconclusive in what refers to JSH_{ij}.

Concerning the other regressors, most of them confirm the expected signs: language and distance are always, respectively, positive and negative, significant and assume the elasticities expected in the trade literature; $GDP_i * GDP_j$, as the measure of the mass of both countries, is, with only one exception, positive and significant. $CGDP_i * CGDP_j$ is surprisingly not significant in most of the cases; although, given the importance of low income

[39] We also check these same results for the cross sections 1962 (first year of our dataset), for which we find significant results if we do not control for multilateral resistance terms. We also check for the cross section 2000, for which there is no effect. As we will see later on, and what is by now only speculation, it seems that the effect of Jews on trade is higher in the first two decades, what is stronger if we keep only observations for trade with Israel.

countries on trade flows (specially in homogeneous goods), it becomes difficult to see a pattern for the GDP per capita - interestingly, $CGDP_i * CGDP_j$ is usually significant and positive in the cases of differentiated goods, what is intuitive: countries with higher GDP per capita trade more in differentiated goods.

Table 5.12: Tobit model for 1970. Anderson and van Wincoop (2003) equation.

	Homogeneous		Refer. Priced		Differentiated	
JSH_{ij}	116.1***	105.8*	42.34	33.15	74.24**	79.58**
	(40.25)	(55.72)	(31.67)	(41.30)	(30.19)	(39.09)
Log $(GDP_i * GDP_j)$	1.108***	0.910***	1.125***	0.722***	1.184***	1.129***
	(0.115)	(0.0981)	(0.0815)	(0.0927)	(0.0580)	(0.0777)
Log $(CGDP_i * CGDP_j)$	0.0917	0.191	-0.0970	0.142	0.271***	0.631***
	(0.125)	(0.137)	(0.117)	(0.0872)	(0.0814)	(0.116)
Log Distance	-1.080***	-0.931***	-1.143***	-1.085***	-1.104***	-1.093***
	(0.0661)	(0.0795)	(0.0517)	(0.0614)	(0.0470)	(0.0557)
Contiguity	0.0153	0.0258	0.331*	0.212	0.494***	0.447**
	(0.237)	(0.265)	(0.194)	(0.213)	(0.181)	(0.198)
Language	0.660***	0.757***	0.869***	1.039***	0.940***	0.946***
	(0.150)	(0.175)	(0.114)	(0.131)	(0.102)	(0.118)
Colony	0.605***	0.380	0.710***	0.327	0.817***	0.764***
	(0.231)	(0.311)	(0.191)	(0.252)	(0.180)	(0.237)
Common Colony	0.279		0.765***		0.286	
	(0.320)		(0.239)		(0.212)	
FTA		0.805***		0.753***		0.494**
		(0.309)		(0.252)		(0.240)
Constant	-43.11***	-34.65***	-39.31***	-25.32***	-48.26***	-50.06***
	(5.471)	(5.008)	(3.560)	(4.143)	(2.949)	(3.181)
Importer fixed effects	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Exporter fixed effects	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Observations	1978	1549	2219	1731	2528	1960

Table 5.13: Tobit model for 1980. Anderson and van Wincoop (2003) equation.

	Homogeneous		Refer. Priced		Differentiated	
JSH_{ij}	65.74	42.37	68.39*	55.01	28.04	-10.48
	(48.09)	(94.21)	(40.77)	(68.70)	(37.95)	(68.71)
Log $(GDP_i * GDP_j)$	1.022***	1.208***	0.946***	0.863***	0.992***	1.296***
	(0.0870)	(0.222)	(0.0926)	(0.269)	(0.0568)	(0.289)
Log $(CGDP_i * CGDP_j)$	-0.187	-0.0961	-0.229*	0.290	0.0729	-1.216**
	(0.125)	(0.386)	(0.126)	(0.548)	(0.0864)	(0.567)
Log Distance	-1.258***	-1.113***	-1.487***	-1.438***	-1.328***	-1.360***
	(0.0658)	(0.111)	(0.0524)	(0.0818)	(0.0460)	(0.0793)
Contiguity	0.285	0.629*	0.240	0.265	0.196	-0.178
	(0.237)	(0.355)	(0.203)	(0.263)	(0.187)	(0.272)
Language	0.292*	0.471*	0.549***	0.551***	0.863***	0.883***
	(0.152)	(0.251)	(0.120)	(0.174)	(0.103)	(0.172)
Colony	0.539**	0.170	0.274	0.172	0.614***	0.421
	(0.256)	(0.422)	(0.221)	(0.307)	(0.206)	(0.318)
Common Colony	0.0993		0.525**		-0.356	
	(0.339)		(0.258)		(0.221)	
FTA		-0.0711		0.376		0.169
		(0.725)		(0.552)		(0.588)
Constant	-29.27***	-43.77***	-22.49***	-27.84***	-31.18***	-25.76***
	(3.916)	(6.274)	(3.848)	(5.892)	(2.627)	(6.771)
Importer fixed effects	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Exporter fixed effects	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Log-likelihood	-3874.69	-3170.31	-4275.30	-3301.86	-4795.15	-3591.34
Observations	1957	799	2329	936	2690	1021

Table 5.14: Tobit model for 1990. Anderson and van Wincoop (2003) equation.

	Homogeneous		Refer. Priced		Differentiated	
JSH_{ij}	97.62**	89.43	100.4***	131.1**	30.64	2.569
	(47.65)	(77.77)	(33.64)	(53.42)	(35.33)	(56.19)
Log $(GDP_i * GDP_j)$	0.268***	-0.0105	0.738***	0.877***	0.994***	1.077***
	(0.0763)	(0.106)	(0.0482)	(0.0519)	(0.106)	(0.0663)
Log $(CGDP_i * CGDP_j)$	0.447***	-0.222**	-0.0545	-0.0440	0.262***	0.258***
	(0.0978)	(0.105)	(0.0650)	(0.0618)	(0.0988)	(0.0625)
Log Distance	-1.096***	-0.993***	-1.185***	-1.121***	-1.012***	-1.000***
	(0.0596)	(0.0748)	(0.0395)	(0.0489)	(0.0408)	(0.0515)
Contiguity	0.209	0.227	0.398***	0.452***	0.646***	0.673***
	(0.202)	(0.223)	(0.140)	(0.149)	(0.148)	(0.162)
Language	0.324***	0.259*	0.516***	0.529***	0.788***	0.753***
	(0.125)	(0.145)	(0.0855)	(0.0957)	(0.0877)	(0.102)
Colony	0.351*	0.373	0.236*	0.0732	0.314**	0.173
	(0.194)	(0.270)	(0.134)	(0.178)	(0.142)	(0.194)
Common Colony	0.175		0.294		-0.238	
	(0.364)		(0.251)		(0.267)	
FTA		0.457**		0.418***		0.0415
		(0.190)		(0.126)		(0.135)
Constant	-0.580	18.87***	-17.36***	-27.92***	-38.92***	-42.09***
	(3.511)	(4.603)	(2.231)	(2.336)	(4.705)	(3.400)
Importer fixed effects	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Exporter fixed effects	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Log-likelihood	-2797.99	-2286.30	-2514.56	-1997.35	-2874.95	-2305.68
Observations	1609	1301	1797	1444	1957	1559

Even though we do not find satisfactory results for these cross sections, we look at a broader picture: the NBER-UN trade data with the Rauch (1999) classification of goods is available since 1962, allowing a rich panel data analysis.

Moreover, we are aware of the consistency, not only efficiency, problems in the Tobit model. Thus, we estimate the effects using PML. Table 5.13 shows a positive and significant at 1% level results for the group of differentiated and reference priced goods. Although, we find negative and significant results for trade in homogeneous goods - which goes against the hypothesis of trade creation effects of Jews (results are also negative using other controls not added in Table 5.13). Period dummies are always significant and distance, GDP and language have the expected signs. [40]. In the case of contiguity, results are significant but the sign is the opposite of what is expected - in this result, contiguos countries trade less. Language has the highest elasticity for trade in differentiated goods and the lowest elasticity for trade in homogeneous goods, which is in line with the argument that language skills lower information costs and facilitate matching among buyers.

An important concern with the interpretation of the results using the Rauch (1999) classification of goods refers to the elasticity of substitution σ: there is no clear interpretation of the coefficients in JSH for the different types of goods, for $(\sigma - 1) * JSH_{ij}$ the effect estimated. The coefficient would be smaller for differentiated goods, once these have a low degree of substitutability in comparison to homogenegous goods. Thus, unless one sets values for the elasticity of substitution, which is not the case in Rauch and Trindade (2002), it is hard to interpret the results for the different types of goods. In this case, the analysis should be conducted for total world trade.

As a last argument, the classification between differentiated vs. homogeneous goods might be stronger for the case of the Chinese population in Rauch and Trindade (2002), comparing to the case of Jews. In the case of the Jewish population, it is not as clear that the effect on differentiated goods should be higher, since this is a religious and cultural network, and not a migration group. Thus, it is more intuitive to study total trade flows, regardless the type of good: following the argument that Jews are known for working in

[40] We performed the same results using the log-linearized equation (5.5). In this case, results are significant only for homogeneous goods (the opposite of what we found using the PML). Although, under heteroskedasticity, the log-linearization violates the consistency of the OLS estimator. We use the RESET test to check whether log-linearized model estimated with OLS was misspecified and we reject the Ho hypothesis that the additional regressor included was not significant. Thus, OLS is misspecified and we opt out this specification.

activities related to international exchange and for building and keeping strong networks, which also reflects in business networks, we might expect that the effects of this group on trade can be better explained with total trade flows. Although, if we instead use the ”percentage of the total number of observations” to divide the sample, following the percentage of total observations in each group in Rauch and Trindade (2002), we find very similar ”trade creation effects” to what they have found (this selection according to the percentage of observations would give us, approximately, a sample of 164 observations in the group $JSHLarge_{ij}$). Moreover, Rauch and Trindade (2002) use only 59 countries in their full sample, while we use 110 countries. Thus, the high values for trade creation found in their estimations might be due to sample selection. Finally, the top five countries in their sample are, respectively, Taiwan, Hong-Kong, China, Singapure and Malasia; those countries might drive their results.

5.D The Novy (2008) model

5.D.1 The Novy (2008) gravity model

In Novy (2008), trade flows are decomposed into tradable and non-tradable goods. Country i comprises the consumer range $[n_{i-1}, n_i]$ and firms in country i optimize in this range. The continuum $[0, 1]$ comprise all consumers and goods. $[n_{i-1}, n_{i-1} + \theta(n_i - n_{i-1})]$ is the range of tradable goods and $[n_{i-1} + \theta(n_i - n_{i-1}), n_i]$ of nontradable goods. θ is the exogenously given fraction of tradable goods. Consumption in country i follows:

$$c_i = \left[\sum_{k=1}^{I} \int_{n_{k-1}}^{n_{k-1}+\theta_k(n_k-n_{k-1})} \left(c_{im}^{\frac{\sigma-1}{\sigma}}\right) dm + \int_{n_{i-1}+\theta(n_i-n_{i-1})}^{n_i} \left(c_{im}^{\frac{\sigma-1}{\sigma}}\right) dm\right]^{\frac{\sigma}{\sigma-1}} \tag{5.8}$$

c_{im} denotes consumption of good m in country i. Note that c_i is total consumption in country i from all countries $j \neq i$ including goods produced and consumed in country i, as was assumed in c_i in equation (5.1). Thus, we can write c_{ij} from equation (5.1), for $i \neq j$, as: $\int_{n_{j-1}}^{n_{j-1}+\theta_j(n_j-n_{j-1})} \left(c_{im}^{\frac{\sigma-1}{\sigma}}\right) dm$, where θ_j is the share of tradable goods in county j - in equation (5.1) it is assumed that $\theta_j = 1$.

Prices are denoted as $p_{ij}^T = (1 + \tau_{ij})p_j$ for tradable goods and $p_{ij}^{NT} = p_j$ for non-tradable goods, i.e., the c.i.f. (cost, insurance and fright) price is $(1 + \tau_{ij})$ times the f.o.b. (free on board) price. Optimal firms' behavior implies that $p_{im}^T = p_{im}^{NT} = \frac{\sigma}{\sigma-1} = lw_i = p_i$. Thus,

Table 5.15: Panel using Gamma-PML for JSH_{ij}, NBER-UN Data. Period 1965-2000 (five years average)

Dep. Variable: c_{ij}	Org.		Reg.		Dif.	
JSH_{ij}	-127.6***	-626.6***	12.12***	99.13***	102.2***	124.6***
	(0.170)	(1.084)	(0.252)	(0.968)	(0.131)	(0.759)
Log $(GDP_i * GDP_j)$	1.077***	1.513***	1.560***	0.812***	2.510***	0.261***
	(0.000260)	(0.000949)	(0.000306)	(0.000721)	(0.000185)	(0.000184)
Log $(CGDP_i * CGDP_j)$	-0.547***		-0.947***		-1.753***	
	(0.000311)		(0.000355)		(0.000217)	
Log distance	-0.453***		-1.472***		-1.629***	
	(0.0286)		(0.0328)		(0.0520)	
Contiguity	0.0963		-1.511***		-4.411***	
	(0.161)		(0.177)		(0.303)	
Language	0.575***		0.916***		1.336***	
	(0.0803)		(0.0840)		(0.140)	
Colony	0.141		-0.592***		-2.559***	
	(0.172)		(0.182)		(0.302)	
FTA		0.324***		0.326***		0.650***
		(0.000491)		(0.000292)		(0.000344)
Constant	-30.95***		-39.03***		-65.55***	
	(0.249)		(0.283)		(0.445)	
Country fixed effects interacted with year	yes	no	yes	no	yes	no
Period dummies (P)	no	yes	no	yes	no	yes
Fixed effects estimation	no	yes	no	yes	no	yes
Observations	17936	6276	19698	7055	21679	7530
Number of pairs	4463	1261	4776	1325	5129	1407

the mill price of a variety produced in region i is identical for all varieties.

In equation (5.1) we write trade flows in terms of consumption c_{ij}. In terms of exports from i to j (x_{ij}), we can write c_{ji} (consumption in j from goods produced in i) as $c_{ji} = (1+\tau_{ij})x_{ij}$, i.e., the difference between c.i.f. and f.o.b. prices [41].

Assuming symmetry among tradable goods produced in county-j over the range $\theta_j(n_j - n_{j-1})$, consumption in country i of goods produced in country j yields, for a country pair $i \neq j$: $x_{ij} = \theta_j(n_j - n_{j-1})q^T_{ji}$, where q^T_{ji} is the range of tradable goods produced in country j for county i such that: $q^T_j = \sum_{k=1}^J q^T_{jk}$ (tradable output for each country k).

Firms produce a differentiated good m with output q^T_{im} for tradable goods and q^{NT}_{im} for non-tradable goods. $q^T_{im} = \sum_{j=1}^I q^T_{ijm}$ for all tradable goods. Equilibrium conditions imply that $q_j = \theta_j q^T_j + (1-\theta_j)q^{NT}_j$ and $q^{NT}_j = q^{NT}_{ii} = q^T_{ii}$, where q_{ii} is total output produced and consumed in country i. Country i GDP is $y_i = (n_i - n_{i-1})q_i$ and the number of consumers in country i is given by $pop_i = q_i(n_i - n_{i-1})$.

Intra-country total output yields: $(n_i - n_{i-1})q^T_{ii} = (n_i - n_{i-1})q_i - \theta_i(n_i - n_{i-1})\sum_{k\neq i} q^T_{ik} = y_i - x_i$, where $x_i = \sum_{k\neq i} x_{i,k}$ is the sum of goods produced in country i and exported to $k \neq i$. Thus, the equilibrium solution of the model, imposing trade cost symmetry $\tau_{ij} = \tau_{ji}$ gives rise to the following gravity equation:

$$x_{ij}x_{ji} = \theta_i(y_i - x_i)\theta_j(y_j - x_j)(1+\tau_{ij})^{2-2\sigma} \tag{5.9}$$

This specification has some advantages for panel data analysis: instead of measuring multilateral resistance terms using theoretical constructs P_i and P_j as in Anderson and van Wincoop (2003), Novy (2008) uses the tractable measure $y_i - x_i$ to control for multilateral resistance terms, which is captured directly from the data [42]. Moreover, in the Novy (2008) model the assumption that all goods are tradable can be relaxed.

As before, the Jewish population share in both countries enters our model as a part of information costs, such that $INFO_{ij} = e^{\bar{\vartheta}(1-LANG_{ij})}I(JSH_{ij})$. The information costs $I(JSH_{ij})$ decrease the greater the magnitude of the network, i.e., the higher the dyadic share of Jews in the country pair.

[41] The choice to write equation (5.1) in terms of consumption c_{ij} was due to data concerns: we use equation (5.1) to estimate trade flows using the NBER-UN yearly bilateral trade data, for which most of the values are reported by the importing country (s. Feenstra, Lipsey, Deng, Ma, and Mo (2005)). In the Novy (2008) model, although, we represent it in terms of exports instead of imports. The reason is the measure $(y_i - x_i)$ in equation (5.1), which must be represented in terms of exports.

[42] Imagine exports of country i with other countries but j increase, then x_i increases and, ceteris paribus, $x_{ij}x_{ji}$ must decrease. In this cenario, trade costs from i with countries $k \neq j$ must have decreased: this implies that it is *relatively* more costly to trade with country j.

The interpretation of equation (5.9)) using the $I(JSH_{ij})$ follows. A decrease in information costs $I(JSH_{ij})$ between countries i and $k \neq j$ causes an increase in trade between i and k. It is relatively less costly to trade with country k than with country j; thus, $x_{ij}x_{ji}$ must decrease.

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Eidesstattliche Erklärung

Hiermit erkläre ich, die vorliegende Dissertation selbständig angefertigt und mich keiner anderen als der in ihr angegebenen Hilfsmittel bedient zu haben. Insbesondere sind sämtliche Zitate aus anderen Quellen als solche gekennzeichnet und mit Quellenangaben versehen.

Mannheim, 02.07.2012

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