Prices and Quality in International Trade

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Prices and Quality in International Trade

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Que serais-je sans toi?

Contents

General Introduction

A The times they are a-changin' [1]

What is fascinating in international economics is how fast paradigms change. Many old facts turn out to be at odds with new evidence. Some models are challenged, and become quickly obsolete. This permanent metamorphosis of facts and ideas is a great source of research and debate. It contributes to fuel our understanding of how, where, and why our societies produce and trade, and how this impacts on other human activities.

Of course, changes in the international economic environment raise many questions. The present thesis addresses four important ones. Along with real world mutations, the field of international economics has experienced many changes in the last three decades. Advancement in views, models, and tools are also reviewed. While the thesis raises four questions, they are all tackled from the same perspective. The last paragraph of this section presents the approach that has been used in the different chapters.

The international economy (our world) is changing. The most striking change of the last two decades for all (trade) economists is probably the rise of China. The spec-

[1] *As the present now // Will later be past // The order is // Rapidly fadin' // And the first one now // Will later be last // For the times they are a-changin'.* Bob Dylan

tacular economic performances of China raise concerns among the public who fear for their jobs and wages.[2] A question often asked of trade economists is how its emergence and that of other low-wage countries has affected manufacturing industries in developed economies. Unquestionably, employment in manufacturing industry has plummeted in almost all developed countries since 1980. The last consensus on the question is that the competition presented by low-wage countries (along with technical change) has contributed to this decline.[3] Surprisingly, however, in those stricken industries, some firms perform very well. A good example is the French fashion industry. On the one hand, most firms in this industry have been subjected to low-wage countries competition, and their economic performances have sharply declined. On the other hand, the sales of luxury big names have rocketed in the last two decades. The third chapter of this thesis considers this asymmetrical impact of competition from low-wages countries on firms in developed economies.

European consumers and firms experienced an important change at the end of the second millennium: the creation of the Euro. The launch of the single currency in 1999 must be seen as "the world's largest economic policy experiment" (Baldwin, 2006). A question often asked is whether the introduction of the Euro has led to price rises in Europe. Another concern that directly calls out to trade economists is whether the Euro affects the competitiveness of European firms. However, the main objective of the single currency was to deepen the economic integration of EU countries. The second chapter of the thesis tries to evaluate this "policy experiment" and calls into question the success of the Euro in enhancing European economic integration.

[2]In 2010, China overtook Japan as the second largest economy. From 1980, its GDP grew 18-fold. China is also the largest global exporter and the second largest importer. See Feenstra and Wei (2010) for an extensive study of the integration of China in the global economy.

[3]See Sachs and Shatz (1994) or Bernard et al. (2006).

Some changes are more subtle, more painless, and they appear in the eyes of the world in some rare events. The international fragmentation of production chains is one of those. Too few studies exist on the question, but all point to the increasing importance of the fragmentation of production across countries.[4] These vertical linkages have important implications not only to explain the patterns of international trade, but also to understand the international transmission of shocks.[5] The halt of production chains in Europe and the US after the 2011 earthquake in Japan is a visible consequence of this new organization of production.

One question raised by monetary policymakers is whether the increasing dependency of nations on foreign inputs has affected inflation in the US, Japan, and Europe. The fourth chapter of the thesis examines the impact that imported inputs have on the dynamic of domestic prices.

It is fair to argue that some aspects of the international economic environment have not changed. For instance, the effect of distance on shaping trade flows has remained incredibly strong over time.[6] Interestingly, this was expected to change. The facilitation of travel, the lower costs of flying and shipping, and the improvement of transport infrastructures should all have contributed to lessen the impact of distance. There are thousands of studies reporting that distance is a strong impediment to trade flows across countries and the participation of firms in foreign markets. It is also a strong impediment to migration, cross-border investments, and financial flows. A particular aspect that has not been analyzed yet - and which matters to consumers - is how distance impacts on firms' pricing decision. It is what the first chapter intends to

[4] Hummels et al. (2001) are among the first to describe what they call the "dramatic changes [that occur] in the nature of international trade". They show that in 1990, 20% of total trade involved the export of goods using imported inputs. This share increased by 30% between 1970 and 1990.

[5] See Burstein et al. (2008) for instance.

[6] See Disdier and Head (2008) for a meta-analysis demonstrating the strong and persistent effect of distance on trade flows over time.

examine.

International economics is changing. Along with real-world mutations, international economics as a field is also changing. Changes in our views, in our understanding, and in our modeling of international trade are driven by three main factors: i) new empirical facts, ii) the developments of new tools in other fields of economics, iii) technological changes.

Our understanding of international trade has changed much these last 40 years. First year students used to be taught that countries traded because they were different. Then, one taught that similar countries traded because consumers enjoyed both domestic and foreign varieties of the same product. Now, one teaches that it is not countries but firms that trade, and that though those firms are very different, they trade similar goods. And it seems that the later phrase "firms trade similar goods" is turning into "firms trade goods of different quality".

The main change in the field was initiated by Paul Krugman and others in the late 1970s. At the time a new facts puzzled those researchers. Namely, Balassa (1966) and Grubel and Lloyd (1971) were pointing out that countries traded similar types of products which was at odds with standard trade theory's predictions.[7] The talent of the 2008 Nobel prize winner and the development of models encompassing increasing returns to scale in Industrial Organization, have allowed trade economists to build new models consistent with the newly established patterns of trade.[8]

A second change in the field occurred in the late 1990s. As noted by Bernard et al. (2011), the focus has shifted from industries and countries to firms and products.

[7]Indeed, Ricardian and HOS models predict inter-industry trade, namely countries specialize in different industries and trade those different products.

[8]See Krugman's Nobel Prize speech for an important review of the process of changes that happened during this period *www.nobelprize.org/nobel_prizes/economics/laureates/2008/krugman_lecture.pdf*.

This has first been made possible by the novel availability of a set of data providing information on trade at the product- and firm-level, as well as the development of computing facilities that allowed researchers to exploit those data.

Microdata have provided new insights into firm heterogeneity in terms of size, productivity, or export participation.[9] The main evidence from these data has been that only a few firms serve both domestic and foreign markets, and that they are disproportionably larger, more productive, and richer than non exporters. In the meantime, other fields such as macroeconomics introduced firm heterogeneity in their models.[10] From these new facts, building on new theoretical frameworks in closed economy, Melitz (2003) has proposed a model with firm heterogeneity and selection of firms on the domestic and foreign markets consistent with the data. This model offers a great framework to think of reallocation of resources within industry in an open economy context. It has been extensively used this last 10 years.

Another piece of empirical evidence that renew our views of international trade have been based on product-level data.[11] A careful examination of these data by several researchers confirmed that countries trade similar type of goods, and this evidence provided new insights. First, while it was thought that similar trade occurred between developed countries, it appears that both developed and developing countries trade similar goods. The most striking example is China whose basket of exported products to the US is more than 90% similar to the basket of products exported by Germany to the US. As emphasized in the next section, data also revealed that while Germany and China exported similar goods to the US, they produced very different quality of these

[9] See Bernard et al. (2011) for a review.

[10] A striking example is Hopenhayn (1992) who has sketched a model in closed economy featuring firm heterogeneity, love for variety and increasing returns to scale. All these ingredients were used ten years latter by Marc Melitz in an open economy framework.

[11] This was not firm-level data, but product-level data, that for the most precise ones, reported the bilateral trade of countries, classified in about 5,000 product categories.

goods.[12]

New insight on international economics from prices and quality Most of the empirical papers on international trade have focused on the value and quantity of trade flows. Two limits arise from this approach. First, most models share similar predictions about the patterns of the value and quantity of trade flows. It is thus difficult to discriminate among them by looking at value and volume only. Second, focusing on value and quantity makes it difficult to comprehend quality, which seems to be an important dimension of international trade.

In the 1990s, several international trade researchers started studying trade prices. In fact, data on prices are very scarce. Instead, they have used unit values (ratio of value over quantity) on bilateral exports. This type of data is highly detailed, sorting trade flows in 5,000 to 10,000 product categories depending on classifications. Nevertheless, unit values are not prices. They better reflect average prices. Using product-level unit values, researchers have established a set of facts that has questioned existing models, and emphasized the crucial role quality plays in world trade. The first set of evidence has been mentioned above: countries trade similar kinds of products, but charge very different prices for these products.[13] This questions the view in the 1980s and 1990s that countries trade similar products, and rather suggests that countries are vertically specialized and trade similar type of products of different quality. The second set of evidence deals with the impact of distance on average prices. Traditional models predict that only highly productive (low-costs) firms should be able to export to remote markets. The data show the opposite, suggesting that it is not the low-cost firms that select in difficult markets, but the high-quality ones.[14]

[12] All these fact can be found in Schott (2004), and Fontagné et al. (2008).
[13] See Schott (2004), and Fontagné et al. (2008).
[14] See Hummels and Skiba (2004) and Baldwin and Harrigan (2011).

Micro-prices have also allowed researchers to measure aggregate outcome such as the degree of economic integrations of countries. In particular, looking at price deviations of a given product across countries has shed light on the effect of borders, exchange rates, and language on economic integration.[15]

Lastly, the study of exchange rate pass-through (ERPT herein) is probably the branch of international economics that has used the most extensively price data. Until very recently, most research papers either used highly precise price data for narrow industries, or they used more exhaustive dataset, but with product-level unit values.[16] More recently authors have used firm-level data set or even dataset of true (not average) prices with a large coverage to study ERPT.[17] An interesting development in this literature has been to use firm-level data to stress the heterogeneity in ERPT behavior across firms and to show its aggregate implication (Berman et al., 2011).

The option adopted in this thesis is to use information on prices to shed light on the four questions presented above; namely, the effect of distance on firms' pricing policy, the impact of the Euro on European economic integration, the consequences of low-wage countries competition on firms in developed nations, and the effect of imported inputs on domestic inflation.

The empirical analysis makes use of detailed firm-level data for France. The heterogeneity of firms' reaction is carefully examined. Furthermore, from the use of micro-data, an attempt is made to provide economic context to the results and to give insights into their macro implications.

In the different chapters of the thesis, we go back and forth between theory and empirics. Actually, the empirical analysis is always guided by the most recent theoretical frame-

[15] See Taylor and Taylor (2004) for a survey.

[16] See for instance Goldberg and Knetter (1997) for a review.

[17] See for instance Berman et al. (2011) for the firm-level data and Gopinath and Rigobon (2008) for the true price data.

works. Furthermore, the empirical results are compared to theoretical predictions, which allow us to discriminate among models and to provide direction for future theoretical modeling.

B Thesis' questions, conclusions, and contributions

I present the main questions raised in this thesis and the conclusions that can be drawn from this work. I then develop four dimensions through which my thesis contributes to the existing literature.

There are four main questions treated in this thesis.

1. Distance has been shown to have a strong impact on economic outcomes, and particularly on trade flows and the participation of firms in export markets. One dimension that has been left unexplored empirically is how distance impacts on trade prices at the firm-level. In Chapter 1, I ask how distance impacts on the pricing policy of exporting firms.

2. The introduction of the single currency in Europe has meant a major change for consumers and firms. The debate about the economic impact of the single currency remains. In chapter 2, jointly written with Isabelle Méjean (Ecole Polytechnique), we investigate whether the Euro has enhanced European economic integration.

3. The rise of China and other low-wage countries raises a number of concerns in developed countries. In chapter 3, jointly written with Isabelle Méjean (Ecole Polytechnique), we examine the impact of low-wage countries competition on the quality content of French exports.

4. The fragmentation of production chains, and the intensive use of imported intermediate inputs suggests strong linkages between countries. These linkages are likely to enhance the international transmission of shocks. In Chapter 4, I examine how firms adjust their domestic prices to changes in the price of their imported inputs.

The main conclusions of the thesis are as follows.

1. Firms charge higher net of transport costs prices on exports to more distant countries. A large part of the price premium paid by distant consumers is thus due to firms charging higher net of transport costs price, while the rest is due to higher transport fees. The positive impact of distance on prices may be rationalized in models using additive transport costs rather than iceberg ones.

2. The Euro has reduced the dispersion of firms' prices in the European Monetary Union. This is particularly true for large firms, which strengthens the aggregate impact of the single currency. Therefore, one can argue that the creation of the Euro has enhanced European economic integration.

3. Over the period 1995-2005, the quality content of French exports jumped by 11% through a reallocation of sales from low- to high- quality firms. This reallocation has been driven by the increasing competitive pressures of low-wage countries.

4. Firms increase their prices by 1,2% after a 10% increase in the price of their imported inputs. The sensitivity of domestic prices to foreign input prices crucially depends on the proportion of imported inputs used in the production process. Changes in the price of inputs imported through a related party have almost no effects on domestic prices. Imported inputs explain on average 9% of the sectoral

volatility of domestic prices.

The first contribution of the thesis concerns the pricing strategy of exporting and importing firms. Chapters 1, 2, and 4 provide new insights into how and why firms react to changes in transport costs, to the adoption of a common currency, or to changes in the price of their inputs.

The literature that considers the impact of distance on prices usually uses product-level unit values. They interpret the positive impact of distance on unit values as evidence that the proportion of high-quality / high-price firms in total exports was increasing with distance (Hummels and Skiba, 2004; Baldwin and Harrigan, 2011). In the first chapter, I have shown that not only high-price firms export to more distance countries, but also that those firms charge higher prices to more distant countries. Strikingly, in parallel works, Bastos and Silva (2010), Manova and Zhang (forthcoming) and Gorg et al. (2010) have found a similar pattern studying unit values from firm-level Portuguese, Chinese, and Hungarian data respectively. have found a similar pattern studying unit values from firm-level Portuguese, Chinese, and Hungarian data respectively. The first chapter, however, departs from the previous three studies by providing insights into the economic significance of this finding, and the theoretical mechanisms that can explain this finding. In particular, it argues that the finding is consistent with firms charging higher markup (reverse dumping see Greenhut et al. (1985) for instance) or selling higher quality goods in more distant markets (consider, for instance, the Alchian and Allen [1964] effect). This can be rationalized in models with additive rather than iceberg transport costs.

Few studies have investigated how firms have reacted to the creation of the Euro. A famous paper by Hobijn et al. (2006) has shown that because of "menu costs", all restaurants have increased their prices following the introduction of the single cur-

rency. A few papers are able to identify the producing firms, and to test how EMU has affected their pricing policies. These studies focus on very specific products; the European automobile market in Goldberg and Verboven (2001) and Gil-Pareja and Sosvilla-Rivero (2008) and electronic products sold online in Baye et al. (2006). These studies find contrasting results for the price impact of the Euro. Our contribution is to provide a more global view of the impact of the Euro on firms' price discrimination. Furthermore, we aim to demonstrate for the first time that the effect has been felt heterogeneously across firms. In this respect, our work is related to Berman et al. (2011) who show that firms react differently to changes in exchange rates.

The last chapter contributes to the literature on price dynamics at the firm level by pointing out the impact of imported inputs on domestic prices. This is related to Fougere et al. (2010), who look at the impact of changes in the minimum wage on restaurant prices. It is also closely linked to Nakamura and Zerom (2010) and Goldberg and Hellerstein (2007), who structurally estimate the determinants of incomplete pass-through in the coffee and beer industries. The contribution with respect to these papers is to study the impact on the domestic prices of firm-specific imported cost-shocks, for a wide range of industries. Furthermore, the data allow for intra-firm prices to be disentangled from arm-length transactions, which cannot be done in other studies.

The second contribution of this thesis is to emphasize the importance of firm heterogeneity in shaping aggregate economic outcomes. A relatively recent albeit burgeoning literature stresses how micro heterogeneity may shape macro outcomes. Gabaix (2011) is a corner stone of this literature. His paper shows that idiosyncratic shocks to firms may have aggregate consequences if the distribution of firms' size is sufficiently skewed. From an applied perspective, Imbs and Méjean (2009) maintain that not taking into account micro heterogeneity may lead to an aggregation

bias.

In Chapter 2, we show that the creation of the Euro has affected French exporters differently. Namely, large firms have reduced more their price discrimination toward Euro countries than smaller firms. Taking into account this heterogeneity is important to measure the aggregate impact of the Euro on price dispersion. In fact, since large firms account for a larger proportion of sales and are more impacted by the single currency, giving the same weight to all firms tends to underestimate the effect of the Euro. In this respect, our paper contributes to new evidence showing that accounting for firm heterogeneity may have important aggregate implication. Related to this view, Berman et al. (2011) state that exchange rate pass-through is low in the aggregate because large firms absorb exchange rate shocks.

In Chapter 3, we emphasize that low-wage country competition impacts firms in developed countries differently depending on the quality of their goods. In other words, LWC competition leads to a reallocation of sales from low- to high-quality firms. As a result, the aggregate quality of developed nations' exports rises up. While Baldwin and Harrigan (2011) have shown how firm heterogeneity in quality may shape bilateral trade flows, we assert in this chapter that the reallocation of sales across heterogeneous quality firms may shape the dynamic of aggregate exports. In particular, we show that the growth of exports may be decomposed into the growth of exported quantity, the growth of individual export prices, or the growth of the quality composition of the exported basket. The quality composition is a strong determinant of export growths, especially in sectors facing strong competitive pressures from low-wage countries.

The third contribution of the thesis is to participate in and hopefully fuel the debate on current policy questions. The effects of the Euro, and the effectiveness of the single currency to deepen economic integration, are closely discussed within political

and academic context. In the first chapter, we find that the Euro has significantly reduced price dispersion within the Euro area. This means that the introduction of the single currency has contributed to deepen the European economic integration. In this respect, we contribute to the debate about the economic impact of the creation of the single currency. The most complete study of the question is by Baldwin et al. (2008). They find that the Euro has increased trade flows in the Euro area by 5%, and that trade creation has been mainly driven by the entry of new firms/products. The study also points to the increasing pricing transparency that favors arbitrage behaviors. However, this report does not find a clear cut impact of the Euro on price dispersion. Taking into account firm heterogeneity, we show that the effect of the Euro on price dispersion is stronger than previously found.

The fear of Chinese products dominating the world production of manufacturing goods has been an important concern in most developed countries over the past two decades. Peter Schott (2004, 2008), Bloom et al. (2009) and others have shown that considering the specialization of countries in high-quality / innovative products is key to figuring out the implications of this new competition. In Chapter 3, we examine strong evidence suggesting that competition for LWC has driven a re-allocation of sales from low- to high-quality producers, increasing the overall quality of French exports. Evidence in favor of within-industry specialization suggests one way for countries to maintain their market share in world exports, while increasing the value added content of their exports. Investing in high-quality production should indeed help countries to insulate themselves from low-wage foreign competition. Furthermore, as long as producing higher quality goods requires more capital / high-skilled workers - which is confirmed by several empirical studies (Verhoogen, 2008; Kugler and Verhoogen, forthcoming) - quality upgrading may have strong effects upon labor market equilibria by increasing

the demand for high-skill workers.

The debate about the impact of globalization on inflation is raging in Europe and in the US. In some empirical papers the authors contend that the increase in low-wage countries pressures has pushed down prices in developed countries (Auer and Fischer, 2010). However, more structural studies have shown that the main channel through which movement in foreign exchange rates or foreign costs affect domestic prices are imported inputs (Goldberg and Campa, 2010). Chapter 4 contributes to this debate by providing the first evidence on this imported input channel at the firm level. Our principal finding is that while changes in imported inputs result in changes in domestic prices, in most sectors the dynamic of domestic prices does not depend on imported inputs.

C A more detailed view of the thesis

C.1 How distance shapes the pricing policy of exporting firms

The context. The recent availability of firm-level data has challenged traditional models of international trade. The standard assumption that firms are similar (Krugman, 1980) is strongly rejected by the data, and departing from this assumption in trade models has strong implication to the allocation of resources in open economies. Leading empirical papers have actually provided evidence on the heterogeneity in the size of firms, their decision to exports, the volume they export, as well as the number of products they sell, or the number of destinations they serve .[18] A crucial determinant of firms' decisions about exports is the distance separating trade partners. Based on these new facts, trade theorists have developed new models explaining the selection of

[18] See Bernard et al. (2007), Bernard et al. (2010) , and Eaton et al. (2004) respectively.

firms and products within firms in foreign markets.[19]

A dimension that has remained unexplored both empirically and to a lesser extent theoretically in the trade literature is the pricing strategy of those firms. In particular, while the effect of trade costs on most firms' decisions has been analyzed, the impact of trade costs on prices attracted much less attention. In workhorse models of international trade the pricing strategy of domestic and exporting firms has been muted to favor models' tractability.[20] Some of the literature, however, has built on alternative frameworks in which firms have less trivial pricing policy. Models based on Ottaviano et al. (2002) features variable markups. A crucial prediction of this model is that firms reduce their markups when facing high transport costs. However, this prediction has never been tested.

The question. The first chapter of this thesis explores the impact of distance on export prices, and questions the economic significance of the estimates.[21] It further determines what models are consistent with the empirical findings.

Methodology. Firm-level unit values proxy prices. Unit values are reported free-on-board (herein fob), i.e. net of transport costs. Unit values are computed as the ratio of values over quantities from French firm-level data describing bilateral trade of French exporters disaggregated at the (8-digit) product level.[22]

[19] See Melitz (2003); Melitz and Ottaviano (2008); Eaton et al. (2011), and Bernard et al. (2010).

[20] In CES models with monopolistic competition and iceberg transport costs, firms are expected to charge the same price (net of transport costs) to all the destination countries (Krugman, 1980; Melitz and Ottaviano, 2008).

[21] I focus on free-on-board (fob herein) prices. In other words, I consider prices net of transport costs. This is done for two reasons. First, the firms report fob values, so one can compute fob unit values only. Second, the models differ in their prediction about fob prices. In all models, the price including transport costs is higher for more distant countries. However, in CES model, the price net of transport costs is the same whatever the destination country, while in quadratic models, the price net of transport costs are lower in more distant countries.

[22] Unit values are not perfect measures of prices. If the goods sold by a firm on its different markets (while belonging to the same nomenclature) are slightly different, or that the mix of product reported

Using the universe of French firms exporting toward more than one destination in 2003, I attempt to measure how a firm, for a given product, adjusts its price depending on the distance to the destination country. Therefore, firm×product fixed effects are introduced in the regressions to isolate firms' own decisions. I further control for other determinants of prices such as the size and wealth of the destination country, or the level of competition in that country. Both linear regressions and non parametric ones are considered. Finally, since the majority of models predicts that distance should not affect prices, a special focus is placed on the statistical significance of results.
Importantly, once a figure for the elasticity of fob unit values to distance is calculated, its economic significance should be assessed. One way to do this consists of evaluating how a change in distance between two countries would affect consumers. Using both or estimate and estimates from the literature enables computation of the elasticity of import prices to distance and to discuss the relative importance of changes in fob prices relative to changes in transport costs.

Results. The main empirical result of this chapter is that firms charge higher free-on-board unit values for export to more distant countries. This finding hold even after controlling for the wealth, size, level of competition, and level of trade barriers of the destination country.
Results indicate that, as distance doubles, the fob unit value charged by an exporter increases by 3.5%. The estimates imply that more distant consumers pay a price premium not only because distance increases transport costs, but also because firms charge higher prices net of transport cost.

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by the firm in this nomenclature changes, then differences in unit values cannot be entirely attributable to markup differentials. Therefore, differences may be due to differences in the costs of production, or difference in the composition of the basket of goods exported by the firm. This drawback will be taken into account when interpreting the results.

The sensitivity of fob prices to distance is economically significant. Indeed, following a trade facilitation, almost 80% of the price decline on imports enjoyed by consumers is due to firms charging lower fob prices, the rest being attributable to the drop in transport costs.[23]

Different mechanisms can explain why firms charge higher unit values on export to more distant countries. They may charge higher markups, sell (more expensive) higher quality goods, or use more expensive packaging for more distant shipments. I maintain that a critical assumption to get the positive impact of distance on prices in trade models is to introduce per unit rather iceberg transport costs.

C.2 Looking at the dispersion of prices to evaluate the economic integration of the European Monetary Union

The context. More than ten years after the creation of the European Monetary Union (EMU), it has become possible to assess empirically how the monetary integration has affected market equilibria in Europe. By furthering market integration, EMU was expected to impact trade patterns within the monetary zone as well as between EMU and the rest of the world; this is the well-known Rose effect.[24] Another manifestation that has been less investigated in the empirical literature is the impact of EMU on the dispersion of prices. According to the law of one price (LOOP), an integrated market should have a unique price for each (properly defined) product. And deviations from this unique price can be related to the degree of economic integration. Anything that furthers market integration, notably the creation of a currency union, is expected to induce a convergence toward the LOOP.

[23] The small sensitivity of import prices to direct changes in transport costs is due to the tiny share of transport costs included in import prices

[24] See Rose (2000) or Baldwin et al. (2008).

This was one of the ideas that proponents of monetary integration were endorsing. The EU Commission was thus arguing that the Euro was going to increase price transparency, mute exchange rate fluctuations between members, and increase competition. Altogether, those effects were expected to ease arbitrage behaviors, reduce markups, and in turn lower price dispersion.

Question. Chapter 2, jointly written with Isabelle Méjean, proposes an empirical test of the previous price convergence effect, asking whether the introduction of the Euro has induced a reduction in the dispersion of prices inside the Euro area. It further investigates whether firms have been impacted in the same way by the single currency, and if so, questions the implication of this heterogeneity.

Methodology. The test is conducted using export data describing the prices set by French exporting firms in each of their destination markets. The sample is quasi-exhaustive, covering the universe of French exporters over the period from 1996 to 2005. For each firm, detailed information is provided about its bilateral exports, including the price set in each single market, before any transportation cost is added. These "free-on-board" prices are interpreted as reflecting the pricing strategy of the firm. The dispersion of prices is measured by the coefficient of variation computed at the firm- and product- level, across countries.

To identify the causal effect of the Euro on price dispersion, we adopt a difference-in-difference (DID) strategy with the rest of the European Union as control group. The method accounts for global trends that are disconnected from the shock using information on a control group that is not directly affected by the shock. More precisely, the DID strategy we use compares the magnitude of price discrepancies in the EMU before and after the Euro with that of an appropriately defined control group.

To account for the heterogeneous impact of the Euro on firms of different sizes, we interact the treatment on treated variable of the DID regression with different measures of firm size. We also employ a less parametric way to track down the impact of heterogeneous behaviors that consists of arranging firms in groups of size and measuring how firms in those groups react to the single currency.

Results. We find that the creation of the Euro has significantly reduced the relative dispersion of French export prices toward Euro countries. Price were 24% more dispersed in the Euro area than in the rest of the EU before 1999, and this dispersion drops to 21% after 1999. The effect is robust to the control group we choose as well as changes in the sample of firms and products we consider.

Moreover, we show that the effect has been felt differently by French exporters. That is to say, more productive firms have been more strongly affected by the common currency. This heterogeneity is important in itself. It also has interesting implications in terms of the aggregate impact of the Euro. Since more productive firms account for a very large share of total exports, their behavior is crucial in determining the dynamics of aggregate prices.

We account for the heterogeneity in the behavior of firms as well as in their relative weight in aggregate exports to estimate the aggregate effect of individual firms adjusting their pricing strategies. Unsurprisingly, the estimated effect of the Euro is found to be greater once we account for the relative weight of different firms in aggregate exports. In this specification, the relative dispersion of within-EMU prices decreases from 27 to 10% following the introduction of the European common currency.

This result suggests that the response of firms to the introduction of the Euro is deeply heterogeneous and that this heterogeneity has important aggregate consequences. The

effect of the Euro is underestimated when the heterogeneity is not accounted for.

C.3 The asymmetrical impact of low-wage countries competition on French firms, and its impact on the quality content of French exports

Context. One of the most widely discussed phenomena in recent trade literature concerns the growing share of emerging countries in world exports. This pattern challenges textbook models of international trade on several grounds. First, recent empirical evidence suggests that emerging economies are becoming competitive not only in labor-intensive sectors, as the neo-classical theory would predict, but also in capital-intensive ones.[25] Second, both emerging and developed countries export the same bundle of products, but more productive, wealthier countries charge higher unit values, on average.[26]. This suggests that countries produce different qualities of the same products, which goes against the horizontal differentiation view of international trade discussed in new trade theories. As argued by Peter Schott (Schott, 2004, 2008), these patterns of international trade are consistent with a specialization occurring *within* industries along the quality dimension. International trade leads countries to specialize in vertically differentiated goods. And developed economies continue exploiting their comparative advantage by producing better qualities.

In addition to the evidence pointing to the vertical specialization of countries, a growing number of empirical studies have emphasized that firms, within countries and within sectors, produce goods of very different qualities.[27]

[25] See Amiti & Freund, 2010, on Chinese data.

[26] See Schott, 2008, Gaulier, Fontagné and Zignago, 2008

[27] The recent trade literature provides evidence of firm heterogeneity in the quality dimension. See among others Crozet et al. (forthcoming) on wine exporters producing in France, Verhoogen (2008)

The interplay between cross-country vertical specialization and within-country heterogeneity in quality across firms has not been analyzed yet. However, we could expect increasing pressures from low-quality developing countries to affect differently firms in developed countries depending on the quality they produce.

The question. Chapter 4 investigates the impact low-wage countries competition has on the relative sales of firms in developed countries and how it affects the quality content of developed countries' exports. In the theoretical section, we determine the conditions under which changes in the competitive environment modify the quality composition of a country's export basket. The empirical section examines how the quality content of French exports has been impacted by changes in low-countries competitive pressures.

Methodology. We start the analysis with an illustrative model describing the conditions under which changes in the competitive environment modify the quality composition of a country's export basket. Our framework borrows from the industrial organization literature, notably Gabszewicz and Thisse (1979). In this setting, increased competitive pressures from the low-wage country are disproportionately felt by the lowest quality producers in the rich country, while the highest quality is somewhat protected by vertical differentiation. This asymmetry triggers a reallocation of market shares in favor of the high-quality firm. The mean exported quality improves as a consequence.

The empirical exercise is conducted using firm-level data on French exports. Our measure of quality changes relies on the methodology proposed by Aw and Roberts (1986) and Boorstein and Feenstra (1987). They illustrate how to quantify changes

on Mexican data or Hallak and Sivadasan (2009) in data covering Indian, US, Chilean and Colombian firms.

in the mean quality of a consumption basket by comparing time-variations in its unit value and its ideal price index. We adapt this methodology to our data and measure quality changes in France's exports due to market shares being reallocated across *firms* producing different qualities of the same *product*. It is worth noting that with this index, quality changes are driven by a reallocation of demand across firms serving the same market with different qualities of the same good.

Then, we relate sectoral changes in the quality of bilateral French exports in 45 countries to changes in the penetration of goods produced in low-wage countries in France's export markets. The most basic regression uses country-specific fixed effects to control for all macroeconomic evolutions that may explain an aggregate improvement in the demand for quality. Some regressions also include sectoral fixed effects that control for overall quality changes in some specific sectors due, for instance, to technological improvements or composition effects on the supply side. Finally, some regressions include additional control variables that have the sector and country dimensions. To reduce the risk of reverse causality, low-wage countries' market shares are computed using as reference the rest of the world less French exports. We further instrument the change in low-wage countries competition to test the robustness of our result to other possible sources of endogeneity.

We build a second measure of "quality competition" that accounts for competition from high-wage countries. We use this to test whether competition from high- and low-wage countries has a symmetric impact on the quality content of French exports.

Results. Results. We show that the quality of the French export basket increased by more than 11% between 1995 and 2005. Quality upgrading is particularly pronounced in sectors and countries where French firms face increasing competitive pressures from

low-quality producers. Interestingly, higher competition from high-wage countries leads to a decrease in the quality content of French exports. The flight to quality is consistent with within-industry specialization along the vertical dimension.

C.4 Globalization of inflation: the impact of imported inputs on the dynamic of domestic prices

The context. Domestic production involves a substantial amount of imported inputs. Manufacturing industries exhibit shares of foreign inputs in total costs ranging from 20 to 67%.[28] For this reason, vertical production linkages are crucial in explaining the international transmission of shocks in open macroeconomics.[29] Related to this issue, the intensive use of imported inputs questions the sensitivity of domestic prices to foreign ones. The strength of these effects depends on the extent to which changes in imported costs are transmitted to domestic prices.

Problematic. Chapter 4 investigates at the firm-level how movements in the price of imported inputs are passed on to domestic prices.

Methodology. The analysis relies on a novel dataset that reports monthly individual quotes for the price of imported inputs as well as production prices. Hence, the micro prices collected by the INSEE (the French statistical agency) are matched at the firm-level to compute the French price indices for production, imports and exports. Thus, one can observe for about 500 manufacturing firms the production prices of goods sold in the French market and abroad, and the price of their imported inputs. We use it to

[28] See Goldberg and Campa (2010). These figures are averages across OECD countries.

[29] di Giovanni and Levchenko (2010) find vertical linkages accounts for 30% of trade-induced business cycle correlation.

estimate the elasticity of domestic prices to imported input price changes.

Since prices are sticky, changes in domestic output prices are explained by changes in imported inputs conditional on observing a change in the output price. To figure out what are the determinants of the sensitivity of domestic prices to foreign ones, several specifications are tested. First, I investigate what role is played by the proportion of imported inputs used in the industry. Second, I test the look at the impact of the market structure, and I compare the transmission of changes in the price of imported inputs to domestic and export prices to evaluate the role on non constant markups. Lastly, I compare the transmission of imported input price changes to domestic prices for intra-firm and arm-length transactions.

I further attempt to check the robustness of our results to the potential endogeneity of imported costs. Typically, a higher demand for the output may lead to an increase in demand for inputs, driving up both the price of inputs and the price of output. In our regressions, we control for changes in sectoral characteristics, including changes in sectoral demand. In order to limit the potential endogeneity bias, we use the nature of the transaction associated with every import price that is reported in our dataset. In particular, I assume that the prices of inputs that importing firms declare as not specific to one supplier, are exogenous. This assumption is that if a firm can import a given input from different suppliers, this means the good is highly standardized. And, we can reasonably argue that the price of such internationally traded good is not affected by changes in the demand of a given firm.

Results. There are four main results documented in this chapter. First, on average, the elasticity of domestic prices to imported inputs prices is 12%. A large part of this incompleteness in pass-through is related to the share of imported inputs used in

the production process. Yet, there is an important heterogeneity across sectors that remains unexplained. Second, the transmission is much lower among firms that import inputs from a related party. Third, movements in imported costs are passed on to the same extent to both domestic and export prices. Finally, I show that, on average, 9% of the volatility of production prices at the sectoral level is driven by imported cost shocks of inputs. Again, there is a significant heterogeneity across sectors, the volatility explained by imported input prices ranging between 0 and 40%. Importantly, most of the dynamic of domestic prices is not explained by imported inputs.

Chapter 1

Markups, Quality, and Transport Costs [1]

1 Introduction

In workhorse models of international trade, exporters either charge the same free-on-board (fob) price to all destination countries (Krugman, 1980; Eaton and Kortum, 2002; Melitz, 2003), or reduce it for more distant countries (Brander and Krugman, 1983; Ottaviano et al., 2002; Melitz and Ottaviano, 2008).[2] In contrast, the present paper finds that firms charge higher fob unit values on exports to more remote countries. I establish this fact using detailed firm-level data describing bilateral trade of French exporters disaggregated at the (8-digit) product level. This finding is robust to the inclusion of other determinants of export prices such as the wealth, size, level of competition, and level of trade barriers of the destination country.

[1] This chapter is substantially revised version of the CREST Working Paper 2010-17 . It has been submitted for publication.

[2] The free-on-board price is the price set by a firm, net of freight and insurance costs.

Results indicate that, as distance doubles, the fob unit value charged by an exporter increases by 3.5%. The estimates imply that more distant consumers pay a price premium not only because distance increases transport costs, but also because firms charge higher prices *net of transportation costs*.

The elasticity of import (cif) prices with respect to distance (ϵ_{dist}^{cif}) may be written as a weighted average of the elasticity of fob prices to distance (ϵ_{dist}^{fob}) and the elasticity of transportation costs to distance (ϵ_{T}^{cif}):

$$\epsilon_{dist}^{cif} = \left(1 - \frac{T}{p_{cif}}\right) \epsilon_{dist}^{fob} + \frac{T}{p_{cif}} \epsilon_{dist}^{T}$$

My estimate of the elasticity of fob prices to distance (ϵ_{dist}^{fob}) is 0.05, Hummels and Skiba (2004) estimate an elasticity of transport costs to distance (ϵ_{T}^{fob}) of 0.26, and Hummels et al. (2001) estimates that the share of transportation costs in import price (ϵ_{T}^{cif}) is 0.038. As a result, the elasticity of import prices with respect to distance is 0.06.[3] This simple decomposition shows that, following a trade facilitation, almost 80% of the price decline on imports enjoyed by consumers is due to firms charging lower fob prices, the rest being attributable to the drop in transport costs. The small sensitivity of import prices to direct changes in transport costs is due to the tiny share of transport costs included in import prices (only 3.8% in Hummels 2001).

This suggests a new and important channel - firms charging lower fob unit values - through which changes in transport costs may affect welfare. This channel adds up to the mechanisms identified in the literature, namely the direct effect of a drop in transport costs on consumer prices, the pro-competitive effect, and the love-for-variety

[3]Using an alternative decomposition and information on the elasticity of cif/fob ratios to distance leads to an identical elasticity of 0.06. I further show that the elasticity of import prices to transport costs is 0.23.

effect.[4]

Different mechanisms can explain why firms charge higher unit values on export to more distant countries.[5] They may charge higher markups, sell (more expensive) higher quality goods, or use more expensive packaging for more distant shipments. In particular, the positive impact of distance on unit values is consistent with the Alchian and Allen (1964) conjecture stating that the demand for more expensive/ higher quality products should increase with transport costs. I further show that a standard CES model under monopolistic competition with per unit rather than iceberg transport costs is constistent with the positive impact of distance on prices found in the data. While these mechanisms rely on the presence of per unit transport costs, it is worth noting that alternative explanatory mechanisms such as selection effects can be obtained with iceberg transport costs. However, I argue that these alternative explanations appear less convincing.

Interestingly, the positive impact of distance on fob unit values at the firm level is not limited to French data. In parallel works, Bastos and Silva (2010), Manova and Zhang (forthcoming) and Gorg et al. (2010) find a similar pattern using bilateral firm level data on Portuguese, Chinese and Hungarian exports respectively. Here, I find the same pattern using French data, I further discuss the economic significance of this fact, and I propose a theoretical explanation. In a related paper, Irarrazabal et al. (2010) sketch and estimate a Melitz type model with additive transport costs. In their model, fob prices increase with per unit costs at the firm level. The present estimates are

[4] Arkolakis et al. (2011) show that recent trade models developed to explain the behavior of firm-level trade flows have the same implications in terms of the gains from trade as old theories assuming homogenous or representative firms. By contrast, models with non constant fob prices can provide new gains as shown by Irarrazabal et al. (2010).

[5] Models with exogenous (Baldwin and Harrigan, 2011; Hummels and Skiba, 2004) or endogenous (Verhoogen, 2008; Hallak and Sivadasan, 2009) quality heterogeneity explain price differential among firms and the impact of distance on average prices but they do not explain why prices, within firms, increase with distance.

consistent with theirs. Like in their paper, I point to the importance of per unit costs to explain this fact.

In addition to the literature cited above, our work is related to empirical studies showing that average prices are higher in more remote countries.[6] In particular, Hummels and Skiba (2004) and Baldwin and Harrigan (2011) show that product level unit values increase with distance, and they propose two distinct models explaining this feature of the data. But, in both papers, fob prices are not observed at the firm level and are assumed identical within firms, and across destinations. Complementary to the literature, this paper focuses on the impact of distance on the dispersion of prices within firms and products across destinations, i.e. on *individual* rather than *average* prices. More generally, the present paper connects to the recent literature describing exporting firms' behavior. Most studies provide evidence on firms' export status and size (Bernard et al., 2007), the number of products they sell (Bernard et al., 2010) or the number of destinations they serve (Eaton et al., 2004). The present paper focuses on unit values charged by those exporting firms.

The rest of the paper is organized as follows. Section 2 describes the data and the econometric strategy. Section 3 presents some stylized facts, the results, and provides insights concerning the economic significance of the estimates. Section 4 discusses the different explanations consistent with the empirical finding. Last, Section 7 concludes.

[6] See Schott (2004), Hummels and Klenow (2005), Mayer and Ottaviano (2007), Baldwin and Harrigan (2011), Hummels and Skiba (2004), or Fontagné et al. (2008).

2 Data and strategy

2.1 Data

The empirical analysis in this paper is based on a French customs database.[7] The database covers yearly bilateral shipments of firms located in France in 2003. Data are disaggregated by firm and product at the 8-digit level of the Combined Nomenclature (CN8). The raw data cover 96,467 firms and 10,050 products for a total exported value of 3.5 hundred billions euro. Since this paper focuses on the dispersion of prices within firms and products, only products sold by a firm on at least two markets are considered. This restriction reduces the number of observations. Actually, only 46 % of firms export toward several destinations. However, these multi-destination exporters realize more than 74% of French exports (in value). For each flow, the fob value and the shipped quantity (in kg) are reported. A flow is described by a firm number, a product category (CN8), and a destination country. Unit values are computed as the ratio of the value over the quantity of the flow. The unit value set by firm f for product k exported toward country j is:$P_{fjk} = \frac{V_{fjk}}{Q_{fjk}}$ where V_{fjk} and Q_{fjk} are the value and quantity of good k exported by firm f to country j.

Unit values are known to be a noisy measure of prices. The main criticism was formulated by Kravis and Lipsey (1974) and more recently Silver (2007). The authors state that unit values do not take into account quality differences among products. The high level of disaggregation of the data and their firm dimension limits the main drawback of unit values and more particularly the mixed-quality effect. Actually with more than 10,000 products, the possibility of having goods with highly different characteristics

[7] Berthou and Fontagné (2008), Méjean and Schwellnus (2009), Crozet et al. (forthcoming) or Berman et al. (2011) use the same source.

within these unit values is limited.[8]

There are some errors in declarations or in reporting. To deal with outliers, we follow Méjean and Schwellnus (2009) and drop observations for which the unit value is 10 times larger or lower than the median unit value set by the firm on its different markets. This procedure retains 73% of total exports.

Like most of the papers in the literature, distance is used as a proxy transport costs. I also use GDP and GDP per capita as a control for the size and wealth of the destination country. Another control used in the empirical analysis is the average multilateral import unit value of destination countries to control for the level of competition on each market.[9] To investigate the impact of product differentiation on the link between unit values and distance, I use the elasticity of substitution computed at the product level by Broda and Weinstein (2006). Last, as an additional control, the tariff faced by French exporters is introduced in some regressions. All these variables are described in the appendix.

2.2 Econometric strategy

First, we estimated the following equation:

$$log(P_{fkj}) = \alpha log(dist_j) + \beta controls_j + FE_{fk} + \epsilon_{fkj} \quad (1)$$

[8]For instance, product CN8 52081296 has this description: *Woven fabrics of cotton, containing 85 % or more by weight of cotton, unbleached, Plain weave, weighing more than 100 g/m2 but not more than 130 g/m2 and of a width not exceeding 165 cm* . For a deeper discussion on the use of this database's unit values as a proxy for prices, see Méjean and Schwellnus (2009).

[9]Because international trade data are harmonized at the HS6 level, the multilateral unit values are measured at the 6-digit level while the firm-level export unit values are measured at the 8-digit level. For EU countries, the COMEXT nomenclature allows us to build multilateral unit values at the 8-digit level. As a robustness, 8-digit COMEXT multilateral unit values are compared with 6-digit BACI ones. The correlation is very high: 0.79. Furthermore, I obtain very similar results in regressions on the EU sample using the 6- or 8- digit multilateral unit values. In regression including COMEXT data, the impact of distance on prices is even stronger. Results are available upon request.

where P_{fkj} is the unit value computed at the firm and product level, $dist_j$ is the distance between France and country j, FE_{fk} is a firm and product fixed effect, $controls_{kj}$ is a vector of control variables, and ϵ is the error term. Three different samples of countries are used to test the robustness of the results: all the countries, the OECD countries, and the euro members. The OECD sample allows comparison of prices toward countries with similar levels of development. Focusing on euro members is a way to get rid of the firm price discrimination due to (i) incomplete exchange rate pass-through and (ii) country specific tariffs.

The impact of distance on prices can be non-linear. Non-parametric regressions of the logarithm of prices on dummies for different intervals of distance are run to tackle this problem. With firm×product fixed effects, interval coefficients yield average prices set by each firm in each distance interval.[10]

Part of the trade literature emphasizes the impact of the size and the wealth of countries on bilateral unit values. GDP and GDP per capita are used to control for these effects.[11] The expected signs are as follows. In large countries, competition is tougher, which should reduce prices. By contrast, wealthy countries are expected to have a higher willingness to pay, which should contribute to higher prices.[12]

Models with quadratic utility functions suggest that prices depend on the average price on the market. Those average prices reflect not only the level of competition in the destination country but also its relative remoteness. Hence, they depend on the

[10]This method is used at lower levels of disaggregation by Baldwin and Harrigan (2011) or Eaton and Kortum (2002) among others.

[11]Using manufacturing output instead of GDP leads to similar results.

[12]Baldwin and Harrigan (2011) use these controls and Hummels and Lugovskyy (2009) bring theoretical foundations to these explanatory variables in a generalized model of ideal variety. One can also interpret the GDP per capita coefficient with respect to trade costs. If the cost of selling a good abroad includes a distribution cost, then trade costs are expected to increase with the wealth of the destination country, because wages are higher there for instance (Corsetti and Dedola, 2005; Berman et al., 2011, see).

number of firms serving the market, the fob price of those firms, but also the average transport cost paid by firms exporting to this country. Multilateral average unit values of imported products for the different countries are introduced in regressions to control for this. They are computed as the value-weighted average of import prices in the destination countries.

Most models of international trade predict that the elasticity of price to distance is nil.[13] Therefore, the statistical significance of estimated coefficients is important. In the regressions, standard errors can be biased by the correlation within groups of observations. To deal with this bias, estimated standard errors are clustered in the country dimension. However this clustering procedure assumes a large number of clusters whereas in our dataset the number of clusters (number of countries) is rather small compared to the number of observations (Harrigan, 2005; Wooldridge, 2005, see). Results with clustered standard errors are in the main text. In Appendix, we describe the methodology proposed by Harrigan (2005) to tackle this issue and the results it yields.

3 Empirical Results

This section presents empirical findings concerning the relationship between prices and distance at the firm level. The first section provides graphical evidence on the link between prices charged by exporters and distance. The following section reports the results of our estimations. The results unambiguously suggest that firms charges higher *free-on-board* prices on exports to more distant countries.

[13] This is true for all the CES models with monopolistic competition and iceberg transport costs like Krugman (1980) or Melitz (2003).

3.1 Stylized facts

Before investigating the impact of distance on individual prices, the variance decomposition of individual prices is investigates. Most of the literature has focused on the dispersion of unit values, within product across destinations (Baldwin and Harrigan, 2011; Hummels and Skiba, 2004). The analysis focuses on the dispersion of unit values within firms and products across destinations. Thus, the variance of individual prices for each product category is decomposed as the sum of the variance of individual prices within firms across destinations, and the variance of firms' average prices across destinations, plus a covariance term. Namely, the following decomposition is made:

$$\sum_{f,j} (p_{fj} - p)^2 = \sum_{f,j} (p_{fj} - p_f)^2 + \sum_{f,j} (p_f - p)^2 + 2 \sum_{f,j} (p_{fj} - p_f)(p_f - p) \quad (1)$$

Where p_{fj} is the price charged by firm f on exports to country j, p is the average price, and p_f is the average price charged by firm f. The first term on the right hand side gives the within-firm price dispersion, the second term gives the between-firms price dispersion, and the last term gives the covariance between the previous two sources of variation. We compute those terms for each CN8 product. Then, the RHS terms are divided by the left hand side term. This provides us with a measure of the contribution of the within and between terms to individual price dispersion. Table 1 gives the different percentiles of the within and between contributions by products. On average, about half of the dispersion in individual prices is explained by within firm price dispersion. The previous variance decomposition shows that a large part of price dispersion occurs within firms and products across destinations. I now investigate whether this price dispersion is related to the distance to the destination country. As preliminary evidence, Figure 1 plots the logarithm of individual prices against the logarithm of distance. To

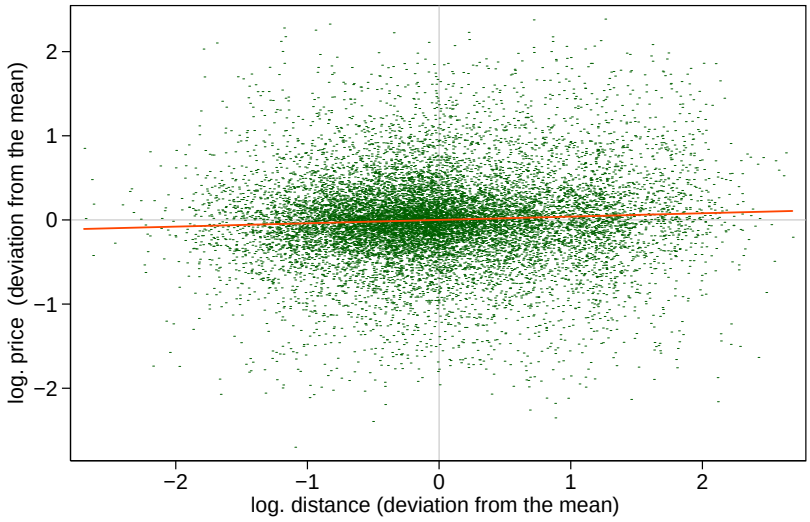
Table 1: Within and between components of price dispersion

	Percentiles	P5	P25	P50	P75	P95
Contribution	Within	0.03	0.26	0.48	0.72	1
	Between	0	0.20	0.48	0.77	1.05

This table reports the contribution of the within and between firms component of price dispersion for each CN8 product category. Namely for each product the following equation is estimated: $\sum_{f,j}(p_{fj}-p)^2 = \sum_{f,j}(p_{fj}-p_f)^2 + \sum_{f,j}(p_f-p)^2 + 2\sum_{f,j}(p_{fj}-p_f)(p_f-p)$ where p_{fj} is the price set by firm f on exports to country j, p_f is the average price set by firm f, and p is the average price across firms and destinations. The within and between contribution are computed for each CN8 category. PX is the contribution for the X^{th} percentile. For instance, 48% of the dispersion for the median product is due to within firm price dispersion. The other 48% percent is due to between firm price dispersion. The last two percent is attributable to covariance effects.

focus on within firms and products patterns, the firm and product mean are removed from the two variables. I keep firm-product pairs present in at least 5 markets. Since the figure is unreadable with too many observation, 5% of observations are randomly drawn from the sample. The figure shows a positive relationship between prices and distance. However, the correlation is not systematic. The slope is 0.04, and we observe an important dispersion of prices, which is is not explained by distance. Distance is destination-specific whereas unit values have the three dimensions: firm, product and destination. Thus, destination-specific variables cannot explain the whole price dispersion. Next, I investigate the importance of distance among destination-specific determinants in explaining individual price dispersion. Figure 2 presents another piece of evidence supporting distance as an important determinant of individual prices. To build the figure, country fixed effects are estimated by regressing the logarithm of prices on country fixed effects and firm-product fixed effects. A large country fixed effect means that on average, a firm charges a higher price to this country than to the other destinations it exports to. Then, those country fixed effects are regressed on the

Figure 1: Price and distance at the firm level, random sample, 2003

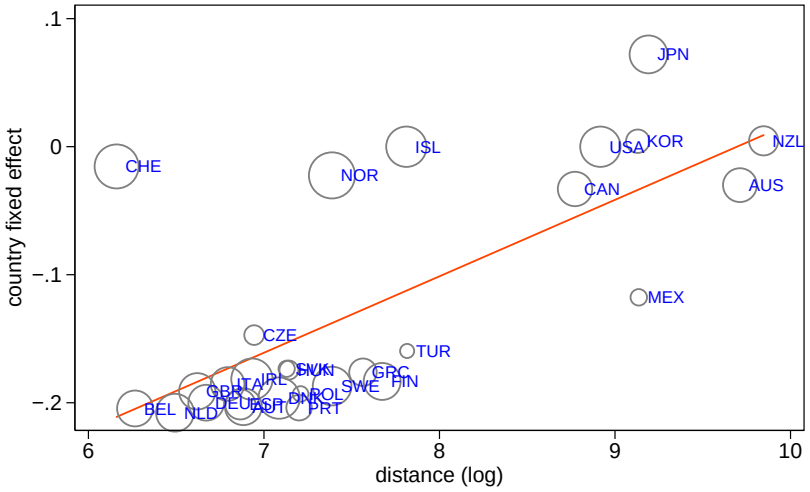


The graphs plots the logarithm of prices at the firm and product level against the logarithm of distance. Both variables are purged of firm×product fixed effects. The slope of the linear fit line is 0.039 and the standard deviation is 0.006. The exercise is done on a sample of 14,387 observations based on 1,195 couples of firms and products (5%) randomly drawn from the initial sample.

logarithm of distance. The figure also indicates the country names and their GDP per capita. We can see a clear positive relationship between estimated fixed effects and distance. This suggests that firms, on average, charge higher fob prices toward the more distant markets. Furthermore, distance alone explains one half of the dispersion of country fixed effects. Thus it appears as one of the main country-specific determinants of prices.[14] There are however some outliers. The most visible is Switzerland. French exporters seem to charge relatively high prices to this neighbor country. This may be explained by the high GDP per capita of Switzerland.

[14] Adding GDP per capita or average unit value increases the R^2 to 0.62 only.

Figure 2: Country fixed effects, distance, and GDP per capita, 2003



The graph plots estimated country fixed effects for OECD countries against distance. Circles are proportional to countries' GDP per capita. Country fixed effects are estimated from a regression of the log of prices (at the firm-product level) on country fixed effects and firm×product fixed effects. the correlation between distance and country fixed effects is 0.7. A regression of country fixed effects on the logarithm of distance yields an R^2 of 0.5.

3.2 Regressions results

We now turn to the regression analysis investigating the determinants of export prices. Results confirm the previous stylized facts: firms charge higher unit values on exports to more distant countries.

Table 2 presents regressions of the logarithm of the price on the logarithm of distance. In all the regressions, the estimated elasticity of prices to distance is positive and almost always significant. In column (1), the sample contains all destination markets of French exporters. The estimated elasticity is 0.042. If the distance doubles, the average exporter increases its fob price by 3% ($2^{0.042} - 1$). Focusing on the OECD sample (column 2), one observes that the elasticity is larger. The estimated elasticity reaches 0.45. Column (3) focuses on the euro sample. This sample is interesting because

the pricing to market in the euro area cannot be due to incomplete exchange rate pass-through, and there are no country specific tariffs for French goods. The elasticity is much lower and weakly significant but still positive (0.011).

Table 2: Price and distance, 2003

Dependent variable:	Price (log)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance (log)	0.042^a	0.045^b	0.011^c	0.050^a	0.051^a	0.019^b	0.050^a	0.051^a	0.019^b
	(0.012)	(0.017)	(0.005)	(0.010)	(0.013)	(0.007)	(0.010)	(0.013)	(0.007)
GDP (log)				-0.004	0.000	0.003	-0.004	0.000	0.003
				(0.004)	(0.006)	(0.002)	(0.004)	(0.006)	(0.002)
GDP per capita (log)				0.020^a	0.047^b	0.014	0.018^a	0.046^b	0.014
				(0.006)	(0.020)	(0.010)	(0.006)	(0.020)	(0.010)
Mean UV (log)							0.018^a	0.010^c	0.003
							(0.005)	(0.005)	(0.002)
Fixed effects	Firm × Product								
Sample:	All	OECD	Eurozone	All	OECD	Eurozone	All	OECD	Eurozone
Observations	1,199,711	910,108	591,733	1,199,711	910,108	591,733	1,198,282	909,398	591,268
R^2	0.003	0.004	0.000	0.004	0.005	0.000	0.005	0.005	0.000
rho	0.911	0.923	0.933	0.911	0.923	0.933	0.910	0.922	0.933

This table investigates the impact of distance on firm's export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by the GDP per capita, the size of the destination country measured by the GDP, and the level of competition in the destination country measured by the average unit value of imports in this country. In columns 1, 4, 7 all destinations are considered. In columns 2, 5, 8 only exports toward OECD countries are considered. In columns 3, 6, 9, only exports toward euro countries are considered. Reported standard errors are clustered by country. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

In columns (4-6) regressions control for market characteristics by introducing the size (GDP) and the wealth (GDP per capita) of the destination country. One can see that the size of the country has no significant impact on prices whereas wealth has a positive impact. The distance coefficient remains positive, significant, and even higher than without controls. This is particularly true for the Eurozone, where the distance elasticity is greater and more significant (column 3 vs column 6). Within the Eurozone, the countries closest to France are also the countries with the highest GDP per capita, which has a positive impact on fob prices.

The average unit value takes into account the competition on the market. Columns (7) to (9) present the results once the average unit value is introduced. As expected, the mean unit value coefficient is positive (even though it is not significant for Eurozone sample regressions). Actually, in highly competitive markets (where the multilateral unit value is low), firms set relatively lower prices. However, even with this control, the distance coefficient remains positive and significant. Namely, the regression including all the control variables indicates that doubling the distance implies a 3.5% increase of the fob price charged by firms (Table 2, column 7: $2^{0.05} - 1 = 0.035$).[15]

Table 3 presents the non-parametric version of the previous regressions. The logarithm of unit values are regressed on distance interval dummies. Since the dummies are collinear with the constant and the fixed effects, the first interval is dropped. For the reasons mentioned previously, firm×product specific fixed effects are added. To obtain a sufficient number of observations in each interval, regressions are run on the entire sample of countries. Overall, the regressions suggest that prices increase with distance. The only noteworthy point is that this increase is not always significant

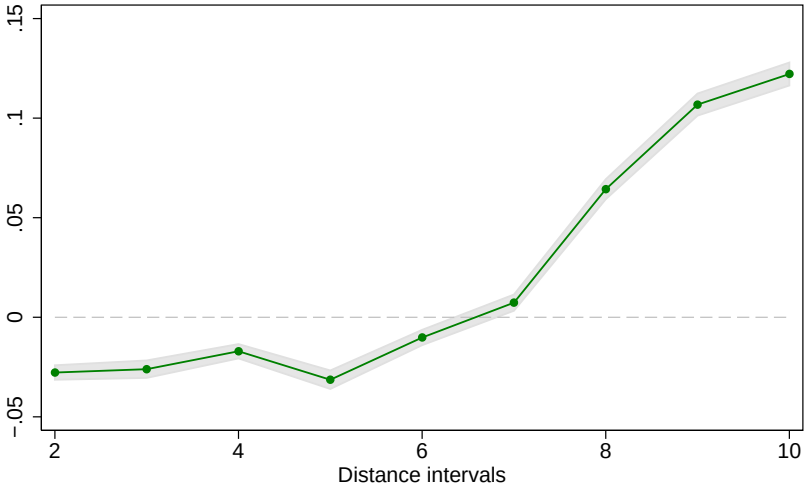
[15]Table C.1 in Appendix presents the results obtained when applying the two-step methodology developed by Harrigan (2005). With this methodology, estimated coefficients are still positive and significant and of even higher magnitude.

Table 3: Price and distance intervals

Dependent variable:	Price (log)		
	(1)	(2)	(3)
$1500 < distance < 3000$	0.024	0.026	0.026
	(0.015)	(0.017)	(0.017)
$3000 < distance < 6000$	0.085^a	0.108^a	0.108^a
	(0.017)	(0.016)	(0.016)
$6000 < distance < 12000$	0.115^a	0.136^a	0.135^a
	(0.021)	(0.017)	(0.017)
$12000 < distance$	0.145^a	0.141^a	0.140^a
	(0.020)	(0.020)	(0.020)
GDP (log)		-0.006	-0.006
		(0.004)	(0.004)
GDP per capita (log)		0.022^a	0.021^a
		(0.007)	(0.006)
Mean UV (log)			0.018^a
			(0.005)
Fixed effects	Firm × Product		
Sample:	All	All	All
Observations	1,199,711	1,199,711	1,198,282
R^2	0.004	0.005	0.006
rho	0.911	0.911	0.910

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by GDP per capita, the size of the destination country measured by GDP, and the level of competition in the destination country measured by the average unit value of imports to this country. Distance is measured using distance interval. Dummy is equal to 1 if the destination country belongs to the interval and 0 elseotherwise. Reported standard errors are clustered by country. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

Figure 3: Price and distance deciles at the firm level, 2003



The figure plots the coefficients on distance deciles obtained from a regressions of the logarithm of prices at the firm and product level against distance deciles and the logarithms of GDP, GDP per capita, multilateral unit value, and firm×product fixed effects. The grey area indicates the 10% confidence interval.

toward countries lying at a distance of between 1,500 and 3,000 kilometers. Exporting to closer countries (less than 3,000 km) increases prices by 2 log points, while exporting to remoter countries (more than 12,000 km) increases prices by 14 log points. In the three regressions, an F-test allows rejection of the equality of distance intervals' coefficients.[16]

As a last graphical evidence, Figure 3 presents the evolution of prices by distance deciles. Namely, prices at the firm level are regressed on deciles of distance, the logarithms of GDP per capita, GDP, multilateral unit values, and firm×product fixed effects. Figure 3 unambiguously suggests that firms charge higher prices in more distant countries. The previous regressions are run on the pooled sample. To gauge how

[16]In Appendix, Table C.2 presents the results when introducing country random effects instead of clustering at the country level. Coefficients are still significant and increasing with distance which reinforces the previous results. Even close intervals become statistically significant.

systematic is the impact of distance on prices, the sample is split into several bins grouping firms according to their size (measured by total exports) or the substitution of products (measured by the elasticity of substitution provided by Broda and Weinstein (2006)). Actually, most models predict that the reaction of markups or quality as well as the strength of composition effects are stronger in more differentiated industries.[17] Furthermore, the recent trade literature emphasizes the importance of firm heterogeneity, which suggests that the reaction to distance may differ across firms.

Table 5 investigates whether their is a heterogeneity in the response of prices to distance depending on the degree of differentiation of te products. It appears that within more differentiated industries (industries with a low elasticity of substitution), unit values are more responsive to changes in distance. This result is confirmed by the negative and significant coefficient that shows up when interacting the logarithm of distance with the elasticity of substitution of the good sold by the firm. In more differentiated sectors, firms have more room to adjust their markups or the quality they sell across destination countries.

Table 4 presents a similar exercise in which regressions are run on different samples of firm sizes. The total value of exports is used as a proxy for firm sizes or performances. There is no significant difference between estimated coefficients for the different samples of firm sizes. The interaction between the log of distance and the log of firms' size is not significant either. This suggests that firms of different size react in the same fashion to changes in distance.[18] Before, attempting to explain the positive impact of distance on prices, let's compare the previous findings in light of the extant empirical literature,

[17] Even if it is not emphasized, this prediction is in models by Baldwin and Harrigan (2011), Ottaviano et al. (2002) or Hummels and Skiba (2004).

[18] Table A.3 presents regressions including the quality of institution in the destination country as well as the market potential of the destination country, computed at the 3 digit sectoral level. Those controls impact neither the statistical significance of the distance coefficient nor their magnitude.

Table 4: Price, distance, and firms' size

Dependent variable:	Price (log)				
	(1)	(2)	(3)	(4)	(5)
Firms' size:	Small	Small-Med	Med-Large	Large	All
Sales×100,000 (euro)	[0, 9]	[9, 56]	[56, 315]	> 315	
Distance (log)	0.076^a	0.052^a	0.039^a	0.042^a	0.074^b
	(0.018)	(0.011)	(0.008)	(0.008)	(0.037)
GDP (log)	-0.002	-0.003	-0.007^b	-0.006	-0.004
	(0.007)	(0.004)	(0.003)	(0.004)	(0.004)
GDP per cap. (log)	0.039^a	0.027^a	0.012^b	0.010^c	0.018^a
	(0.012)	(0.008)	(0.005)	(0.005)	(0.006)
Mean UV (log)	0.012^b	0.014^a	0.021^a	0.026^a	0.018^a
	(0.006)	(0.005)	(0.004)	(0.004)	(0.005)
Dist. (log)×Size (log)					-0.002
					(0.002)
Fixed effects	Firm × Product				
Sample:	Q1	Q2	Q3	Q4	All
Observations	299,532	299,631	299,544	299,575	1,198,282
R^2	0.010	0.005	0.004	0.004	0.005
rho	0.922	0.905	0.908	0.906	0.910

This table investigates the impact of distance on firm's export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by GDP per capita, the size of the destination country measured by GDP, the level of competition in the destination country measured by the average unit value of imports in this country, and firms' total sales. The first four columns present the regressions run on subsamples of the data. Subsamples group firms belonging to the same quartile range in terms of total export sales. Q1 is for the small, Q2 for the small-medium, Q3 for the medium-large, and Q4 for the large firms. In the last column, we interact the log of distance with the log of firms' size measured as total sales. Reported standard errors are clustered by country. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

Table 5: Price, distance, and elasticity of substitution

Dependent variable:	Price (log)				
	(1)	(2)	(3)	(4)	(5)
Elasticity:	Small	Small-Med	Med-Large	Large	All
	[1, 4.3]	[4.3, 5.1]	[5.1, 5.8]	[5.8, 27]	
Distance (log)	0.073^a	0.045^a	0.042^a	0.037^a	0.066^a
	(0.015)	(0.010)	(0.008)	(0.008)	(0.014)
GDP (log)	-0.001	-0.012^a	-0.010^a	0.004	-0.004
	(0.006)	(0.004)	(0.003)	(0.004)	(0.004)
GDP per cap. (log)	0.027^a	0.019^a	0.006	0.025^a	0.018^a
	(0.010)	(0.005)	(0.006)	(0.007)	(0.006)
Mean UV (log)	0.012	0.025^a	0.016^a	0.022^a	0.018^a
	(0.009)	(0.004)	(0.003)	(0.006)	(0.005)
Dist. (log)×					-0.003^a
Elasticity (log)					(0.001)
Fixed effects	Firm × Product				
Sample:	Q1	Q2	Q3	Q4	All
Observations	320,882	308,396	258,696	293,680	1,181,654
R^2	0.010	0.005	0.004	0.004	0.005
rho	0.880	0.883	0.914	0.908	0.907

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by GDP per capita, the size of the destination country measured by GDP, the level of competition in the destination country measured by the average unit value of imports in this country, and product level elasticity of substitution. The elasticity of substitution is computed at the HS6 product level by Broda & Weinstein (2004). The first four columns present the regressions run on subsamples of the data. Subsamples group products belonging to the same quartile range in terms of elasticity of substitution. Q1 is for products with a small elasticity, Q2 for the small-medium, Q3 for the medium-large, and Q4 for the large. In the last column, we interact the log of distance with the log of the elasticity of substitution. Reported standard errors are clustered by country. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

and assess its economic significance.

3.3 Comparison with the literature

Three papers are highly comparable in terms of methodology. Bastos and Silva (2010), Manova and Zhang (forthcoming) and Gorg et al. (2010) also explore the determinants of individual fob unit values. In doing so, they use bilateral firm level data on Portuguese, Chinese and Hungarian exports respectively. The most comparable estimates are those for the manufacturing sample in 2005 for China and Portugal, and 2003 for Hungary. The estimated elasticity of fob prices to distance is 0.052 for Portugal (Table 6, column 11 in Bastos & Silva), 0.056 for Hungary (Table 2, column 5 in Gorg et al.), and 0.014 for China (Table 8, column 1 in Manova & Zang). Those estimates - in particular for Hungary and Portugal - are very close to the elasticity of 0.050 estimated in the previous section (Table 2, columns 7-8).

Another paper addressing similar issues is Irarrazabal et al. (2010). The authors study the importance of the form of transport costs in a Melitz type model. In particular, they develop a model combining per unit and iceberg trade costs, and then bring it to the data to estimate the prevalence of per unit costs. They use Norwegian firm-level data and structurally estimate their model using a minimum distance estimator. They find per unit trade costs account on average for 35% of consumer prices. However, the main results emerging from their empirical exercise are not directly comparable with the estimates obtained in the previous section. To obtain a comparison, the elasticity of fob prices to distance implied by their estimates is derived.

In their model, the elasticity of fob prices to distance is firm specific. Therefore, it is necessary to write down the average elasticity, and then compute it using their estimates. Computations are described in Appendix D. Their estimates yield an elasticity

of fob prices to transport costs of 0.23. The implied elasticity of fob price to distance is the product of this elasticity and the elasticity of transport costs to distance. They estimate an elasticity of transport costs to distance of 0.07. This implies an elasticity of fob price to distance of 0.016 (0.23×0.07). The elasticity is a bit smaller to what is find this paper (and what is found in the literature) but has the same order of magnitude.[19] Overall, those results suggest that the elasticity of fob prices to distance is positive and around 0.05. This seems quite robust to the sample, and the method used to compute it.

3.4 Economic significance

This section discusses the economic significance of the estimates. We have measured an elasticity of fob prices to distance of 0.05. What does this mean for consumers? To better interpret our estimates, the elasticity of import (cif) prices with respect to distance and transport costs are computed.[20] Two alternative formulas are used to compute the elasticity of import prices to changes in distance.

First, the logarithm of the cif price is decomposed in two parts: the logarithm of the fob prices and the logarithm of cif/fob margins. Using this decomposition yields the following formula for the elasticity of import prices to distance:

$$\frac{\delta log(p_{cif})}{\delta log(dist)} = \frac{\delta log(p_{fob})}{\delta log(dist)} + \frac{\delta log(p_{cif}/p_{fob})}{\delta log(dist)} \tag{2}$$

[19] Another prediction from Irarrazabal et al. (2010) is that the dispersion of quantities within products, should decrease in more distant countries. Measuring dispersion by the P90/P10 ratio of quantities, I regressed the dispersion measured for every product and country on distance, GDP, GDP per capita, and product fixed effects. Consistent with the prediction, distance is found to have a negative and significant impact on dispersion. Results are available upon request.

[20] For simplicity, we refer to cost, insurance and freight (cif) prices as import prices. The consumer price is composed of the import price and the local costs. Conclusions for consumer prices would be similar to the ones for import prices if local costs such as VAT or distribution margins affect import prices in a multiplicative way.

The first term on the right hand side of the equality is the elasticity of fob prices to distance, the second term is the elasticity of the cif/fob margins to distance. From the previous section, the elasticity of fob prices to distance is 0.05, and Hummels and Lugovskyy (2006) estimate an elasticity of the cif/fob margins of 0.01 (table 6, national data, US imports). Therefore, the implied elasticity of firm-level cif prices to distance is 0.06 $(0.05 + 0.01)$.[21]

The second formula build from the definition of import prices. The import price (p_{cif}) is the sum of the fob price (p_{fob}) and freight costs (T):

$$p_{cif} = p_{fob} + T \tag{3}$$

Taking the first derivative of this expression with respect to distance, multiplying by distance, dividing by the price, and rearranging yield:

$$\frac{\partial p_{cif}}{\partial dist} \times \frac{dist}{p_{cif}} = \left(\frac{\partial p_{fob}}{\partial dist} \times \frac{dist}{p_{fob}} \right) \times \frac{p_{fob}}{p_{cif}} + \left(\frac{\partial T}{\partial dist} \times \frac{dist}{T} \right) \times \frac{T}{p_{cif}} \tag{4}$$

In words, the elasticity of import prices to distance is a weighted average of the elasticity of fob prices to distance and the elasticity of transport costs to distance. Each elasticity is weighted respectively by the share of the fob price and the freight costs in the import price. The intuition for this formula is straightforward. The sensitivity of import prices to distance not only depends on the elasticity of its components but also on the relative importance of those components in the final price. Hummels and Skiba (2004) estimate an elasticity of transport costs to distance of 0.26.[22] Furthermore, Hummels et al.

[21] The elasticity of the cif/fob margins for all countries is estimated to be 0.045 (Hummels and Lugovskyy, 2006, table 6). This yields to an elasticity of import prices to distance of almost 0.10. The elasticity of cif/fob margins is considered for the US because the second formula uses information for the US only. Furthermore US cif/fob ratios are based on DOTS, which are of better quality than the IMF-COMTRADE cif/fob ratios (Hummels and Lugovskyy, 2006).

[22] Hummels et al. (2001) estimates an elasticity of 0.27. However, freight costs are measured as the

(2001) shows that for in the US, the share of freight costs in import prices is 3.8%. Using this information and the elasticity of fob prices to distance give an elasticity of cif prices to distance of: 0.06 ($0.038 \times 0.26 + 0.962 \times 0.005 = 0.058$). This means that more than 80% of the change in import prices is due to the indirect effect of distance on fob prices ($0.05 \times 0.962/0.06$).[23]

Using the elasticity of import prices to distance and the elasticity of transport costs to distance, it is easy to compute the elasticity of import prices to transport costs. It is equal to 0.23 ($0.06/0.26 = 0.23$). This means that about one fourth of the changes in transport costs are passed on import prices.

Welfare gains from trade liberalization emphasized by the literature are mainly due to two effects: an increase in the number of varieties available to consumers and a decrease in the prices paid by consumers. Traditionally, two mechanisms explain the drop in prices. First, the direct effect linked with the drop in transport costs. Since part of the import price paid by consumers includes the cost of shipment, reducing this cost mechanically reduces the consumer price. Second, there is an indirect "pro-competitive" effect. Actually, in models with variable markups, the decline in transport costs increases competition and the pressure on firms' markups. The present results suggest that a third mechanism explains the fall in consumer prices following a trade facilitation. Following a decline in transport costs, firms react by charging a lower price net of transportation costs. Moreover, it appears this channel is far from negligible: after a drop in transport costs, 80% of the import price decline enjoyed by consumers is due to firms charging lower prices. The rest is attributable to the direct effect of

ratio between freight expenditure and the value of imports. Hummels and Skiba' s estimation relies on the ratio of freight expenditure over quantities. This is exactly T.

[23] We can see how important is the share of freight costs in import prices. For instance, if it was a bit higher, say 10%, the elasticity of import prices to distance would be 0.07 ($0.9 \times 0.05 + 0.1 \times 0.26$), and changes in freight costs would contribute to 1/3 of the change ($0.1 \times 0.26/0.07$).

transport costs on import prices.[24]

The direct effect of transport costs is very small since those costs account for a tiny share of final prices. By contrast, the indirect effect of a change in transport costs through fob prices is small, but changes in fob prices are almost entirely transmitted to import prices (96% of the change is passed on). Therefore in economies in which transport costs account for a tiny share of import prices, most of the action comes from changes in fob unit values. The next section discusses through which theoretical mechanisms distance and transport costs may affect those unit values.

4 Theoretical mechanisms

In most models of international trade, firms are expected to charge the same fob price to all countries or to reduce their markups to more distant ones.[25] This section reviews the different theoretical mechanisms that may explain the positive impact of distance on unit values found in the data. As noticed in Section 2, unit values are imperfect proxy for prices. As a result, one cannot interpret differences in unit values as differences in markups only.

First, firms may simply charge higher markups to more distant countries. This arises naturally if the elasticity of demand is increasing with distance, like in a CES model with additive transport costs.[26]

Second, firms may choose to sell upgraded versions of their product to more dis-

[24]The effect of a drop in transport costs on prices through a change in competition is not considered in the estimation.

[25]Some papers focus on dumping strategies: firms reduce their markup when exporting toward more distant countries to remain competitive (Brander, 1981; Brander and Krugman, 1983; Ottaviano et al., 2002; Melitz and Ottaviano, 2008). But most of the international trade literature gets rid of price discrimination in the interest of tractability. In models à la Krugman (1980) or Melitz (2003), firms charge the same markup across countries.

[26]See Greenhut et al. (1985), and Hoover (1937).

tant countries. Such quality upgrading is consistent with a CES model with additive transport costs where firms endogenously choose a destination-specific quality for their goods.

Third, if firms are multi-products within CN8 categories, the positive impact of distance on fob unit values may reflect the fact that the share of more expensive, higher quality varieties within firms and 8 digit level categories increases with distance. Such an explanation is consistent with both a composition effect due to additive transport costs as in Alchian and Allen (1964) and a selection of higher quality varieties (within firms) to more difficult markets. The selection effect may be driven by the presence of fixed costs, paid by multi-product firms, for each of their products. The mechanism is similar to Baldwin and Harrigan (2011), but the selection occurs within firms among products rather than among firms. Since only high qualities are sold in more difficult markets, the average price is higher in those markets.

Last, higher unit values in more distant markets may simply reflect some additional costs of shipping such as packaging costs included in the free-on-board prices.

It is worth emphasizing that most of these mechanisms are connected to the Alchian-Allen conjecture: the relative demand for more expensive/higher quality goods increases with transport costs. Interestingly, this demand-driven mechanism builds on the hypothesis of non-multiplicative transport costs. This hypothesis may explain the first two mechanisms. Actually, both the markup and the quality upgrading mechanisms can easily be sketched in a monopolistic competition CES model with per unit transport costs (rather than (multiplicative) iceberg ones). The intuition is straightforward. A higher per unit cost implies that the share of the producer (fob) price in the final price paid by the consumer reduces. Therefore, the perceived impact of producer price changes is also lessened. This offers some room for firms to increase their prices.

More formally, the introduction of a per unit cost changes the results concerning the relationship between prices and transport costs (in some models) because it introduces a disconnection between the elasticity of demand to the cif price and the elasticity of demand to the fob price. Assuming that the transport cost has both an additive and a multiplicative component, it is easy to show that the elasticities of demand to cif and fob prices are linked by the following equation.

$$\epsilon^{fob} = \epsilon^{cif}/(1 + \frac{T}{\tau p_{fob}}) \tag{1}$$

where $\epsilon^m = \frac{\partial log(demand)}{\partial log(p_m)}$ with $m \in (cif, fob)$. In the case of pure iceberg transport cost, T is nil and the elasticities of demand to fob and cif prices are the same. By contrast, for a given elasticity of demand to the cif price, the elasticity of demand to fob price decreases in T. All else equal, with an additive transport cost, the demand is less responsive to changes in prices. Therefore, remote firms are able to set higher fob prices, which allows them to compensate a part of the loss due to the lower demand they face because of freight costs.

The last discussion assumes that distance impacts the fob price only through T. However, in a lot of models such as quasi linear demand models, the elasticity of demand to cif prices positively depends on the cif price itself. Consequently with additive transport costs, two opposite forces are at stake. The elasticity of demand to fob price tends to decline due to the additive cost, but it also increases because the cif price increases due to higher transport costs. In linear demand models, the price effect dominates, therefore the elasticity increases with transport costs and distance and prices decrease with distance. This results holds if prices not only depend on markups but also on the quality of the exported product. This is shown more formally for the CES and quasi

linear models in Appendix E. In particular, in a CES model in which firms endogenously choose the (costly) quality they serve in every market, the quality is higher in more distant countries only if firms face per unit transport costs. By contrast, in a quadratic model, firms choose to sell lower quality in more distant markets whatever the structure of transport costs.

The composition mechanism is even more closely related to Alchian-Allen's original statement. If firms are multi-product within CN8 categories, in the presence of per unit transport costs, the relative demand for higher quality varieties is expected to increase with distance. By contrast, the selection mechanism is a supply mechanism that does not require per unit transport costs.

5 Conclusion

Using highly detailed data on bilateral trade of French exporters, this paper finds that firms charge higher free on board unit values on exports to more distant countries. This result is robust to the inclusion of other determinants of export prices such as the wealth, the size, the level of competition, and the tariffs faced by French exporters in the destination country.

The positive impact of distance on free-on-board unit values is far from negligible. After a drop in transport costs, about 80% of the import price decline enjoyed by consumers is due to firms charging lower prices net of transport costs. The rest is attributable to the direct effect of a drop in transport cost on consumer prices. This suggests a potential new channel through which changes in transport costs may affect welfare.

However, several mechanisms may explain the positive impact of distance on fob unit values: higher markups, higher quality, composition effects, selection effects, or costs of

packaging. Understanding the contribution of these mechanisms is the next step before we can evaluate precisely the gains from trade linked with this feature of the data.

A Appendix. Data.

Distances are from the dataset developed by Mayer and Zignago (2006). [27]

Real GDP and GDP per capita in PPP, from the IFS database, are used as control variables. We also use average imported unit values by country. These unit values are computed from BACI, the database of international trade at the product level developed by Gaulier and Zignago (2008).[28]

For each hs6 product and country, average unit value weighted by the quantities are computed. For product k in country j :$UV(kj) = \sum w_{ijk} UV_{ijk}$. Where UV_{ijk} is the unit value of the good k imported from country i to country j. And w_{ijk} is the weight of good k exports from country i. Then these hs6 unit values are merged with customs data. Thus for each product exported from a French firm in 2003, we have the corresponding average unit value in each potential destination market.

In our empirical analysis we also investigate the interplay between distance and product differentiation. Product differentiation is measured by the elasticity of substitution between products within narrowly defined sectors. Information on this comes from Broda and Weinstein (2006).

As a robustness check, I control for the Real market potential in the destination market. I use the Head and Mayer market potential computed for 144 countries at the industry level (ISIC rev2, 3 digit). See Mayer (2008) for details on the computation of the market potentials and the database.

Last, a measure of the quality of institution is introduced as a control variable. I use the ICRG index which is a composite score giving the risk exposition of countries. More details are available at the following address:

[27] Data are available on CEPII's website: *http* : *//www.cepii.fr/anglaisgraph/bdd/distances.htm*.
[28] For a description of the database, see *http* : *//www.cepii.fr/anglaisgraph/bdd/baci.htm*.

http : *//www.prsgroup.com/ICRG_Methodology.aspx*.

B Appendix. Methodology.

The alternative methodology to clustering proposed by Harrigan (2005) consists in a two way error component model. The basic idea is to introduce both firm× product fixed effects and country random effects. Since one cannot run such a regression, one first removes the firm and product means from all variables and then runs the random effects regressions on the transformed variables as indicated in this paper.

C Appendix. Empirical Results.

Table C.1: Price and distance, mixed effects, 2003

Dependent variable:	Price (log)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance (log)	0.057^a	0.059^a	0.055^a	0.068^a	0.081^a	0.092^a	0.068^a	0.081^a	0.093^a
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
GDP (log)				-0.006^a	-0.002	0.017^a	-0.006^a	-0.002	0.017^a
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita (log)				0.022^a	0.036^a	0.030^a	0.021^a	0.036^a	0.030^a
				(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Mean UV (log)							0.016^a	0.010^a	0.007^a
							(0.001)	(0.001)	(0.001)
Fixed effects	Firm × Product								
Random effects	Country								
Sample:	All	OECD	Eurozone	All	OECD	Eurozone	All	OECD	Eurozone
Observations	1,199,711	910,108	591,733	1,199,711	910,108	591,733	1,198,282	909,398	591,268
rho	0.015	0.009	0.000	0.015	0.006	0.000	0.013	0.005	0.000

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by the GDP per capita, the size of the destination country measured by the GDP, and the level of competition in the destination country measured by the average unit value of imports in this country. In columns 1, 4, 7 all destinations are considered. In columns 2, 5, 8 only exports toward OECD countries are considered. In columns 3, 6, 9, only exports toward euro countries are considered. Country random effects are added to control for unobserved heterogeneity. Robust standard errors in parenthesis. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

D Appendix. Comparison with the literature

I build on the following equations from Irarrazabal et al. (2010). The authors define $B_n^k = t_n^k \times \left(\tau_n^k / \bar{z}_n^k\right)$, where t is the per unit transport cost, τ is an iceberg trade cost and $\bar{z}$ is the productivity of the least efficient exporter. For simplicity it is assumed $\tau = 1$. The fob price charged by a firm with productivity relative to the cutoff z is:[29]

$$p_n^k(z) = \frac{\sigma w t_n^k}{\sigma - 1}\left(\frac{1}{z B_n^k} + 1/\sigma\right)$$

where p is the fob price, w is the unit cost, σ is the elasticity of substitution among goods, and z is the productivity of the firm measured relative to the cutoff.

The elasticity of fob price to transport cost for firm with relative productivity z is simply:

$$\frac{\delta log(p_n^k(z)}{\delta log(t_n^k)} = 1/\left(1 + \sigma/(z \times B_n^k)\right) \tag{D.1}$$

The average elasticity is:

$$\frac{\delta log(p_n^k)}{\delta log(t_n^k)} = \int_1 1/\left(1 + \sigma/(z \times B_n^k)\right) dF(z) \tag{D.2}$$

where $F(z)$ is the distribution of firm productivity.

Computing it requires some values for σ, B_n^k and to know the distribution F. I follow the authors and assume an elasticity σ of 4 and a Pareto distribution with a parameter of 1.31. We derive B_n^k using their estimate of the trade cost relative to average consumer prices. Namely, they estimate:

$$\frac{w t_n^k}{\bar{p}_n^k} = \frac{\sigma - 1}{\sigma} \frac{B_n^k(\gamma + 1)}{\gamma + B_n^k(\gamma + 1)}$$

[29] Notice that the focus is on the fob price and not the cif price as in the paper.

where γ is the Pareto parameter. B is solved given the authors' assumptions $\sigma = 4$, $\gamma = 1.31$ and their estimation: $\frac{wt_n^k}{\bar{p}_n^k} = 0.35$. This gives $B = 0.496$. Then, I solve equation D.2 numerically which yields an average elasticity of fob price to transport costs of 0.23.

E Appendix. Theory.

This section discusses the impact of transport costs on markups, quality and prices depending on the structure of transport costs, the nature of demand and the capacity of firms to adapt the quality of their products. In particular, it focuses on CES and quasi linear demands, with exogenous or endogenous quality choices, in presence of both iceberg and per unit costs.

Framework

No assumption is made on who pays or how transport costs are passed-on to the consumer, but the structure of transport cost is specified:

$$Transport\ Cost = p_{fj}^{cif} - p_{fj}^{fob} = (\tau_{fj} - 1)p_{fj}^{fob} + T_{fj} \tag{E.1}$$

where f and j denote respectively the firm and the destination country, p^{fob} is the fob price, p^{cif} is the price faced by the consumer, w is the marginal cost of production and T and τ are the additive and multiplicative components of the transport cost. If T is nil the transport cost has an iceberg form whereas if τ is one, it is a per unit transport cost.[30] As long as T is strictly positive, the transport cost is less than proportional to

[30]This formulation is restrictive, but it allows us to highlight the different predictions one can get when modifying τ and T. It is similar to Hummels and Skiba (2004) but here it is assumed that both the ad-valorem and the additive parts increase with distance. In Harrigan and Deng (2008), the

the fob price. Several assumptions common in trade models bear on firms behavior. First, the firm's strategy in a given market is supposed to be independent from its strategy in other markets. The second assumption is that in market j, the firm faces a mixed transport cost (see Equation E.1). Last, it is assumed that the firm maximizes the following operational profit:

$$\pi_{if} = \left[p_{fj}^{fob} - w_f\right] q_{fj} = \left[(p_{fj}^{cif} - T_{fj})/\tau_{fj} - w_f\right] q_{fj} \tag{E.2}$$

where q_{fj} is the quantity sold on market j (that depends on the cif price) and w is firm specific but constant across markets.We further assume that firms are in monopolistic competition.

CES demand

In Krugman (1980) or Melitz (2003) type models, firms face the following inverse demand:

$$p_{fj}^{cif} = k_j q_{fj}^{-1/\sigma} \lambda^{(\sigma-1)/\sigma} \tag{E.3}$$

with k a positive parameter, exogenous for the firm, and σ the elasticity of substitution, greater than 1. In this type of model, k is in general a function of the size of the destination country and the price index in the destination country. λ is a taste/quality parameter. A high quality shifts up the demand for the variety. In a first step, λ is supposed to be exogenous.

Since λ is exogenous, it is dropped this paragraph. Firm f maximizes its operational profit (eq. E.4) on market j considering a CES demand (eq. E.3). The program is

transport cost also depends on physical characteristics of the good. Here we implicitly assume that physical characteristics of a product sold on different markets by a firm are identical.

given by:

$$arg\ max_{p^{cif}} \left[(p_{fj}^{cif} - T_{fj})/\tau_{fj} - w_f\right] \left[\frac{p_{fj}^{cif}}{k_j}\right]^{\sigma} \tag{E.4}$$

The first order condition of the maximization program yields:

$$p^{fob} = \frac{1}{\sigma - 1}(\frac{T}{\tau}) + \frac{\sigma}{\sigma - 1}w \tag{E.5}$$

If the transport cost has the standard iceberg structure ($T = 0$), the fob price is a constant markup over marginal costs. This is the textbook case of a large part of trade models (Krugman, 1980; Melitz, 2003; Baldwin and Harrigan, 2011).

By contrast, if the transport cost is per unit ($\tau = 1$), then the markup is increasing in transport costs. That is the first possible channel through which prices may increase with distance.

Firms may also adjust the quality of their product depending on market characteristics. Here we focus on the distance to the destination market. If quality is costly, then the relationship between prices and transport costs could be driven by changes in the quality of the exported product.[31]

The inverse demand is given by equation E.3. In a first step, the optimal price is computed. The first order condition of the maximization of firm's profit with respect to price gives the same result as the exogenous quality case but the marginal cost now depends on the quality level:

$$p^{fob} = \frac{1}{\sigma - 1}(\frac{T}{\tau}) + \frac{\sigma}{\sigma - 1}w(\lambda) \tag{E.6}$$

Here one sees that the price depends on transport costs through τ and T but transport cost could also impact the price indirectly by affecting λ and so $w(\lambda)$.

[31] An existing model where the quality is explicitly destination specific is Verhoogen (2008).

To find the optimal level of quality, the firm maximizes its profit with respect to λ, replacing price by the expression of the first step. Firms maximize the following profit:

$$\Pi = \frac{\sigma^{-\sigma}}{(\sigma-1)^{1-\sigma}} \frac{k^{\sigma}\lambda^{\sigma-1}}{\tau} (T + \tau w(\lambda))^{1-\sigma} \tag{E.7}$$

Assumption that w is exogenous is relaxed when considering that quality is market specific. Producing a better quality increases your demand but is costly. Thus, one considers that the marginal cost $w(\lambda)$ is a function of quality. The following assumptions are made. The marginal cost is increasing in quality and convex ($\partial w(\lambda)/\partial\lambda > 0$ and $\partial^2 w(\lambda)/\partial\lambda^2 > 0$). If marginal cost does not increase in quality then a price increase cannot be thought as a quality upgrading phenomenon. This assumption is in line with recent empirical evidence showing that quality requires high skilled workers and higher quality inputs.[32] The second assumption ensures that it is sufficiently costly to produce quality to not choose an infinite quality. The third assumption, $w(0) > 0$, states that even if the firm produces a nil quality, it faces a positive cost. Under this assumption, the elasticity of costs to quality is not a constant which is a necessary condition to have a finite solution. Last, the elasticity is supposed to be greater than or equal to one for all positive levels of quality ($\partial ln(w(\lambda))/\partial ln(\lambda) \geq 1, \forall\lambda \geq 0$). This last assumption is in fact a combination of assumptions on convexity of costs and non nil marginal costs. It is useful to check the second order condition.

The first order condition with respect to λ is equivalent to:

$$\frac{\partial\Pi}{\partial\lambda} = 0 \Leftrightarrow T/\tau + w(\lambda) - \lambda w'(\lambda) = 0 \tag{E.8}$$

Let's consider the function $H(\lambda, \tau, T) = T/\tau + w(\lambda) - \lambda w'(\lambda)$. The function H is a

[32] See Kugler and Verhoogen (forthcoming).

decreasing function of λ ($\partial H/\partial\lambda = -\tau\lambda w''(\lambda)$) because costs are convex in λ. $H()$ is a positive function of T. It is a negative function of τ if T is non nil and does not depend on τ else.[33]

$H(0,\tau,T)$ is positive. When λ tends to infinity, the limit of $H(\lambda,\tau,T)$ is negative. And H is a decreasing function of λ. Therefore there exists a unique point λ^* such that $H(\lambda^*,\tau,T) = 0$. To understand how λ changes with per unit and iceberg transport costs we use the property that in the neighborhood of λ^* the total derivative of H with respect to τ or T should be equal to zero. Hence:

$$\frac{\partial H(\lambda,\tau,T)}{\partial\tau} + \frac{\partial H(\lambda,\tau,T)}{\partial\lambda}\frac{\partial\lambda}{\partial\tau} = 0 \tag{E.9}$$

and

$$\frac{\partial H(\lambda,\tau,T)}{\partial T} + \frac{\partial H(\lambda,\tau,T)}{\partial\lambda}\frac{\partial\lambda}{\partial T} = 0 \tag{E.10}$$

Since H is decreasing in λ and τ and increasing in T, for the two identity to hold one must have: $\partial\lambda/\partial\tau < 0$ if T is strictly positive, $\partial\lambda/\partial\tau < 0$ if T is nil, and $\partial\lambda/\partial T > 0$. Therefore under CES demand, if they have the possibility, firms increase the quality of exported product when per unit transport costs are higher. Since i) prices depend positively on marginal costs, ii) marginal costs increase with the level of quality, and iii) the level of quality itself increases with per unit transport costs, then prices increase with per unit transport costs. However, neither the quality nor the markup vary when transport costs have an iceberg formulation. Neither does the price.

[33]Note that the derivative of H with respect to τ is negative if the elasticity of costs to quality is equal to or greater than 1. If not, there is no solution to this equation. The first order condition cannot be verified but if $\lambda = 0$ which implies a nil demand.

Quasi linear demand

While CES models are omnipresent in international trade, several papers consider quasi linear demand (Ottaviano et al., 2002; Melitz and Ottaviano, 2008). In such models, firms face the following inverse demand function:

$$p_{fj}^{cif} = z_j - k_j q_{fj} \tag{E.11}$$

where j and f denote the firm and the destination country respectively, and z and k are a positive parameters, exogenous for the firms. z includes the price index.[34] k is a positive parameter capturing the degree of differentiation across varieties. In the rest of the paper, we drop the subscripts f and j.

It is first assumed that quality is exogenous. The program of the firm is to maximize its operational profit (eq. E.4) given the linear demand (eq. E.11). The first order condition yields:

$$p^{fob} = \frac{1}{2}(\frac{z}{\tau} - \frac{T}{\tau}) + \frac{w}{2} \tag{E.12}$$

The price net of transport cost negatively depends on transport costs whatever their structure. This has already been verified in the literature: Ottaviano et al. (2002) use a per unit transport cost whereas Melitz and Ottaviano (2008) use an iceberg one and in both models firms absorb part of the transport costs.

The link between prices and transport costs is explored in a quasi linear demand model in which firms choose the level of quality they produce. Quality is introduced in this framework through an additive shifter as in Antoniades (2008):

$$p^{cif} = z - kq + \alpha\lambda \tag{E.13}$$

[34] For expositional ease, we consider a population of size 1.

In Antoniades (2008) the marginal cost does not depend on the level of quality. Instead, the fixed cost is increasing in quality. In what follows, it is assumed the marginal cost is increasing and convex in quality. Furthermore, it is assumed that $w'(0) = 0$ which is a sufficient condition for the second order condition to be verified.
In the first step, firms set their optimal price, taken quality as given. The price is the same as without quality.

$$p^{fob} = \frac{1}{2}(\frac{z+\lambda}{\tau} - \frac{T}{\tau}) + \frac{w(\lambda)}{2} \tag{E.14}$$

In a second step, the firm maximizes its profit with respect to quality level. Firm's profit is:

$$\Pi = \frac{1}{4k\tau}(z - T + \lambda - \tau w(\lambda))^2 \tag{E.15}$$

The first order condition with respect to λ yields:

$$H(\lambda, \tau, T) = 1 - \tau w'(\lambda) = 0 \tag{E.16}$$

Function H is positive if $\lambda = 0$ and the limit of H tends to negative infinite when λ tends to positive infinity. There exist a optimal point in which H is nil. At the neighborhood of this point, the derivative of H with respect to τ has to be nil:

$$-\frac{\partial w(\lambda)}{\partial \lambda} - \frac{\partial^2 w(\lambda)}{\partial \lambda^2}\frac{\partial \lambda}{\partial \tau}\tau = 0 \tag{E.17}$$

Since costs are increasing in λ and convex, the equality holds if $\partial\lambda/\partial\tau$ is negative.
Thus, in quasi-linear demand models, firms reduce the quality they export when iceberg transport costs increase. The level of quality is independent of per unit costs. Since under this framework firms reduce their markup, the overall effect of transport costs

on prices is negative, whatever the structure of transport costs.

Table C.2: Price and distance intervals, mixed effects

Dependent variable:	Price (log)		
	(1)	(2)	(3)
$1500 < distance < 3000$	0.024^a	0.026^a	0.026^a
	(0.002)	(0.002)	(0.002)
$3000 < distance < 6000$	0.085^a	0.108^a	0.108^a
	(0.003)	(0.003)	(0.003)
$6000 < distance < 12000$	0.115^a	0.136^a	0.135^a
	(0.002)	(0.002)	(0.002)
$12000 < distance$	0.145^a	0.141^a	0.140^a
	(0.006)	(0.006)	(0.006)
GDP (log)		-0.006^a	-0.006^a
		(0.000)	(0.000)
GDP per capita (log)		0.022^a	0.021^a
		(0.001)	(0.001)
Mean UV (log)			0.018^a
			(0.001)
Fixed effects	Firm × Product		
Random effects	Country		
Sample:	All	OECD	Eurozone
Observations	1,199,711	1,199,711	1,198,282
rho	0.000	0.000	0.000

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by the GDP per capita, the size of the destination country measured by the GDP, and the level of competition in the destination country measured by the average unit value of imports in this country. Distance is measured using distance interval. Dummy is equal to 1 if the destination country belongs to the interval and 0 otherwise. Country random effects are added to control for unobserved heterogeneity. Robust standard errors in parenthesis. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

Table C.3: Price and distance, robustness

Dependent variable:	Price (log)					
	(1)	(2)	(3)	(4)	(5)	(6)
Dist (log)	0.050^a	0.052^a	0.017^a	0.065^a	0.077^a	0.013
	(0.010)	(0.012)	(0.003)	(0.008)	(0.009)	(0.008)
GDP (log)	-0.005	-0.002	0.000			
	(0.004)	(0.007)	(0.001)			
GDP cap (log)	0.027^a	0.060^b	0.029^a	0.010	0.017	0.018^b
	(0.008)	(0.026)	(0.006)	(0.006)	(0.014)	(0.006)
Mean UV (log)	0.017^a	0.010^c	0.003	0.016^a	0.010^a	0.005^b
	(0.005)	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)
IRCG index	-0.034	-0.047	-0.040^a			
	(0.020)	(0.038)	(0.007)			
Market potential				0.008	0.017^b	0.000
				(0.006)	(0.007)	(0.003)
Fixed effects	Firm × Product					
Sample:	All	OECD	EU	All	OECD	EU
Observations	1,170,543	909,398	591,268	818,563	672,936	428,236
R^2	0.005	0.006	0.000	0.007	0.009	0.000
rho	0.911	0.922	0.933	0.907	0.916	0.926

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by GDP per capita, the size of the destination country measured by GDP, the level of competition in the destination country measured by the average unit value of imports to this country, the quality of institution measured by the ICRG index, and the Head and Mayer market potential of the destination country (computed at the 3 digit level). Distance is measured using distance interval. Dummy is equal to 1 if the destination country belongs to the interval and 0 otherwise. Reported standard errors are clustered by country. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

Chapter 2

Price dispersion and the Euro [1]

1 Introduction

More than ten years after the creation of the European Monetary Union (EMU), it becomes possible to empirically assess how the monetary integration has affected market equilibria in Europe. By furthering market integration, EMU was expected to impact trade patterns within the monetary zone as well as between EMU and the rest of the world; this is the well-known *Rose effect*.[2] Another manifestation that has been less investigated in the empirical literature is the impact of EMU on the dispersion of prices. According to the law of one price (LOOP), an integrated market should have a unique price for each (properly defined) product. And deviations from this unique price can be related to the degree of economic integration. Anything furthering market integration, notably the creation of a currency union, is expected to induce a convergence toward

[1] This chapter is based on two papers written with Isabelle Méjean (Ecole Polytechnique). The first paper has been published in French in Economie et Statistique in 2011 under the title "Euro et dispersion des prix à l'exportation". The second paper is a new version of the paper in French, with two new sections devoted to firm heterogenity, and the macroeconomic consequences of this heterogeneity.

[2] See Rose (2000) or Baldwin et al. (2008).

the LOOP.

This idea was one of the arguments that proponents of the monetary integration were pushing forward. On its website, the EU Commission was thus assessing that the Euro was going to increase price transparency, mute exchange rate fluctuations between members, and increase competition.[3] Altogether, those effects were expected to ease arbitrage behaviors, reduce markups, and in turn lower price dispersion. This paper proposes an empirical test of the previous price convergence effect, asking whether the introduction of the Euro has induced a reduction in the dispersion of prices inside the Euro area.

The test is conducted using export data describing the prices set by French exporting firms in each of their destination markets. The sample is quasi-exhaustive, covering the universe of French exporters over the period from 1996 to 2005. For each firm, detailed information is provided about its bilateral exports, including the price set in each single market, before any transportation cost is added. These "Free On Board" (FOB) prices are interpreted as reflecting the pricing strategy of the firm.

At the firm- and product-level, the data exhibits quite a huge amount of price dispersion across (OECD) destination markets. Surprisingly, the magnitude of price discrepancies is almost unchanged once the sample is restricted to EU destinations. These price discrepancies are attributable to French exporters discriminating their foreign markets, even within a fairly well integrated area. Would arbitrage be perfect, such price differentials would be unsustainable. We thus interpret the dispersion of prices as evidence of deviations from the LOOP. Based on this, we ask whether the introduction of the European common currency has reduced such deviations, leading to a convergence of prices between European markets, within firms.

[3]See: $http://ec.europa.eu/economy_finance/euro/why/consumer/index_en.htm$

Our results indicate that the Euro adoption has significantly reduced the price discrimination of French firms toward EMU countries. Using a difference-in-difference strategy with the rest of the European Union as control group, we show that the relative price dispersion in the Euro area is reduced by about 3 percentage points due to the single currency. Though significant, the quantitative effect we obtain is thus small. However, we also document an heterogeneity across firms in the size of price discrimination and the effect of the Euro. In particular, we show that large firms have been more impacted by the single currency: while they tend to discriminate more than the average firm before EMU, the dispersion of their prices has strongly reduced after the Euro has been introduced. Given that these firms account for the lion's share of French exports, their behaviors are likely to matter at the aggregate level. When we account for the heterogeneity across firms, we indeed find a much larger impact of the Euro on price dispersion. Namely, the single currency lowered by 17 percentage points the relative dispersion of prices with the euro area.

This empirical analysis is related to a large literature testing how market integration affects the magnitude of deviations from the LOOP. With respect to this literature, our main contribution is to provide empirical evidence that are directly interpretable in terms of micro-level price strategies. This is not the case of product-level studies[4] that are not able to identify the producer of the goods which prices are observed. In such studies, the price effect of the monetary integration identified in the data is related to mean prices of a given product category converging across countries after the common currency has been introduced. But the convergence can be due to two alternative factors: either did the common currency change the extent of price discrimination, or did it affect the composition of the local supply, with an end effect on mean prices.

[4]See among others Lutz (2003) and Engel and Rogers (2004). Both find that the introduction of the Euro has had a small to negligible effect on price dispersion and price convergence.

Both explanations are observationally equivalent at the product-level, while they are not at the firm-level. The price convergence we observe in our data can directly be interpreted as evidence of exporting firms adjusting their pricing strategies following the institutional shock.[5]

In the literature, a few papers are able to identify the identity of the producing firms, and test how EMU has affected their pricing policies. These studies focus on very specific products, the European automobile market in Goldberg and Verboven (2001) and Gil-Pareja and Sosvilla-Rivero (2008) and electronic products sold online in Baye et al. (2006). These studies find contrasted results for the price impact of the Euro. Namely, EMU is found to increase the convergence of prices in the automobile industry but not for electronic products. While cars and electronics are interesting products, the drawback of using data on a single product is clearly related to the lack of generality for the results. Our results instead cover a very broad array of products.

The paper is also in line with recent studies evaluating the gain from EMU integration using firm-level trade data (Fontagné et al., 2009). The novelty of this approach is that it allows asking how institutional shocks are perceived by firms and whether their individual responses are heterogenous. In that respect, our paper is closely related to Méjean and Schwellnus (2009). They study the convergence of prices within and outside the EU and how it is affected by extensive versus intensive adjustments. We instead explicitly focus on the natural experiment of monetary integration that EMU provides and study price differentials across countries rather than the dynamics of relative prices.

Finally, our paper is related to Berman et al. (2011). Their estimates suggest that

[5] As a related advantage over the literature, our dataset provides us with price data which *level* is interpretable. Instead, a number of papers is forced to focus on the time path of relative prices, based on price indices (Engel, 1993; Engel and Rogers, 1996). Crucini et al. (2005) emphasize that the LOOP is better suited for an interpretation in terms of levels rather than in terms of price changes.

more productive exporters adjust more their markup and less their volume than less productive ones following an exchange rate shock. We also document such an heterogeneity in firms' pricing strategies following macroeconomic shocks. In particular, our estimates suggest that large firms have been more impacted by the facilitation of arbitrage behaviors that followed the introduction of the Euro.

The rest of the paper is organized as follows. The next section discusses the theoretical channels through which the introduction of the Euro may impact the extent of price discrimination. Section 2 describes the data and provides some stylized facts. Section 5 presents the empirical strategy and details the results. Section 7 concludes.

2 Theoretical background

This section details the different mechanisms through which the introduction of the Euro may impact firms' price discrimination. By definition, a firm price discriminates if she sets different prices depending on the market she serves. According to Knetter and Slaughter (1999), price discrimination is due to i) differences in characteristics of demand across markets that provide incentive to discriminate, and ii) the ability of firms to exploit those differences in presence of arbitrage costs. There is no obvious reason why the introduction of a single currency should affect consumer preferences, thus the incentive for firms to price discriminate. However, monetary integration is expected to affect the cost of arbitrage over markets, therefore the ability of firms to price discriminate.

Arbitrage behaviors are the main barriers to price discrimination. As noticed by Asplund and Friberg (2001), the introduction of the Euro is expected to enhance these behaviors for two reasons. First, price comparisons are made easier when prices are

expressed in the same currency. Second, transaction costs, such as conversion costs, decrease or disappear. The strengthening of arbitrage behaviors should dampen the ability for firms to price discriminate and reduce price discrepancies.

These convergence forces may not be felt identically by all firms, however. In particular, the impact of reducing currency-related barriers to arbitrage is going to be all the stronger since these barriers are an important component of overall barriers to arbitrage for consumers of the firm's product. If, on the contrary, arbitrage is complicated because of physical reasons (high transportation costs), or the differentiation of products (e.g. instructions for the product to be edited in the local language), there is no reason to believe that price convergence will be severely affected by EMU. Since the nature of barriers to arbitrage is product and even firm-specific, one can expect EMU to have a heterogenous impact on different firms.

This effect is potentially amplified by greater competition resulting from the monetary integration. If it pushes new firms to enter the market, monetary integration may have a pro-competitive effect.[6] This will force firms to price closer to their marginal costs, which mechanically reduces price dispersion. Once again, the impact of such a pro-competitive effect is likely sector- and even firm-specific.[7]

In addition to its effect on the ability of firms to price discriminate, the Euro may affect the propension of firms to adopt such behavior. Friberg (2003) sketches a model in which firms have to pay a fixed cost to segment markets. In this framework, firms' optimal price is a function of the exchange rate and the option value of investing in

[6] See Melitz and Ottaviano (2008) for the theory, and Chen et al. (2009) for empirical evidence on the pro-competitive effects of European integration.

[7] A additional channel through which EMU may induce a convergence of prices across countries is the harmonization of psychological prices. This argument is discussed by Friberg and Matha (2004). The intuition behind is straightforward. Psychological prices differ depending on the currency in which the price is expressed. Adopting a single currency standardize those psychological prices, thus withdrawing this source of price dispersion.

the "segmentation" technology depends on the expected volatility of the exchange rate. The adoption of a single currency thus reduces firms' incentive to pay the fixed cost, and to price discriminate. Méjean and Schwellnus (2009) show that, in this context, price discrimination is not only a function of current macroeconomic conditions but also of the firm's characteristics. Once again, this suggests that the optimal reaction of firms to enhance market integration is likely heterogenous. To strengthen this argument, let's sketch a highly stylized model in which heterogenous firms endogenously choose to segment markets or not.

Let's assume that firms (indexed by s) have a monopoly power on their variety. Firms serve two markets (1 and 2) and choose whether to pay a fixed cost of segmenting the two markets, or to charge the same price to all consumers, whatever the market. The cost of segmenting is denoted F, the profit of segmenting firms is π^S and the profit of non segmenting firms is π^{NS}. Firms face a (quasi) linear demand and differ by the consumers' willingness to pay for their product. Namely, they draw a demand shifter that can be interpreted as a quality parameter (DiComite et al., 2011).

The demand faced by firm s in country i is:

$$d_i(p_{is}) = \alpha_s \beta_i - \gamma_i p_{is} \tag{1}$$

For simplicity we assume that $\beta_1 = 1$, $\beta_2 = \beta > 1$, $\gamma_i = 1$, and that the marginal cost of production (c) is the same across firms. We further assume that all firms serve the two markets. They choose whether to segment markets or not and the price(s) and quantities sold on each market. They compare their profit with and without

segmentation, namely they compare the following two profits:

$$\pi^S = (p_{1s} - c)(\alpha_s - p_{1s}) + (p_{2s} - c)(\alpha_s\beta - p_{2s}) - F \quad (2)$$

$$\pi^{NS} = (p_{1s} - c)(\alpha_s - p_{1s}) + (p_{2s} - c)(\alpha_s\beta - p_{2s}) \; s.t. \; p_{1s} = p_{2s} \quad (3)$$

$$(4)$$

The gains to segment the market for firm s are given: $G(s) = \pi^S - \pi^{NS}$. Maximizing the profit with segmentation with respect to p_1 and p_2, and the profit without segmentation with respect to p, and taking the difference of the two profits yields:

$$G(s) = \frac{\alpha_s^2}{4}\left(\frac{3}{2} + \frac{3}{2}\beta^2 - \beta\right) - F \quad (5)$$

We see that firms with a high α_s - enjoying larger sales - are more likely to segment markets. Furthermore, the incentive to segment markets is a positive function of β meaning the gains to segment markets increase with market differentiation. Last, the incentive to segment markets is a decreasing function of the cost of segmentation F. As reviewed above, the introduction of the single currency was expected to ease arbitrage behavior and, as a result, reduce the segmentation of markets. In the context of our model, the facilitation of arbitrage behaviors maybe seen as a rise in the cost of segmenting markets. In such case, the introduction of the euro is expected to reduce firms' gains from market segmentation. Of course, the only firms that are affected by the euro, are firms that used to segment markets. For those firms, we expect the variance of prices to decline to 0 after the introduction of the common currency.

The previous model implies that the incentive to discriminate is heterogeneous across firms of different sizes but that the costs of segmenting is the same. Another mechanism that would yield to an heterogeneity in the response of firms to the creation of the Euro

is that the single currency has increased more the cost of segmentation for large firms than for small firms. This may happen in a model in which arbitragers are supposed to pay a fixed costs for each variety they re-export. If they face such a fixed costs plus a variable cost, they are more likely to re-import large volume, ie. to re-import goods produced by large firms. In such case, the introduction of the Euro, by lowering the variable cost of conversion, could disproportionably increase the incentive of arbitragers to re-exports large volume. As a result the segmentation cost for large firms increases. Thus, large firms should reduce relatively more their level of price discrimination.

The different mechanisms stressed in this section suggest that (i) the Euro should dampen firms' price discrimination and (ii) this effect may differ across firms. The remaining of the paper tests these two predictions.

3 Data and stylized facts

3.1 Data

We use an individual database of export flows provided to us by the French customs. The dataset covers the 1996-2005 period, which allows us to study export prices before and after the introduction of the Euro. Data are disaggregated by firm and product, at the 8-digit level of the Combined Nomenclature (CN8).[8]

Our measure of export prices is based on unit values, defined as the ratio of value over quantity for each bilateral flow:

$$P_{fkjt} = \frac{Val_{fkjt}}{Qty_{fkjt}}$$

[8]The CN nomenclature is regularly updated, which is an issue when we want to follow products over time. Before starting working on the data, we thus apply the Pierce and Schott (2011) algorithm to harmonize CN8 categories over time.

where f, k, j and t respectively design a firm, a CN8 product, a destination market and a year between 1996 and 2005. Using firm and product data is particularly convenient when working on unit values because this price proxy is well-known to be biased by composition effects (Kravis & Lipsey, 1974). The more disaggregated trade data are, the more accurate the price proxy.

Even when working at the firm and product level, it may be the case that export unit values are biased. For instance, mis-declarations by French firms or reporting errors by the customs transmit into unit value errors. To account for this, we first apply an outlier treatment procedure to the raw data. Namely, we compute the median unit value for each product declared by a given firm in a particular year. We then delete unit values that are 5 times higher or lower than the firm and product-specific median. At this stage, the sample includes 205,689 firms declaring a total exported value of 2.91 trillion Euros. We however reduce it further, to OECD destinations. Since we want to compare export prices in the eurozone with that of an appropriate control group, it is convenient to keep countries of comparable development level. Besides, we drop Greece from our sample. Greece entered the Euro area in 2001 which raises issues when building our treatment and treated groups. The resulting database contains 12,997,607 observations, over 10 years (1996-2005), covering 28 countries (OECD less France, Greece, and Luxembourg, which is merged with Belgium in the customs data), 195,208 firms and 8,987 products. The total export value is 2.39 trillion Euros.

Our measure of price dispersion aggregates the previously described firm- and destination-specific unit values at the level of the region. Namely, we compute the coefficient of variation of prices within the Euro area and in a control group:

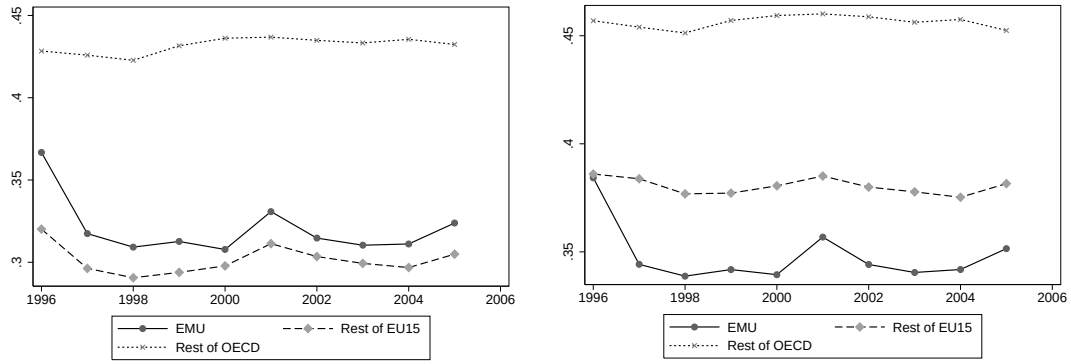
$$cv_{fkrt} = \frac{stdev(\{P_{fkjt}\}_{j \in r})}{mean(\{P_{fkjt}\}_{j \in r})}$$

where r is the region under consideration (either the EMU or the control group), $stdev(\{P_{fkjt}\}_{j\in r})$ is the standard deviation of prices, computed over the set of countries in r, and $mean(\{P_{fkjt}\}_{j\in r})$ is the average price in r. This statistics thus indicates the extent of price discrepancies set by a given firm for a particular product across countries of the considered area, which we assimilate to a measure of price discrimination.

3.2 Stylized facts

As a first description of the extent of price discrimination, Figure 1 illustrates the time evolution of the average price dispersion for different geographic areas (namely the EMU, the rest of the OECD, and the rest of the EU15). Here, each bar corresponds to the simple average, computed over firms and products, of the price discrimination indicators obtained for the corresponding zone. Its size is thus correlated with the "mean" level of price discrepancies within the area.

Figure 1: Average coefficient of variation, EMU vs Rest of the OECD



(a) Raw data

(b) Controlling for market access and wealth

For every region the average coefficient is computed on the universe of French exporting firms. In panel (b), prices are purged from wealth and market access effects.

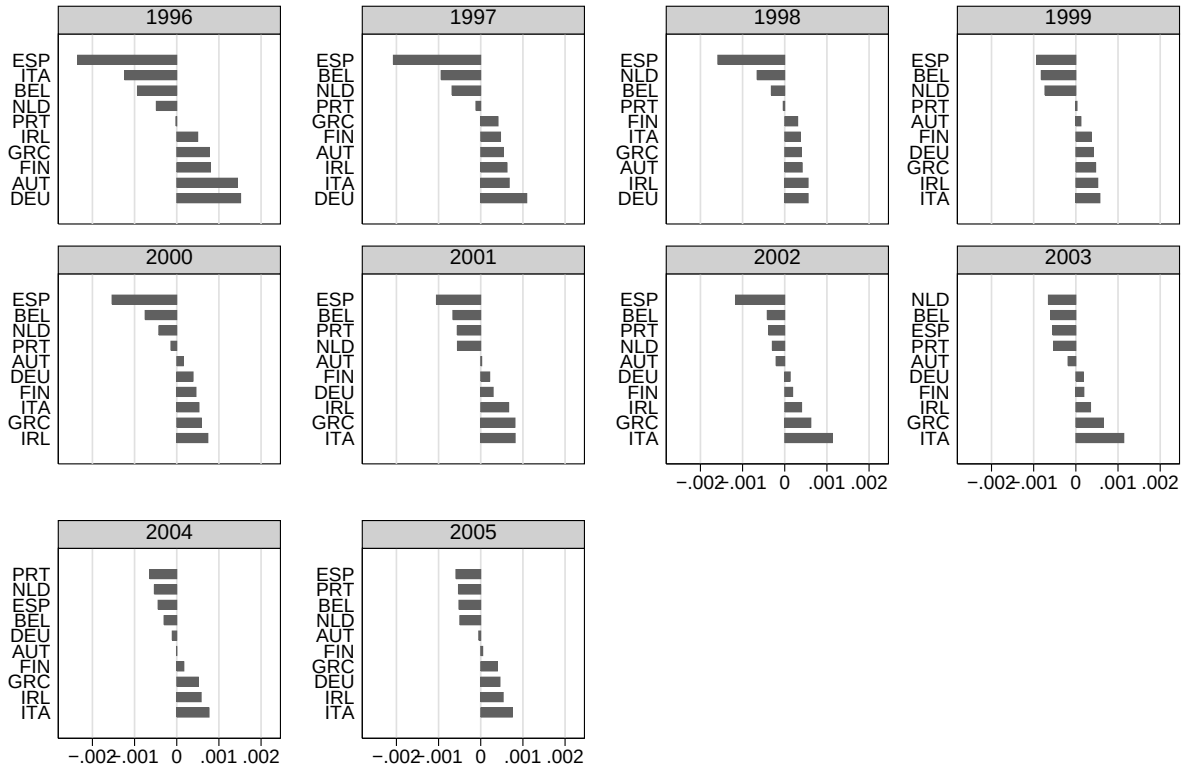
This graphs shows that the dispersion of prices set by a given firm is low, on average, in the EMU. Namely, the mean coefficient of variation is equal to 43% outside the European Union. Price discrepancies are marginally smaller in the eurozone and even more in the rest of the European Union. On average, the mean coefficient of variation is equal to 32% in the EMU and 30% in the rest of the EU.

At first sight, it may seem surprising that the dispersion of prices is higher in the EMU than inside the rest of the EU15. Other sources of price heterogeneity, that are orthogonal to the monetary integration, may however explain the counter-intuitive result. Hummels and Lugovskyy (2009) thus show that export prices depend on both the size and the wealth of the destination country. Within a group of countries, heterogeneity in these two country-specific characteristics may thus create some price dispersion. We control for these determinants of price discrepancies in panel (b) of Figure 1. Namely, we first regress unit values on the country's GDP, its distance to France and its GDP per capita. The residuals of this regression can be interpreted as the component of prices that is unrelated to size, market access and wealth effects. They are used to compute price dispersion indicators that are orthogonal to the previously described structural determinants. Once the correction is applied, the counter-intuitive result disappears. Namely, the residual price dispersion is the lowest in the EMU, followed by the rest of the European Union and the rest of the OECD.

The ranking of areas in terms of aggregate price dispersion seems to hold throughout the period. However, Figure 2 depicting the distribution of *intra-EMU price discrepancies* over countries and time shows a process of gradual convergence. Here, each bar corresponds to the average price deviation with respect to the EMU average for the corresponding member of the eurozone. The negative number obtained for Spain thus suggests individual firms tend to set lower prices, on average, on their Spanish market

than in other EMU countries. Comparing these histograms over time shows that both negative and positive country-specific deviations reduce throughout the period. This suggests that intra-EMU prices tend to converge.

Figure 2: Price deviations with respect to the EMU mean, French sample

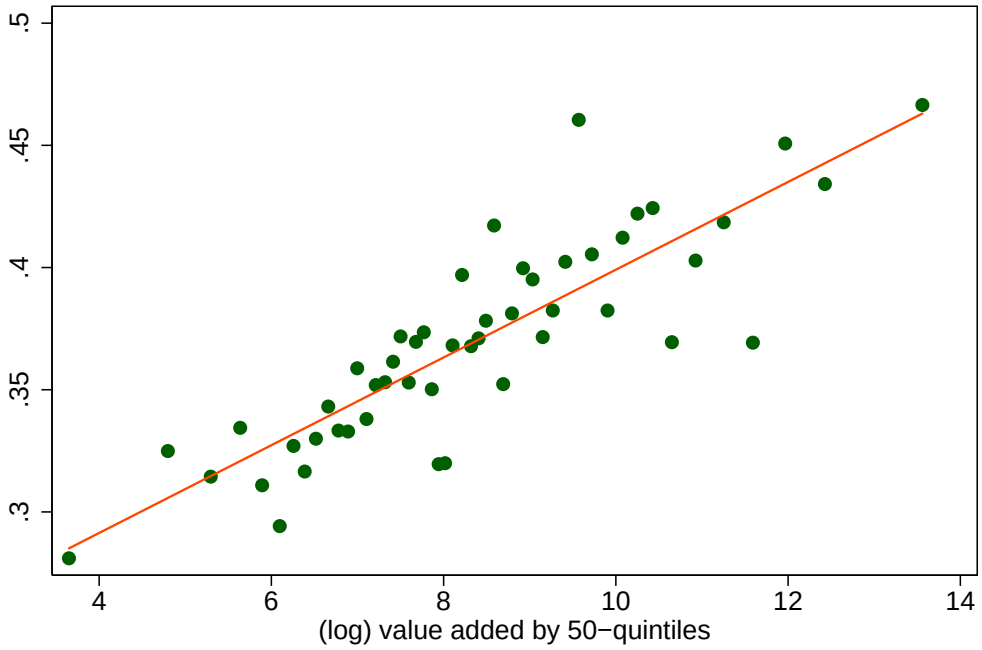


These average statistics thus suggest that French firms price discriminate across markets, that price deviations are lower toward EMU countries, and that, within the Euro area, price dispersion has decreased over time. Figure 3 goes deeper into the data, studying how these price behaviors vary across firms. Namely, we plot the size of price discrimination toward the Euro area by 50-quintiles of firms, ranked according to their value added, in 1996.[9] Within the population of French firms, more productive ones

[9]The relationship is robust to other firms characteristics such as TFP, employment or total sales.

seem to have the most pronounced price discrimination strategies as measured by more dispersed prices. This is consistent with the pricing behavior of firms being heterogenous, in our sample. The heterogeneity may also translate into a heterogenous response of firms to the monetary integration. We consider this possibility in section 4.2.[10]

Figure 3: Firms' size and price discrimination



This graph plots the average price dispersion toward the Euro area in 1996 computed by 50-quintile bins of value-added against the (logarithm of the) average value added of firms in those bins. Average dispersion is computed at the firm and product level and then average by bins. The linear fit indicates a positive relationship between firms' size and the size of price dispersion.

[10]Note that the link between firms' size and price dispersion might be due to an omitted variable bias. In particular, large firms export to many markets which mechanically increases price dispersion. Firm-product fixed effects correct such bias.

3.3 Estimation strategy

This subsection describes the difference-in-difference (DID) strategy we adopt to study the evolution of price discrimination.

The DID estimation is a useful tool when trying to measure the quantitative impact of a shock (here, the introduction of the Euro) on a specific group (EMU members). The method accounts for global trends that are disconnected from the shock using information on a control group that is not directly affected by the shock. More precisely, the DID strategy we use compares the magnitude of price discrepancies in the EMU before and after the Euro with that of an appropriately defined control group. For the effect to be interpretable in terms of the monetary integration impact, the control group has to be as similar as possible to the treatment group (the Euro area). We successively take the non-EMU members of the European Union (i.e. Denmark, Sweden and the United Kingdom) and the rest of the OECD. In theory, the first group is better suited to serve as control group since these countries have experienced the same economic policies aimed at increasing market integration as EMU members. However, the number of countries composing the reference group is small, this explains why we also test the robustness of our results using the rest of the OECD as control.

In the DID methodology, the variable of interest (the coefficient of variation here) is regressed on an intercept and three binary variables. The first dummy variable, called Euro, is equal to one for EMU members. The second one (Post99) takes a value of one in the years following the introduction of the Euro.[11] Last, the third dummy (Euro×Post99) interacts the Euro and Post99 binary variables. It is thus equal to one

[11] Here, we consider that the introduction of the Euro takes place in the beginning of 1999, i.e. when European exchange rates have been irrevocably fixed. An alternative date for the treatment could be January 2002, when bank notes and coins have been introduced. We ran the DID regressions with this treatment date. However, results are less accurate in this case because the treatment period is strongly reduced.

for EMU members since the introduction of the Euro. The estimated equation is:

$$cv^r_{fkt} = \alpha_{fk} + \beta EURO + \gamma POST99 + \delta EURO \times POST99 + u^r_{fkt} \quad (1)$$

The interpretation of estimated coefficients is the following. The constant gives the average size of price discrimination for non EMU countries before 1999. It is possible to let it vary over firms and/or products in order to account for pre-existing heterogeneity in pricing behaviors. The Post99 dummy corresponds to the general trend in the magnitude of price discrepancies, after 1999. The Euro dummy captures the characteristics shared by all EMU members that should make price discrimination different within this set of countries over the pre-1999 period. Last, the Euro×Post99 dummy captures the impact that the introduction of the Euro has had on price discrimination toward EMU members.

The DID strategy is particularly suitable for our study because it allows us to clean out all the shocks that may affect the dispersion of prices but which are not specific to Euro countries. For instance, the surge in Chinese competition may discipline prices and reduce price dispersion. As a result a simple look at the dispersion of prices before and after 1999 could simply reflect the effect on dispersion of the surge in Chinese exports. The DID strategy allows us to purge out our estimates from such macroeconomic shocks common to countries of the treated and treatment groups.

There are of course some drawbacks associated with this method. In particular, if outcomes are serially correlated, the standard errors are often underestimated in DID regressions as pointed out by Bertrand et al. (2004). To limit such bias, we introduce firm×product fixed effects to get rid of firms specific trend. Furthermore, we use two techniques proposed by Bertrand et al. (2004) to limit the underestimation of standard

errors. First, we ignore the time series information of the data. Namely, we pool the data in the time dimension before and after the introduction of the Euro. Second, we apply variance-covariance matrix corrections by computing robust or clustered standard errors.

4 Results

4.1 Difference in difference estimates

To evaluate whether the introduction of the Euro in 1999 has reduced price discrimination strategies of exporting firms, we apply the difference in difference method (DID) with the non-EMU members of the European Union as control group.

Results are presented in Table 1. We first run benchmark regressions (columns 1 and 4) in which the DID dummies are the only control variables. In the second and fifth columns we control for the variance in market access and wealth of the bundle of countries served by the firm. Finally, Columns 3 and 6 cluster the standard errors in the area dimension. In all specifications we control for unobserved heterogeneity using product fixed effects (columns 1-3) or fixed effects for each firm $\times$ product combination (columns 4-6).

Consistent with panel (a) of Figure 1, results confirm that the dispersion of prices is higher in the EMU than in the rest of the EU. The first regression documents an average positive gap of 12% (0.036/0.294 + 1=1.12) before 1999. Without the introduction of the Euro, the gap would have reached 13% after 1999 ([0.036+0.001]/[0.294+0.001]+1=1.13). Instead the relative price dispersion within the Eurozone has declined. Indeed, in the Euro period, price deviations become 7% higher in the EMU than in the rest of the EU ([0.036+0.001 -0.015]/[0.294+0.001]=1.07).

The effect is robust to the inclusion of control variables for the heterogeneity of countries within groups. In particular, when we control for the dispersion of group members' GDP and GDP per capita in column (2), we find that more dispersion in the characteristics of the destination countries increases the dispersion of export prices at the firm level. But those controls do not impact previous findings. The coefficient on the $Euro \times Post99$ dummy remains negative and highly significant. Finally, when we control for heteroscedasticity within areas (column 3), the coefficient of interest remains negative and significant at the 5% interval.

Controlling for unobserved heterogeneity in the firm-product dimension reduces the magnitude of the estimated EMU effect (columns 4 to 6). Once heterogeneity across firms in the magnitude of the average dispersion of their prices is accounted for, the remaining difference between the EMU and the rest of the EU in terms of their relative price dispersion strongly increases. Namely, for a typical firm in the pre-Euro period, the dispersion of export prices is 18% higher in the Euro area than in other EU countries (column 4). After the introduction of the Euro, the relative price dispersion decreases to 14%. Compared with the product fixed effects specification, this represents a smaller decline in EMU relative price dispersion of 3.5%. The effect even becomes non significant when standard errors are clustered in the area dimension (column 6).

The fact that our result is not significant in regression in which standard errors are clustered may mean that in other regressions, those standard errors are under estimated because of serial correlation. To check whether this effect plays a role, and to test the robustness of our results we apply the Bertrand et al. (2004) correction. Namely, we ignore the time dimension of our data by pooling observation before and after the treatment. Results are presented in Table A.1. The coefficients are close to what is estimated using the time dimension. Furthermore, the effects of the euro on

price discrimination is found to be statistically significant at the 1% level in all the specifications. Thus, it seems that, while small, the effect of the Euro is statistically significant.

To evaluate the robustness of our results to the choice of the control group, Table A.2 in Appendix presents results obtained when EMU is compared to the rest of the OECD. Overall results are consistent to those of Table 1. Namely, the impact of the Euro remains negative and significant in all specifications. Before the introduction of the single currency, prices are 12% less dispersed in the Euro area than in the rest of the OECD (Table A.2, column 1). After the introduction of the Euro, the gap increases to reach 17%. Absent the Euro, the gap would have declined to 10%.

The comparison of the Euro effect estimated using different control groups suggests that the price dispersion reduction attributable to the Euro is stronger when the control group is the rest of the OECD than when it is the rest of the European Union. For instance comparing columns 5 of Tables 1 and A.2, we find a reduction in the relative price dispersion of 2.5% when the control group is the rest of the EU against 3.5% when the control group is the rest of the OECD. One reason for the limited effect of the Euro obtained with EU as a control group might be related to the integration of good and service markets within the EU that also reduced price dispersion while being orthogonal to the monetary integration.

Overall, the DID results suggest that the Euro significantly reduced the price dispersion of French exports toward Euro countries relative to other destinations. However, the magnitude of the effect is sensitive to the specification, and is small in the most restrictive ones. One explanation for this small effect is that most of the integration actually occurred along the nineties, as notably argued by Engel and Rogers (2004). The limited effect of the Euro that we identify suggests that the remaining barriers to

Table 1: Difference in difference, control group: rest of the EU

	(1)	(2)	(3)	(4)	(5)	(6)
	Coefficient of variation of prices					
Post99	0.001	-0.001	-0.001	0.012^a	0.009^a	0.009
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Euro	0.036^a	0.048^a	0.048^c	0.050^a	0.056^a	0.056^c
	(0.001)	(0.001)	(0.007)	(0.001)	(0.001)	(0.007)
Euro×Post99	-0.015^a	-0.010^a	-0.010^b	-0.009^a	-0.005^a	-0.005
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
CV(GDP/dist)		0.035^a	0.035		0.036^a	0.036^b
		(0.001)	(0.009)		(0.001)	(0.002)
CV(GDPc)		0.017^a	0.017		-0.013^a	-0.013
		(0.004)	(0.051)		(0.002)	(0.045)
Constant	0.294^a	0.247^a	0.247^c	0.272^a	0.237^a	0.237^b
	(0.001)	(0.002)	(0.027)	(0.001)	(0.002)	(0.018)
Control	Rest of EU15					
Fixed effects	product			firm×product		
Cluster	No	No	Zone	No	No	Zone
Obs.	1,886,920	1,886,920	1,886,920	1,886,920	1,886,920	1,886,920
rho	0.182	0.181	0.181	0.572	0.572	0.572
	Relative dispersion of Euro prices					
Before 99	1.12	1.19	1.19	1.18	1.24	1.24
After 99	1.07	1.15	1.15	1.14	1.21	1.21

This table investigates the impact of the introduction of the Euro on the evolution of firms' price dispersion across countries using a difference-in-differences strategy. We consider the sample of French firms exporting between 1996 and 2005 toward at least two countries in the Eurozone and in the rest of the EU. The explained variable is the coefficient of variation of prices computed at the firm-product-year-area level. Here we consider two areas, namely the Euro countries and the rest of the EU. The main explanatory variables are three dummy variables: $Post99$ equals to one after 1999, Euro is 1 for Euro countries, and the interaction term $Euro \times Post99$. As control variables, we use the dispersion in GDP per capita $CV(GDPc)$ and GDP over distance $CV(GDP/dist)$ of countries served by the firm, within each group. We add product or firm-product fixed effects in our regressions. Robust standards errors in parenthesis. In columns (3) and (6), standard errors are clustered in the area dimension. Superscripts ^{c}, ^{b}, ^{a} indicates significance at 10%, 5% and 1% level.

arbitrage did not entirely vanish with the Euro.

Another, potentially complementary, explanation is that the effect of the Euro has been felt differently by the firms depending on their characteristics. Given that the previous regressions implicitly assume the impact of the Euro to be the same across firms, estimates may be affected by a heterogeneity bias. We explore this possibility in the next section.

4.2 Heterogeneity and selection bias

Results of section 4.1 implicitly assume an homogenous impact of the Euro on the firms' pricing strategies. When we control for unobserved heterogeneity in the firm-product dimension, the impact of the Euro is however dampened. Figure 3 indeed highlights a strong heterogeneity across firms in the magnitude of price discrimination, with large firms' prices exhibiting more variance across markets. It is possible that this heterogeneity transmit into the effect of EMU on firms' pricing strategies. On top of this behavioral heterogeneity, it is possible that our results are biased by composition effects. In particular, the previous estimates are based on the pooled sample of exporters, without distinguishing firms that export throughout the whole period from firms that enter and/or exit the market during the period of observations. In the following, we test the robustness of our results in those two dimensions. We first consider whether they are sensitive to extensive margin effects, before accounting for heterogenous behaviors at the intensive margin.

Extensive margin adjustments. A number of recent papers discuss extensive margin adjustments related to market integration. Berthou and Fontagné (2008) thus show that EMU induced a net entry of firms/products in the European market. If those new

firms have different pricing behaviors as incumbents, it may be that the effect captured in previous section's estimations is due to extensive adjustments rather than changes in the pricing strategy of stayers. Méjean and Schwellnus (2009) find an important effect of those extensive adjustments on the convergence of prices induced by the EU integration.[12] To test whether such composition effects also trigger the previously described results, we estimate the impact of the single currency on an "intensive" sub-sample made of firms with positive export flows before *and* after the Euro has been introduced.

Results are displayed in Table 2. Overall, they are consistent with estimates provided in Table 1, obtained on the whole sample of exporters. Most of the time, the EMU effect is negative and significant, but small. Moreover, the magnitude of the effect identified in this sub-sample is not significantly different. This suggests that the results discussed in section 4.1 are not triggered by composition effects.

Firms' heterogeneity. Beyond the extensive effects, it may be that the *response* of firms to the Euro introduction is itself heterogenous. This is all the more likely since ex-ante pricing strategies are heterogenous, as illustrated in Figure 3. Moreover, this would be consistent with Berman et al. (2011) who show how firms' response to exchange rate shocks is strongly heterogenous across firms.

We thus pursue the analysis by studying the link between firms' characteristics and their strategic adjustment to EMU. In table 3, we interact the treatment on treated variable of the DID regression with different measures of firm size. We use three different proxies, namely the firm's value-added, its total sales, and its export sales. We compute these different measures using firm-level data obtained from the fiscal

[12]The heterogeneity across firms in the length of their participation to export markets is somewhat controlled for in regressions with firm × product fixed effects, though.

Table 2: Difference in difference, intensive margin

	(1)	(2)	(3)	(4)	(5)	(6)
	Coefficient of variation of prices					
Post99	0.008^a	0.006^a	0.006^b	0.013^a	0.009^a	0.009
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.002)
Euro	0.043^a	0.052^a	0.052	0.051^a	0.056^a	0.056^c
	(0.002)	(0.002)	(0.009)	(0.001)	(0.001)	(0.008)
Euro×Post99	-0.012^a	-0.008^a	-0.008	-0.011^a	-0.007^a	-0.007^c
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
CV(GDPc)		0.006	0.006		-0.019^a	-0.019
		(0.005)	(0.056)		(0.003)	(0.044)
CV(GDP/Dist)		0.030^a	0.030		0.038^a	0.038^c
		(0.002)	(0.012)		(0.001)	(0.004)
Cons.	0.291^a	0.253^a	0.253^c	0.281^a	0.244^a	0.244^c
	(0.001)	(0.003)	(0.033)	(0.001)	(0.002)	(0.021)
Control	Rest of EU15					
Fixed effects	product			firm×product		
Cluster	No	No	Zone	No	No	Zone
Obs.	931351	931351	931351	931351	931351	931351
rho	0.213	0.212	0.212	0.447	0.447	0.447
	Relative dispersion of Euro prices					
Before 99	1.15	1.20	1.20	1.18	1.23	1.23
After 99	1.10	1.17	1.17	1.14	1.18	1.18

This table investigates the impact of the introduction of the Euro on the evolution of firms' price dispersion across countries using a difference-in-differences strategy. We consider the "intensive" sample of French firms exporting before 1998 and after 1999, between 1996 and 2005 toward at least two countries in the Eurozone and in the rest of the EU. The explained variable is the coefficient of variation of prices computed at the firm-product-year-area level. Here we consider two areas, namely the Euro countries and the rest of the EU. The main explanatory variables are three dummy variables: $Post99$ equals to one after 1999, Euro is 1 for Euro countries, and the interaction term $Euro \times Post99$. As control variables, we use the dispersion in GDP per capita $CV(GDPc)$ and GDP over distance $CV(GDP/dist)$ of countries served by the firm, within each group. We add product or firm-product fixed effects in our regressions. Robust standards errors in parenthesis. In columns (3) and (6), standard errors are clustered in the area dimension. Superscripts ^{c}, ^{b}, ^{a} indicates significance at 10%, 5% and 1% level.

administration for 1996. Table 3 shows that the negative effect of the Euro has been disproportionably felt by the largest firms. In particular, the effect is negative for firms that exhibit a value added greater than 148 (exp(0.010/0.002)). Since a bit less than 95% of the firms have a value added greater than this threshold, the effect of the Euro is in fact negative for almost all firms. But it is more pronounced for the largest ones. This finding is robust to other measures of firms' size.

It is worth to note that our measure of price discrimination depends on the number of destinations served by the firm. To ensure that the stronger effect we get for large firms is not only due to an artefact linked with the number of observation used to measure price discrimination, Table A.3 offers some controls for the number of destinations served by firms. In column 1, the number of destinations served by the firm, in each area, is added, as well as the number of destinations interacted with the treatment dummy. As expected, the level of discrimination is positively linked to the number of destinations served by the firm. However, the interaction term is not significant. In column, the same specification is used, but the interaction with firms' size is added. The latter is negative and statistically significant, while the interaction with the number of destinations is not. This suggests that the results are not driven by the difference in the number of destinations served by the firms.

To illustrate the quantitative impact of the single currency on firms of different size, compare two hypothetical firms, exporting toward the same set of countries but being heterogenous in terms of their size. The value added of the two firms corresponds to the first and the ninth deciles of the distribution of value added, namely 270 and 54,176, respectively. Our estimates predict the Euro to reduce the relative dispersion of prices by less than 1% for the less productive firm. On the other hand, the effect is expected much stronger for the most productive one, which relative price dispersion reduces by

3.8% (column 1). A less parametric way to track down the impact of heterogenous behaviors consists in ranging firms in size groups and measuring how firms in those groups react to the single currency. In this spirit, figure 4 presents the effect of the Euro on price dispersion depending on firms' value-added where firms are grouped by decile of value added. Namely, we first estimate:

$$cv^r_{fkt} = \alpha_{fk} + \beta EURO + \gamma POST99 + \delta EURO \times POST99 + \sum_{i \geq 2} \eta_i \left(EURO \times POST99 \times D_i \right) + u^r_{fkt} \quad (1)$$

where D_i is a dummy equal to one is the firms belong to the i^{th} decile of value added. Firms in the first decile of the distribution of value-added are used as reference. The coefficient η_i thus measures the additional impact of EMU on the dispersion of prices of firms in the ith decile, in comparison with firms in the first decile. The total impact of the Euro for decile i is then measured by $\hat{\delta} + \hat{\eta}_i$.

The figure offers a clear-cut message: the impact of the Euro on firms' pricing dispersion is significantly stronger for firms from the seventh decile of value-added. On the other hand, the impact is estimated non-significant for firms in smaller deciles of the value added distribution. This means that small firms do not adjust their pricing strategies because of the Euro, while the price dispersion of large firms shrinks.

This phenomenon has two (complementary) explanations. First, in presence of exchange rate volatility, large firms have a stronger incentive to price discriminate (a shown in the model of section 2). Therefore, their prices are more dispersed, everything else equal. This explains the heterogeneity observed before 1999. Provided that the introduction of the common currency reduces their ability to price discriminate, it is not surprising that the reduction in price dispersion is more pronounced for firms

Table 3: Difference in difference, size effect

	(1)	(2)	(3)	(4)
	Coef. of variation of prices			
Post99	0.009^a	0.010^a	0.010^a	0.007^a
	(0.001)	(0.001)	(0.001)	(0.001)
Euro	0.057^a	0.057^a	0.057^a	0.062^a
	(0.001)	(0.001)	(0.001)	(0.001)
Euro×Post99	-0.006^a	0.010^a	0.024^a	0.013^a
	(0.001)	(0.003)	(0.003)	(0.005)
Euro×Post99×log(VA)		-0.002^a		
		(0.000)		
Euro×Post99×log(Sales)			-0.003^a	
			(0.000)	
Euro×Post99×log(Exports)				-0.001^a
				(0.000)
CV(GDP/dist)	0.036^a	0.036^a	0.036^a	0.039^a
	(0.001)	(0.001)	(0.001)	(0.001)
CV(GDPc)	-0.013^a	-0.015^a	-0.015^a	-0.018^a
	(0.003)	(0.003)	(0.003)	(0.003)
	0.243^a	0.243^a	0.243^a	0.267^a
	(0.002)	(0.002)	(0.002)	(0.002)
Fixed effects	firm×product			
Observations	1,542,210	1,542,210	1,542,130	1,219,400
rho	0.563	0.564	0.565	0.540

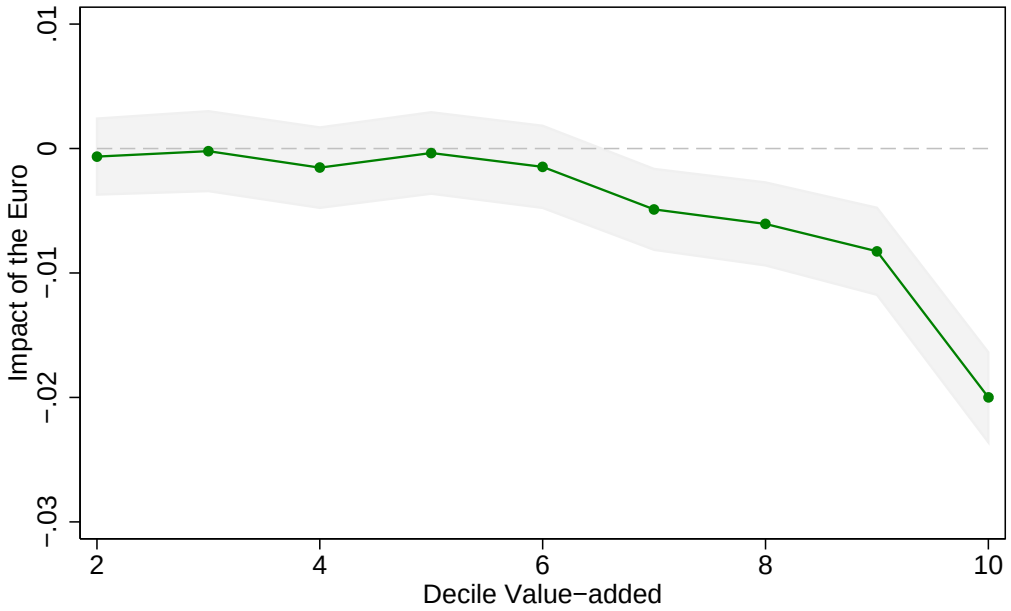
This table investigates the impact of the introduction of the Euro on the evolution of firms' price dispersion across countries for different type of firms. We consider the sample of French firms exporting from 1996, between 1996 and 2005 toward at least two countries in the Eurozone and in the rest of the EU. The explained variable is the coefficient of variation of prices computed at the firm-product-year-area level. Here we consider two areas, namely the Euro countries and the rest of the EU. The main explanatory variables are: $Post99$ equals to one after 1999, Euro is 1 for Euro countries, the interaction term $Euro \times Post99$, and triple interaction term $Euro \times Post99 \times log(size)$. Where firms' size is measured by total sales, value added and total exports in 1996. As control variables, we use the dispersion in GDP per capita $CV(GDPc)$ and GDP over distance $CV(GDP/dist)$ of countries served by the firm, within each group. We add firm-product fixed effects in our regressions. Robust standards errors in parenthesis. Superscripts ^{c}, ^{b}, ^{a} indicates significance at 10%, 5% and 1% level.

which ex-ante propensity to price discriminate is the stronger.

A second explanation relies on the behavior of arbitrageurs. One mechanism through which the Euro was expected to impact prices was the strengthening of arbitrage behaviors. If the arbitrageurs' activity is featured by scale economies, one can expect them to be more active in trading products that are sold in larger volumes. In such case, large firms are also more likely to be subjected to arbitrage behaviors, which forces them to strongly reduce the dispersion of their prices.

A raw way to discriminate among these two explanations is to control for the ex-ante level of price discrimination. The firm-product fixed effect introduced in some regressions account for the level of this variable. However, the impact of the Euro may differ across firm depending on their ex-ante level of price discrimination. To control for such effect, we interact the ex-ante level of price discrimination with the treatment effect dummy. To limit endogeneity, the level of discrimination is proxied by the associated 50-quantile of price discrimination to which the firm belongs to in 1996. Table A.3, columns 3-4 present the results. The first regression present the interaction of the treatment with the ex-ante level of price discrimination. The coefficient is positive and statistically significant. It suggest that after the Euro introduction, firms that discriminated the most, increase their relative price discrimination. In column 4, the interaction between the treatment and the ex-ante level of price discrimination is added along with the interaction between the treatment and firm size. Both are statistically significant. The interaction with firms' size is negative while the interaction with firms' ex-ante level of discrimination is positive. This suggests that the stronger effect of the Euro on price discrimination of large firms is not due to the higher level of dispersion per-se, but to the higher difficulty - due to the Euro introduction - for firms to segment markets when they trade large volumes.

Figure 4: Euro, price discrimination and firms' size



This graph plots the impact of the Euro on price dispersion by decile of firms' value-added. Reported coefficients are the linear combination of the Euro effect irrespective of firms'size and the specific impact of the Euro for each decile of value-added. The estimated impact is relative to the first decile. The underlying coefficients are estimated using a difference in differences augmented by interaction terms with value-added decile dummies. The grey area is the confidence interval at 10 percent.

5 Aggregate implications

We finish the analysis discussing the aggregate implications of the heterogeneity we just identified in the data. Previous section indeed shows that, in terms of price discrimination, large firms have been more impacted by the introduction of the single currency. From recent advances in international trade (Bernard et al., 2007; Mayer and Ottaviano, 2007), we also know that those large firms account for the lion's share of international trade flows. In our estimates we gave the same weight to all firms, irrespective of their contribution to international trade. Thus, we measured the average

impact of the Euro on French firms. In terms of the aggregate consequences of the Euro, it however makes sense to put a larger weight on those firms that accounts for the bulk of international trade flows. In what follows, we propose two methods that use the relative weight of goods in the consumption basket to quantify the impact of the Euro on *aggregate* price discrepancies.

A first way to measure the aggregate impact of the Euro is to use the results of the DID regression with decile-specific coefficients, described in equation (2). This equation estimates the degree of heterogeneity in the response of different classes of firms to the Euro. The simple average of the coefficients obtained for each decile is equal to -0.006, once again a very limited effect. However, the weighted average implies a twice as large effect, equal to -0.012.

A second way to deal with heterogeneity relies on the comparison of OLS results with weighted least squares. This comparison is illustrated in Table 4. The weights used in the WLS regression correspond to the share of each firms in total exports in 1996.[13] Without weighting, the relative dispersion of export prices in the Euro area is found to drop from 1.23 to 1.20 because of the monetary integration. Once we give more weight to the behaviors of larger firms, however, we find a bigger effect. The relative dispersion of prices is found to fall from 1.27 to 1.1.

Both sets of results show that accounting for the heterogenous response of firms to a common macroeconomic shock modifies the quantitative assessment one can make of the shock's aggregate impact.

[13] We are not the first ones to weight observations by sales to study price discrimination at the firm-level. Fitzgerald and Haller (2010) adopt this strategy in their study of pricing-to-market behaviors.

Table 4: Ordinary versus weighted least squares

	(1)	(2)
	Coef. of variation of prices	
Post99	0.009^a	-0.031^a
	(0.001)	(0.009)
Euro	0.057^a	0.087^a
	(0.001)	(0.010)
Euro×Post99	-0.006^a	-0.028^a
	(0.001)	(0.010)
CV(GDP/dist)	0.036^a	0.041^a
	(0.001)	(0.012)
CV(GDPc)	-0.013^a	-0.032^c
	(0.003)	(0.018)
Constant	0.243^a	0.322^a
	(0.002)	(0.016)
Fixed effect	firm×product	
Method	OLS	WLS
Observations	1,219,400	1,219,400
	Rel. dispersion of Euro prices	
Before 99	1.23	1.27
After 99	1.20	1.10

This table investigates the impact of the introduction of the Euro on the evolution of firms' price dispersion across countries using a difference-in-differences strategy. We consider the sample of French firms exporting between 1996 and 2005 toward at least two countries in the Eurozone and in the rest of the EU. The explained variable is the coefficient of variation of prices computed at the firm-product-year-area level. Here we consider two areas, namely the Euro countries and the rest of the EU. The main explanatory variables are three dummy variables: $Post99$ equals to one after 1999, Euro is 1 for Euro countries, and the interaction term $Euro \times Post99$. As control variables, we use the dispersion in GDP per capita $CV(GDPc)$ and GDP over distance $CV(GDP/dist)$ of countries served by the firm, within each group. We add product or firm-product fixed effects in our regressions. In the second column, observations are weighted by firm's share in total exports. Robust standards errors in parenthesis. In columns (3) and (6), standard errors are clustered in the area dimension. Superscripts ^{c}, ^{b}, ^{a} indicates significance at 10%, 5% and 1% level.

6 Conclusion

This papers studies the impact of the creation of a monetary union on the magnitude of deviations to the law of one price. We identify the impact of the single currency by measuring the relative dispersion of French export prices toward Euro countries before and after 1999, allows us to

We find that the Euro significantly reduced the relative dispersion of French export prices. Price were 24% higher in the Euro area than in the rest of the EU before 1999, and this dispersion drops to 21% after 1999. The effect is robust to the control group we choose as well as changes in the sample of firms and products we consider.

Moreover, we show that the effect has been felt differently by French exporters. Namely, more productive firms have been more strongly affected by the common currency. This heterogeneity is important in itself. It also has interesting implications in terms of the aggregate impact of the Euro. Since more productive firms account for a very large share of total exports, their behavior is crucial in determining the dynamics of aggregate prices.

We account for the heterogeneity in the behavior of firms as well as in their relative weight in aggregate exports to estimate the *aggregate* effect of individual firms adjusting their pricing strategies. Unsurprisingly, the estimated effect of the Euro is found larger once we account for the relative weight of different firms in aggregate exports. In this specification, the relative dispersion of within-EMU prices decreases from 27 to 10% following the introduction of the European common currency.

This results suggest that the response of firms to the introduction of the Euro is deeply heterogenous and that this heterogeneity has important aggregate consequences. The effect of the Euro is underestimated when the heterogeneity is not accounted for.

A Appendix

Table A.1: Difference in difference (pooled sample)

	(1)	(2)	(3)	(4)
	Coef. of variation of prices			
Post99	0.011^a	0.012^a	0.009^a	0.010^a
	(0.001)	(0.001)	(0.001)	(0.001)
Euro	0.010^a	0.010^a	0.056^a	0.057^a
	(0.002)	(0.002)	(0.001)	(0.001)
Euro×Post99	-0.010^a	0.013^a	-0.022^a	-0.001
	(0.002)	(0.003)	(0.002)	(0.003)
Euro×Post99×log(VA)		-0.003^a		-0.003^a
		(0.000)		(0.000)
Euro×Post99×# dest.	-0.000	0.000		
	(0.000)	(0.000)		
Euro×Post99×Price disc. 96			0.001^a	0.001^a
			(0.000)	(0.000)
# destinations	0.015^a	0.015^a		
	(0.000)	(0.000)		
CV(GDP/dist)	0.015^a	0.015^a	0.036^a	0.036^a
	(0.001)	(0.001)	(0.001)	(0.001)
CV(GDPc)	-0.002	-0.004	-0.013^a	-0.015^a
	(0.003)	(0.003)	(0.003)	(0.003)
Fixed effects	firm×product			
Observations	1542210	1542210	1542210	1542210
R^2	0.010	0.011	0.006	0.007
rho	0.563	0.565	0.555	0.555

This table investigates the impact of the introduction of the Euro on the evolution of firms' price dispersion across countries. We consider the sample of French firms exporting between 1996 and 2005 toward at least two countries in the Eurozone and in the rest of the EU. The explained variable is the coefficient of variation of prices computed at the firm-product-year-area level. Here we consider two areas, namely the Euro countries and the rest of the EU. In this specification, we ignore the time dimension of the data to limit the issues induced by the serial correlation of variables. Namly, we pool observation in the time dimension, before and after the treatment. The main explanatory variables are: $Post99$ equals to one after 1999, Euro is 1 for Euro countries, the interaction term $Euro \times Post99$. Where are respectively the number of destinations served by the firms, the value added of the firm and the level of price discrimination of the firm in 1996. As control variables, we use the dispersion in GDP per capita $CV(GDPc)$ and GDP over distance $CV(GDP/dist)$ of countries served by the firm, within each group. We add firm-product fixed effects in our regressions. Robust standards errors in parenthesis. Superscripts ^{c}, ^{b}, ^{a} indicates significance at 10%, 5% and 1% level.

Table A.2: Difference in difference, control group: OECD

	(1)	(2)	(3)	(4)	(5)	(6)
	Coefficient of variation of prices					
Post99	0.007^a	0.009^a	0.009^c	0.020^a	0.020^a	0.020^b
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Euro	-0.047^a	-0.026^a	-0.026	-0.020^a	-0.004^a	-0.004
	(0.002)	(0.002)	(0.004)	(0.001)	(0.001)	(0.003)
Euro×Post99	-0.021^a	-0.018^a	-0.018^c	-0.017^a	-0.014^a	-0.014^c
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
CV(GDPc)		0.026^a	0.026		0.027^a	0.027
		(0.001)	(0.016)		(0.001)	(0.006)
CV(GDP/Dist)		0.099^a	0.099^c		0.097^a	0.097^a
		(0.002)	(0.016)		(0.002)	(0.000)
Cons.	0.383^a	0.317^a	0.317^b	0.353^a	0.290^a	0.290^a
	(0.001)	(0.002)	(0.007)	(0.001)	(0.001)	(0.004)
Control	OECD countries excepted Euro countries					
Fixed effects	product			firm×product		
Cluster	No	No	Zone	No	No	Zone
Obs.	2211700	2211700	2211700	2211700	2211700	2211700
rho	0.170	0.169	0.169	0.558	0.558	0.558
	Relative dispersion of Euro prices					
Before 99	0.88	0.92	0.92	0.94	0.86	0.86
After 99	0.83	0.87	0.87	0.90	0.83	0.83

This table investigates the impact of the introduction of the Euro on the evolution of firms' price dispersion across countries using a difference-in-differences strategy. We consider the sample of French firms exporting between 1996 and 2005 toward at least two countries in the Eurozone and in the rest of the OECD. The explained variable is the coefficient of variation of prices computed at the firm-product-year-area level. Here we consider two areas, namely the Euro countries and the rest of the OECD. The main explanatory variables are three dummy variables: $Post99$ equals to one after 1999, Euro is 1 for Euro countries, and the interaction term $Euro \times Post99$. As control variables, we use the dispersion in GDP per capita $CV(GDPc)$ and GDP over distance $CV(GDP/dist)$ of countries served by the firm, within each group. We add product or firm-product fixed effects in our regressions. Robust standards errors in parenthesis. In columns (3) and (6), standard errors are clustered in the area dimension. Superscripts ^{c}, ^{b}, ^{a} indicates significance at 10%, 5% and 1% level.

Table A.3: Difference in difference, size effect, robustness

	(1)	(2)	(3)	(4)
	Coef. of variation of prices			
Post99	0.011^a	0.012^a	0.009^a	0.010^a
	(0.001)	(0.001)	(0.001)	(0.001)
Euro	0.010^a	0.010^a	0.056^a	0.057^a
	(0.002)	(0.002)	(0.001)	(0.001)
Euro×Post99	-0.010^a	0.013^a	-0.022^a	-0.001
	(0.002)	(0.003)	(0.002)	(0.003)
Euro×Post99×log(VA)		-0.003^a		-0.003^a
		(0.000)		(0.000)
Euro×Post99×# dest.	-0.000	0.000		
	(0.000)	(0.000)		
Euro×Post99×Price disc. 96			0.001^a	0.001^a
			(0.000)	(0.000)
# destinations	0.015^a	0.015^a		
	(0.000)	(0.000)		
CV(GDP/dist)	0.015^a	0.015^a	0.036^a	0.036^a
	(0.001)	(0.001)	(0.001)	(0.001)
CV(GDPc)	-0.002	-0.004	-0.013^a	-0.015^a
	(0.003)	(0.003)	(0.003)	(0.003)
Fixed effects	firm×product			
Observations	1542210	1542210	1542210	1542210
R^2	0.010	0.011	0.006	0.007
rho	0.563	0.565	0.555	0.555

This table investigates the impact of the introduction of the Euro on the evolution of firms' price dispersion across countries for different type of firms. We consider the sample of French firms exporting from 1996, between 1996 and 2005 toward at least two countries in the Eurozone and in the rest of the EU. The explained variable is the coefficient of variation of prices computed at the firm-product-year-area level. Here we consider two areas, namely the Euro countries and the rest of the EU. The main explanatory variables are: $Post99$ equals to one after 1999, Euro is 1 for Euro countries, the interaction term $Euro \times Post99$, and triple interaction term $Euro \times Post99 \times X$. Where are respectively the number of destinations served by the firms, the value added of the firm and the level of price discrimination of the firm in 1996. As control variables, we use the dispersion in GDP per capita $CV(GDPc)$ and GDP over distance $CV(GDP/dist)$ of countries served by the firm, within each group. We add firm-product fixed effects in our regressions. Robust standards errors in parenthesis. Superscripts ^{c}, ^{b}, ^{a} indicates significance at 10%, 5% and 1% level.

Chapter 3

Low-Wage Countries' Competition, Reallocation Across Firms, and the Quality Content of Exports [1]

1 Introduction

One of the most widely discussed phenomena in the recent trade literature concerns the growing share of emerging countries in world exports. This pattern challenges textbook models of international trade on several grounds. First, recent empirical evidence suggest that emerging economies are becoming competitive not only in labor-intensive sectors, as the neo-classical theory would predict, but also in capital-intensive ones.[2] Second, both emerging and developed countries export the same bundle of products but more productive, wealthier countries charge higher unit values, on average (See Schott,

[1] This chapter is revised version of CEPR Discussion Papers 2011-8231, jointly written with Isabelle Méjean (Ecole Polytechnique). It has been submitted for publication.

[2] See Amiti & Freund, 2010, on Chinese data.

2008, Gaulier, Fontagné and Zignago, 2008). This suggests that countries produce different qualities of the same products, which goes against the horizontal differentiation view of international trade discussed in new trade theories. As argued by Schott (Schott, 2004, 2008), these patterns of international trade are consistent with a specialization occurring *within* industries along the quality dimension. International trade leads countries to specialize in vertically differentiated goods. And developed economies continue exploiting their comparative advantage by producing better qualities.

This paper uses firm-level data to test whether increased competition from low-wage countries induces such a shift in the specialization of rich nations in favor of better qualities. Our methodology quantifies changes in the mean quality of a country's export basket due to a reallocation of market shares across firms producing different qualities. In a world of within-industry specialization, this reallocation is driven by changes in competitive pressures faced by exporting firms in international markets. To test this assumption, we relate the magnitude of quality changes in French exports to various measures of international competition. We show that quality upgrading is more pronounced in markets where French exporting firms face increased competitive pressures from low-wage countries. In the meantime, competition from high-income countries has the opposite impact, driving the quality of French exports down. To the extent that low-wage countries have a comparative advantage in the production of standardized, low-quality varieties, these patterns are consistent with within-industry specialization along the quality dimension. To our knowledge, we are the first ones to identify such dynamic specialization patterns in firm-level data.

We start the analysis with an illustrative model describing the conditions under which changes in the competitive environment modify the quality composition of a country's export basket. Our framework borrows from the industrial organization literature,

notably Gabszewicz and Thisse (1979). We consider a highly simplified economy in which two firms located in a high-income country compete in international markets with a low-wage country's producer. Firms are differentiated along the quality dimension and the low-wage country is assumed to offer the lowest quality.[3,4] In this setting, increased competitive pressures from the low-wage country are disproportionately felt by the lowest quality produced in the rich country while the highest quality is somewhat protected by vertical differentiation. This asymmetry triggers a reallocation of market shares in favor of the high-quality firm. The mean exported quality improves as a consequence.[5] If competitive pressures instead come from a high-quality producer, the mean quality that is exported is predicted to go down. The model thus emphasizes a potential relationship between the mean quality of a country's exports and the nature of competition it faces in foreign markets. In particular, increased competition from low-quality producers in emerging countries should induce a quality upgrading in rich countries' exports.

The empirical exercise is conducted using firm-level data on French exports. Our measure of quality changes relies on the methodology proposed by Aw and Roberts (1986) and Boorstein and Feenstra (1987).[6] They show how to quantify changes in the mean

[3]The recent trade literature provides evidence of firm heterogeneity in the quality dimension. See among others Crozet et al. (forthcoming) on wine exporters producing in France, Verhoogen (2008) on Mexican data or Hallak and Sivadasan (2009) in data covering Indian, US, Chilean and Colombian firms.

[4]Results in Schott (2004), Hallak (2006), Hallak and Schott (forthcoming) and Khandelwal (2010) suggest that it is indeed the case that low-income countries tend to export goods of worse quality.

[5]In our example, quality adjustments occur at the intensive margin - the low-quality firm loses market shares - and through extensive adjustments - the low-quality eventually exits export markets. This differentiates us from previous models of trade with quality heterogeneity, e.g. Baldwin and Harrigan (2011), Helbe and Okubo (2008), Johnson (2008), Verhoogen (2008), Hallak and Sivadasan (2009). In these models, the reallocation of market shares is solely driven by the selection of firms into export markets. Beyond these extensive margin adjustments, our model shows how changes in the competitive environment may rebalance sales between firms that are different in terms of the quality they produce.

[6]This method has been recently used by Harrigan and Barrows (2009) on sectoral data.

quality of a consumption basket by comparing time-variations in its unit value and its ideal price index. We adapt this methodology to our data and measure quality changes in France's exports due to market shares being reallocated across *firms* producing different qualities of the same *product*. In firm-level data, particular attention has to be paid to entries and exits of firms from the export market. Namely, we disentangle quality improvements due to a reallocation of market shares toward high-quality producers from those caused by a net entry of better qualities in the export market. Our estimates suggest that, over the 1995-2005 period, the overall quality of French exports has improved by 11%. Three quarters of the improvement are attributable to extensive margin adjustments.

Despite the trend in aggregate quality, our data exhibit a huge amount of heterogeneity in the direction and magnitude of quality changes. In particular, the variance in quality patterns is high between sectors, and across destination markets within sectors. We test whether this heterogeneity is related to changes in the nature of competition faced by French firms in foreign markets. Namely, we show that quality upgrading is significantly more pronounced in markets where the penetration of low-wage countries has increased the most. By contrast, the quality content of French exports tends to reduce in those markets where other high-wage countries have increased their position. This is consistent with competitive pressures in foreign markets driving a reallocation of market shares among vertically differentiated firms. Over the considered period, low-wage countries, in particular China, have doubled their share in world trade. Their increased penetration in France's export markets explains around 15% of the quality upgrading identified in the data. We interpret these results as evidence in favor of factor-proportion specialization *within* products, with France being increasingly specialized in high-quality goods.

The result that low-wage country competition induces a flight to quality has important macroeconomic implications. A specialization of rich countries in high-quality goods is expected to modify the relative demand of skilled and unskilled workers with an end effect on wage inequality and employment rates. This may help explain the increased wage premium between skilled and unskilled workers observed in a number of developed countries.[7] A change in the mix of exported products could also affect long-run growth, as discussed in Hausmann et al. (2007). If high-quality goods are associated with higher productivity levels, a country specialization toward high qualities should increase its aggregate prospects. Finally, quality upgrading may be a way for developed countries to maintain their level of exports in a world of increasing competitive pressures from low-wage countries. Specializing in high-quality goods will insulate them from wage movements in developing countries (Khandelwal, 2010).

Our paper is related to a growing literature analyzing the impact that competition from low-wage countries has on developed countries' performance. In particular, a number of recent papers study North-South trade and its heterogeneous impact on firms located in developed countries. Bernard et al. (2006) show that competition from low-wage countries reallocates production towards capital-intensive plants while labor-intensive ones are pushed out of the market. This is consistent with evidence discussed in this paper if the production of better qualities is more capital intensive.[8]

[7] The within-industry shift in demand away from unskilled and toward skilled workers is documented in a number of papers. See, among others, Berman et al. (1994) and Bernard and Jensen (1997) for the US, Strauss-Kahn (2004) and Biscourp and Kramarz (2007) for France and Machin and Reenen (1998) and Berman et al. (1998) for a panel of developed countries. Berman et al. (1994), Machin and Reenen (1998) and Berman et al. (1998) interpret the evidence as the result of skilled-biased technological change. Results in Bernard and Jensen (1997) rather suggest that the lion's share of the raise in wage premia comes from shifts from production to non-production intensive establishments within the same industry. Biscourp and Kramarz (2007) and Strauss-Kahn (2004) relate the phenomenon to international trade.

[8] Verhoogen (2008) provides evidence of a positive link between the capital intensity of a firm and the quality of its output.

Our results allow us to go one step further and interpret the reallocation as driven by quality differentiation across firms.

Recently, the literature has focused on *within-firm* technology upgrading induced by Chinese competition. These papers show that increased competitive pressures from China make firms adopt production processes that are more intensive in skilled and non-production workers (Mion and Zhu, 2011) and rely more on innovation (Bloom et al., 2009). Such technology upgrading may be related to the firm increasing the quality of its products. Our methodology neglects this possibility. Namely, we assume quality to be constant at the firm-level and focus on aggregate quality upgrading driven by a reallocation of sales *across firms*. The previous papers suggest that within-firm quality upgrading goes in the same direction as the reallocation we measure. Our estimate of the impact of low-wage countries' competition on the aggregate quality of French exports is thus probably a lower bound.

Finally, the paper the most closely related to ours is Khandelwal (2010). Using estimates of the relative quality of products exported by different countries in the US, he shows that Chinese competition is more painful - in terms of employment in the US - in sectors with less quality heterogeneity (shorter "quality ladders"). This suggests that vertical differentiation protects the most developed economies against competition from low-wage countries. We go one step further and argue quality upgrading is a natural consequence of competition from emerging countries. We show that the mean quality of a country's exports increases when firms face competitive pressures from low-quality producers. Countries climb the quality ladder which in turn reduces their sensitivity to competitive pressures.

The paper proceeds as follows. Section 2 describes the mechanism we have in mind to

explain the link between low-wage countries' competition and the aggregate quality of exports. Section 3 presents the strategy and data we use to test the prevalence of this mechanism. We discuss the results in Section 5. Finally, Section 7 concludes.

2 An Illustrative Model

We present a stylized model illustrating how increased competition from low-wage countries can affect the quality composition of developed countries' exports. Our logic is based on the assumptions that goods are vertically differentiated and that low-wage countries have a comparative advantage in the production of low-quality goods. If this is indeed the case, competitive pressures coming from emerging markets is felt disproportionately by low-quality producers in developed countries. One thus observes a redistribution of market shares in favor of high-quality varieties when competition from low-wage countries becomes more intense.

Our example builds upon a model of quality differentiation based on Gabszewicz and Thisse (1979) and Tirole (1988). There are three firms in the economy that compete in prices to sell goods in the same import market. Two firms are located in a rich country, called North, while the third one is in a low-wage country, called South. Firms are assumed to be endowed with a quality level, while they are able to choose their prices strategically. In the following, we use L, M and H to denote the low, medium and high-quality, respectively. We assume the Southern firm offers the lowest quality L.[9]

In this framework, we consider what happens to the relative sales of Northern firms when competition from the low-wage country becomes more intense. Stronger compe-

[9] A technical appendix available on-line considers the other two possibilities, namely that the Southern firm offers the intermediate, or the high-quality.

tition is modeled as an exogenous reduction in the export price of the Southern firm. The relative price shock can come from various sources, e.g. the Southern firm becoming more productive, its cost of exporting reducing, Southern wages decreasing, or the country's currency depreciating. The nature of the shock is irrelevant from our standpoint. We do not try to explain why emerging markets represent an increasing share in world markets but what consequence this has on the mean quality and price of developed countries' exports. In the following, we use the term "trade cost shock" as a shortcut.

Demand side: Following Tirole (1988), the demand side of the market consists of a large number of consumers with discrete preferences. Utility is increasing in the quality of the consumed variety. Consumers are heterogeneous in terms of their marginal rate of substitution between income and quality. This assumption is equivalent to supposing income is heterogeneous across consumers: a higher marginal rate of substitution can be interpreted as the consumer being poorer.

The utility of the consumer, with marginal rate of substitution $1/\theta$, is equal to $U = s_i - \frac{1}{\theta}\tau_i p_i$ if she consumes the quality s_i. With $s_L < s_M < s_H$, utility is increasing in quality. The price $\tau_i p_i$ of the variety is the product of an ad-valorem cost τ_i (> 1) that is exogenous to the firm and the price p_i that is strategically chosen. In the following, τ_i is assumed country-specific: $\tau_M = \tau_H = \tau$, $\tau_L = \tau^*$ where τ (respectively τ^*) is the exogenous cost faced by Northern (resp. Southern) firms.

There is a mass one of consumers with marginal rates of substitution uniformly distributed over $[\underline{\theta}, \overline{\theta}]$. Following Tirole (1988), it is assumed that i) the market is covered, i.e., all consumers consume the differentiated good, and ii) all qualities are sold

in equilibrium.[10] In this framework, the poorest consumers choose the lowest quality L, while the richest ones buy the highest quality H. The consumer with $\theta = \tilde{\theta}_{LM}$ is indifferent between consuming the lowest and the medium quality, with $\tilde{\theta}_{LM}$ such that $U(\tilde{\theta}_{LM}, s_M, \tau p_M) = U(\tilde{\theta}_{LM}, s_L, \tau^* p_L)$. Similarly, the consumer with a θ just equal to $\tilde{\theta}_{MH}$ is indifferent between consuming the medium and the high-quality.

The demand faced by each producer can be expressed as a function of the distribution of incomes, called $F(.)$, and the previously defined income thresholds. For the high, medium and low-quality producers, respectively,

$$
\begin{aligned}
D_H &= \sup - F(\tilde{\theta}_{MH}) && (1)\\
D_M &= F(\tilde{\theta}_{MH}) - F(\tilde{\theta}_{LM}) && (2)\\
D_L &= F(\tilde{\theta}_{LM}) - \inf && (3)\\
\text{with} \quad & \tilde{\theta}_{LM} = \frac{\tau p_M - \tau^* p_L}{s_M - s_L}, \quad \tilde{\theta}_{MH} = \frac{\tau p_H - \tau p_M}{s_H - s_M}.
\end{aligned}
$$

Supply side: Firms are differentiated in terms of the quality they sell, and compete in prices. As in Gabszewicz and Thisse (1979), we assume quality is an exogenous characteristic of the firm.[11] Each quality level is associated with a marginal cost c_i, which is increasing in s_i. Without loss of generality, the maximum quality gap is normalized to unity: $s_H - s_L = 1$. We further call: $s_H - s_M = \alpha$ and $s_M - s_L = 1 - \alpha$.

The profit function of firm i is given by $\pi_i = (p_i - c_i) D_i(\tau^* p_L, \tau p_M, \tau p_H)$. Using the

[10] In analytical terms, the first condition is fulfilled as long as there exists at least one variety i the poorest consumer is willing to buy. This occurs if $\underline{\theta} s_i > \tau_i p_i$. The second condition is met when the delivered price per unit of quality increases in quality:

$$\frac{\tau^* p_L}{s_L} < \frac{\tau p_M}{s_M} < \frac{\tau p_H}{s_H}.$$

[11] We do not seek to endogeneize quality choices since our empirical strategy assumes that, at the firm-level, quality is constant over time.

demands (1)-(3), one can compute the best response functions associated to each firm:

$$\begin{aligned} BR_H &= \frac{c_H}{2} + \frac{1}{2\tau}\left[\tau p_M + \alpha\overline{\theta}\right] \\ BR_M &= \frac{c_M}{2} + \frac{1}{2\tau}\left[\alpha\tau^* p_L + (1-\alpha)\tau p_H\right] \\ BR_L &= \frac{c_L}{2} + \frac{1}{2\tau^*}\left[\tau p_M - (1-\alpha)\inf\right]. \end{aligned}$$

This implicitly defines optimal mark-ups as a function of the firm and its competitors' marginal and ad-valorem costs (see details in the Technical Appendix).

Relative price shock: Using the optimal price strategies just derived, it is easy to show how Northern firms react to a change in the Southern relative competitiveness. Here, we model the shock as a drop in the Southern ad-valorem cost τ^*. The shock is exogenous from all firms' standpoint. It increases the relative price of Northern firms and induces a strategic reaction. In particular, the response of Northern firms is

$$\frac{dp_H}{d\tau^*} = \frac{\alpha c_L}{6\tau} > 0 \quad \text{and} \quad \frac{dp_M}{d\tau^*} = \frac{\alpha c_L}{3\tau} > 0.$$

Both Northern firms reduce their price following the shock in order to partially counteract increased competitive pressures from the Southern firm.[12] However, the price adjustment is more pronounced for the firm producing the medium quality: $\frac{dp_H}{d\tau^*} < \frac{dp_M}{d\tau^*}$. This firm is directly hurt by increased competitive pressures induced by the Southern shock and must reduce its mark-up. On the other hand, the highest quality producer is only indirectly impacted, through the price adjustment of its local competitor.

Despite price adjustments, the demand faced by Northern firms diminishes following

[12]The shock has no impact on the mark-up of the southern firm: $\frac{dp_L}{d\tau^*} = 0$.

the shock:

$$\frac{dD_H}{d\tau^*} = \frac{c_L}{6} > 0 \quad \text{and} \quad \frac{dD_M}{d\tau^*} = \frac{c_L}{3(1-\alpha)} > 0.$$

and is redistibuted to the Southern firm, which market share thus increases:

$$\frac{dD_L}{d\tau^*} = -\frac{3-\alpha}{6(1-\alpha)}c_L = -\frac{dD_H}{d\tau^*} - \frac{dD_M}{d\tau^*}$$

Once again, the medium-quality firm is more strongly affected than its high-quality competitor. As a consequence, its market share loss is more pronounced: $\frac{dD_H}{d\tau^*} < \frac{dD_M}{d\tau^*}$. In some circonstances, the medium quality can even be pushed out of the market. This happens if the shock is large enough (see details in the Technical Appendix).

When the Southern firm produces the lowest quality in the market, our example thus shows that an improvement in the South competitiveness reduces the aggregate market share of Northern firms in foreign markets to the benefit of the Southern one. Moreover, as they also contract their mark-up while the Southern one is left unchanged, North's aggregate market share loss is even more pronounced in nominal terms.

Besides its negative impact on the North's market share, the shock also modifies the allocation of sales *between* firms located in the North. Namely, market shares are redistributed in favor of the high-quality firm, as the medium-quality producer is more vulnerable to competitive pressures exerted by the Southern low quality. Once again, this is true in real and in nominal terms (since both the price and the demand of the medium-quality firm reduce more than those of the high-quality producer). This result also holds true at the extensive margin: when Southern costs continue to go down, the medium-quality producer is the first one to exit the market.

All in all, these results suggest that stronger competition from low-quality producers

induces an improvement in the mean quality exported by the rich country. As discussed in the Technical Appendix, the opposite holds true when competitive pressures come from a high quality producer. In this case, the mean quality goes down. Those quality adjustments are driven by intensive margin adjustments, a redistribution of market shares in favor of high-quality producers, and by extensive margin adjustments, the exit of the lowest qualities from export markets. This differentiates us from most of the literature that discusses the aggregate consequences of firms heterogeneous in quality selecting into export markets (Baldwin and Harrigan, 2011)eg.. In these models, quality changes are solely explained by extensive margin adjustments.

3 Measuring Quality Changes in the Data

3.1 Definition

In our example, quality changes are driven by a reallocation of demand across firms serving the same market with different qualities of the same good. There are two challenging issues to deal with when it comes to measuring this in the data. First, one obviously needs firm-level data to capture the reallocation of demand *across* heterogeneous firms. Second, one needs a method that measures aggregate quality changes induced by such reallocation.

Because we want to have a method that is general enough and covers the whole set of exporting firms, we choose to measure quality changes using the approach developed by Aw and Roberts (1986) and Boorstein and Feenstra (1987). Boorstein and Feenstra (1987) define the "quality" of a basket of goods as the mean utility its consumption

induces per unit of goods:

$$\mathrm{Q}_t = \frac{g(c_{1t}, ..., c_{It})}{\sum_{i=1}^{I} c_{it}},$$

where Q_t is the quality index, c_{it} is the consumed quantity of variety i, $g(.)$ is an aggregate of the I consumed varieties, and $\sum_{i=1}^{I} c_{it}$ is the aggregate volume of consumption. This definition is general in the sense that it does not associate the "quality" of a variety to any specific observable characteristic. Instead, it relies on revealed preferences and considers a variety that induces more utility to consumers, conditional on the quantity consumed, as being of better quality.

A nice feature of Boorstein and Feenstra's quality index is that its computation requires little information on the considered set of varieties. Namely, changes in the aggregate quality index can be inferred from the comparison of the unit value and ideal price indices computed over the set of varieties under consideration:

$$\Delta \ln \mathrm{Q}_t = \Delta \ln \mathrm{UV}_t - \Delta \ln \pi(p_t), \tag{1}$$

where Δ is the first-order difference operator. Here, $\Delta \ln \mathrm{Q}_t$ is a percentage change in the quality composition of the considered basket of goods, $\Delta \ln \mathrm{UV}_t$ is the growth of its unit value and $\Delta \ln \pi(p_t)$ denotes changes in the ideal price index as a function of the vector of prices $p_t = \{p_{it}\}$.[13]

The intuition surrounding the decomposition is the following. The unit value computed over a basket of varieties can be written as the weighted average of individual prices:

[13]The decomposition is detailed in Boorstein and Feenstra (1987). It crucially relies on two assumptions. First, $g(.)$ must be homogeneous of degree one. Second, the considered basket of goods has to be separable from other consumptions in the aggregate utility function. In particular, the consumption of varieties produced in France is assumed separable from the consumption of goods produced in other countries. This assumption is necessary in the absence of firm-level data on non-French export flows.

$\text{UV}_t \approx \sum_{i=1}^{I} w_{it} p_{it}$, where p_{it} is the price of variety i and w_{it} its share in aggregate consumption (in real terms). Thus, a change in the unit value either reflects price adjustments (changes in p_{it}) or a change in the relative weight of each variety in aggregate consumption (changes in w_{it}). With a well-defined ideal price index, price adjustments are captured by the $\Delta \ln \pi(p_t)$ term in equation (1).[14] The remaining changes in the composition of the consumption basket are then assigned to quality changes ($\Delta \ln \text{Q}_t$). This decomposition thus says that any increase in the unit value index that is not matched by an equivalent price increase is the result of consumption being reallocated toward more expensive varieties. From the point of view of consumers, the reallocation is optimal only to the extent that these varieties are of better quality. The aggregate quality index increases as a consequence.

Quality improvements captured by Boorstein and Feenstra (1987)'s index are thus the result of consumption being reallocated across varieties of different quality. In their model as in Section 2, the quality produced by a given firm is assumed exogenous. It may well be the case that changes in competitive pressures also induce within-firm quality adjustments. Such changes in the nature of exported goods are not accounted for in our measure of quality upgrading. Instead, they are captured by the price term in equation (1) which is thus upward biased in case of within-firm quality upgrading.[15] If changes in the mean quality induced by within- and between-firm adjustments go in the same direction, our measure of quality upgrading is thus a lower bound.

Finally, it has to be noted that this definition of quality changes crucially relies on

[14]The way price adjustments are controlled for crucially depends on the definition of the ideal price index. Its functional form varies depending on the underlying assumption on the consumer's preferences over the set of varieties (the assumption on $g()$). In the empirical exercise, we use two alternative assumptions for the functional form of $g()$, namely that it is a CES or a translog function. See details in Section 3.2.

[15]See Feenstra (1994) for a discussion of the bias induced by within-firm quality changes in the measure of the CES price index.

the assumption that goods and firms are vertically differentiated. This assumption is consistent with the recent empirical trade literature showing that quality is a critical dimension of firms' heterogeneity within sectors.[16] If they are not, however, increases in the quality index simply reflect a reallocation of consumption in favor of more expensive varieties (e.g. less productive plants). The fact we later observe aggregate "quality" improvements and these adjustments are stronger where competitive pressures from low-wage countries are more intense let us favor the quality interpretation. The link between changes in Q_t and the intensity of competition would indeed go the other way round if the index was solely reflecting a reallocation of demand among heterogenously productive firms. Competition from emerging countries would then mostly affect low productive firms which would push the index down.

3.2 Data

We measure changes in the quality composition of French exports using firm-level data provided to us by the French customs. The dataset exhaustively describes exports by French firms toward each of their export markets between 1995 and 2005. The empirical analysis however focuses on the sub-sample of partner countries that represent at least 1% of French exports, less Taiwan, Nicaragua, Kuwait, Kazakhstan for which we were unable to construct the explanatory variables used in the econometric analysis. The restriction insures that our sample contains destination markets that are served by a large enough number of French firms, even at the disaggregated sectoral level. Together, those markets represent 85% of French exports.

We also drop exports in non-manufacturing industries that are less likely to be vertically

[16] See Verhoogen (2008), Kugler and Verhoogen (forthcoming), Crozet et al. (forthcoming), Manova and Zhang (forthcoming).

differentiated, as well as the tobacco industry, which is very concentrated in France, and the industries of "Other food products, not elsewhere classified" and "Miscellaneous products of petroleum and coal." These restrictions leave us with a sample of 49 countries and 24 ISIC sectors that covers 65% of French exports. In this sample, observations are identified by a firm ID (f), a product category (p) defined at the 8-digit level of the combined nomenclature (cn8), a destination market (c) and a time period (t). We call "variety" a firm $\times$ product $\times$ destination triplet and assume the quality of each variety to be constant over time. The dataset is a panel describing how the exported value and quantity of these varieties evolve between 1995 and 2005.

The time-series can be aggregated across firms selling the same good in a given market to compute a sector- and market-specific quality index Q_{kct}. The index measures changes over time in the quality of French exports in sector k and country c due to a reallocation of demand across "varieties" (i.e. across firms and/or products). As the measure of quality upgrading is an index, it can be compared across sectors and/or destination countries to study the relative evolution of quality in different export markets. It has to be noted however that it does not say anything about the absolute quality level in market (k, c).

For varieties to be comparable in terms of the utility they induce and the quantity consumed, they have to be similar enough. In what follows, quality indices are computed at the 6-digit level of the harmonized system (hs6). A "good" is thus a hs6 sector, while a variety is the product sold by a particular firm in that sector.[17] Since the analysis

[17]It may be that the same firm serves the same market with several cn8 varieties within the same hs6 "sector". These varieties are assumed as substitutable from each other as two varieties produced by different firms. These "multi-product" companies represent a very small share of our sample, however. More than 90% of the firms (that represent more than 80% of French exports in values) we consider produce a single product *within* a given hs6 category. The reallocation we focus on thus mostly occurs across firms.

uses the time dimension of the panel, particular attention has to be paid to potential changes in the nomenclature. Before computing the quality indices, product data are concorded over time using a procedure similar to the one used by Pierce and Schott (2011) for the US "hs" nomenclature. After the harmonization, the data cover 238,842 firms producing goods in 7,741 cn8 categories.

For each bilateral flow (each "variety"), the customs data record the "free-on-board" value in Euros (v_{fpct}) as well as the exported quantity in tons (q_{fpct}). This allows us to compute the unit value index for good k, defined as

$$\begin{aligned} \Delta \ln(UV_{kct}) &= \Delta \ln \frac{\sum_{(p,f)\in I_{kct}} v_{fpct}}{\sum_{(p,f)\in I_{kct}} q_{fpct}} \\ &= \underbrace{\Delta \ln \frac{\sum_{(p,f)\in I_{kc}} v_{fpct}}{\sum_{(p,f)\in I_{kc}} q_{fpct}}}_{\text{Intensive component}} + \underbrace{\Delta \ln \tilde{\lambda}_{kct} - \Delta \ln \lambda_{kct}}_{\text{Extensive component}} \end{aligned} \tag{2}$$

$$\text{with} \quad \lambda_{kct} \equiv \frac{\sum_{(p,f)\in I_{kc}} v_{fpct}}{\sum_{(p,f)\in I_{kct}} v_{fpct}}, \quad \tilde{\lambda}_{kct} \equiv \frac{\sum_{(p,f)\in I_{kc}} q_{fpct}}{\sum_{(p,f)\in I_{kct}} q_{fpct}}$$

where I_{kct} is the set of varieties of good k exported to country c in year t. The unit value index is the log-difference of the total value of exports divided by the total quantity. One can easily show that this index can be decomposed into an intensive and an extensive components as in equation (2). The intensive component is computed from the sub-sample of firms that export in a given market over two consecutive periods ($I_{kc} = I_{kct} \cap I_{kct-1}$). The extensive component is the difference between the value and the volume shares of new varieties in the overall sample of bilateral trade flows at time t minus the difference between the value and the volume shares of disappearing varieties at time $t-1$.

As is clear from equation (1), our measure of quality changes is crucially affected by the assumption on preferences, that determines the form of the ideal price index ($\Delta \ln \pi(p_t)$). In order to check the robustness of our results to this assumption, we construct two alternative series of quality changes, based on two alternative preference assumptions.

As in Harrigan and Barrows (2009), the ideal price index for good k is first built using the Sato-Vartia-Feenstra formula. This makes the assumption that preferences over varieties (i.e. the $g()$ function in Section 3.1.) are CES:[18]

$$\Delta \ln \pi_{kc}(p_t) = \underbrace{\sum_{(p,f)\in I_{kc}} w_{fpct}(I_{kc}) \Delta \ln(p_{fpct})}_{\text{Intensive component}} + \underbrace{\frac{1}{\sigma_k - 1} \Delta \ln \lambda_{kct}}_{\text{Extensive component}} \tag{3}$$

$$\text{where} \quad w_{fpct}(I_{kc}) \equiv \frac{\left(\frac{s_{fpct}(I_{kc}) - s_{fpct-1}(I_{kc})}{\ln s_{fpct}(I_{kc}) - \ln s_{fpct-1}(I_{kc})} \right)}{\sum_{(p,f)\in I_{kc}} \left(\frac{s_{fpct}(I_{kc}) - s_{fpct-1}(I_{kc})}{\ln s_{fpct}(I_{kc}) - \ln s_{fpct-1}(I_{kc})} \right)}$$

$$\text{with} \quad s_{fpct}(I_{kc}) \equiv \frac{v_{fpct}}{\sum_{(p,f)\in I_{kc}} v_{fpct}}.$$

The first component of equation (3) is the ideal price index computed over the sub-sample of intensive trade flows. The second part of equation (3) corrects the price index for extensive margin effects. The magnitude of extensive adjustments is decreasing in σ_k, the (constant) elasticity of substitution between varieties. In the empirics, we use a homogeneous value of 5 to calibrate σ_k.

We also compute quality adjustments based on an alternative form of preferences,

[18] See Sato (1976), Vartia (1976) and Feenstra (1994).

namely a translog function. As shown by Feenstra and Weinstein (2010), the ideal price index with translog preferences is defined as follows

$$\Delta \ln \pi_{kc}(p_t) = \underbrace{\sum_{(p,f)\in I_{kc}} \frac{1}{2}(s_{fpct}(I_{kc}) + s_{fpct-1}(I_{kc}))\Delta \ln(p_{fpct})}_{\text{Intensive component}} + \underbrace{\frac{-1}{2\delta_k}\left\{\underbrace{\sum_{(p,f)\notin I_{kc}} \left[s^2_{fpct}(I_{kct}) - s^2_{fpct-1}(I_{kct-1})\right]}_{\text{Extensive...}} + \frac{1}{I_{kc}}\left[\left(\sum_{(p,f)\notin I_{kc}} s_{fpct}(I_{kct})\right)^2 - \left(\sum_{(p,f)\notin I_{kc}} s_{fpct-1}(I_{kct-1})\right)^2\right]\right\}}_{\text{...component}} \tag{4}$$

$$\text{where} \quad s_{fpct}(I_{kc}) \equiv \frac{v_{fpct}}{\sum_{(p,f)\in I_{kc}} v_{fpct}}$$
$$\text{and} \quad s_{fpct}(I_{kct}) \equiv \frac{v_{fpct}}{\sum_{(p,f)\in I_{kct}} v_{fpct}}$$

Once again, it can be decomposed into an intensive and an extensive components, with the intensive side being a Tornqvist index computed on the sub-sample of "intensive" firms ($(p,f) \in I_{kc}$) and the extensive side measuring the welfare effect of new/disappearing varieties. While the welfare effect of extensive flows is scaled by the elasticity of substitution σ_k in the CES case, extensive price changes in (4) are conditional on the δ_k parameter that determines the magnitude of the own price and cross-price elasticities in the translog case (Feenstra and Weinstein, 2010)see details in . Based on the median estimate obtained by Feenstra and Weinstein (2010), we calibrate the value of δ_k to 0.5.

The ideal price indices (3) and (4) aggregate price adjustments observed at the variety

(firm) level. These individual prices are proxied by unit values: $p_{fpct} \equiv \frac{v_{fpct}}{q_{fpct}}$. As noted by Kravis and Lipsey (1974), unit values are a biased measure of prices because of quality composition effects. In our data, changes in the quality composition of a firm's exports in one particular product are indeed assigned to price adjustments. Our indicator of quality assumes away those within-firm changes in quality and is downward biased, in absolute terms. Given the very high level of disaggregation, however, we expect these measurement errors to be small. At least in the medium run, most quality adjustments should occur between rather than within firms. Unit values may however be polluted by other measurement errors, notably misleading reports on the value or quantity of exports. We account for this possibility using a trimming procedure. Namely, we drop from the sample annual growth rates in unit values larger than 300% (in absolute value). The number of observations shrinks by less than 3% as a consequence.

Using the previous unit value and ideal price indices computed at the product-level, (2) and (3) or (4), we can infer a quality index from the decomposition in (1). For each index, the annual growth in aggregate quality is computed on the whole sample, and on the "intensive" sample, i.e., on the sub-sample of trade flows that are present in the data over two consecutive years. The comparison of the aggregate and intensive quality indices conveys information about the sources of aggregate quality changes. Namely, the evolution of the intensive quality indicator can be attributed to the demand being reallocated between firms producing different quality levels. Additional movements in the aggregate quality indicator come from the relative quality of firms entering/exiting the market being different than the mean quality of firms already in the market.

In what follows, the product- and market-specific quality indices (Q_{kct}) are either used

as regressors or aggregated at the country- or sector-level to obtain a broader picture of aggregate quality changes. The aggregation of hs6-specific quality indices into more aggregated indicators either uses a Sato-Vartia formula (when the quality index is based on the price index in (3)) or a Tornqvist formula (when it is based on (4)). Finally, we measure quality changes on a year-by-year basis. We then chain-weight quality indices to compute the growth rate in quality over the whole 1995-2005 period.

4 Results

4.1 Patterns in the Quality of French Exports

At the ISIC level, our sample contains 1,453 (market- and sector-specific) time-series. Table D.1 gives summary statistics on the corresponding end-period quality indices, as well as their components. The top panel in Table D.1 corresponds to quality indices computed under a CES preference assumption, while the bottom panel assumes translog preferences. The comparison of both panels illustrates the robustness of our results to the preference assumption. Over 1995-2005, the mean quality has increased by 18%. This decomposes into a 7% increase at the intensive margin, and a 11% raise related to the net entry of firms into export markets.[19] In the meantime, firm-level export prices grew by 7.5% on average.[20]

These summary statistics do not account for the composition of the French export basket across sectors and destinations. Figure 1 aggregates the 1,453 series into a multilateral quality index, using a weighting scheme that reflects the specialization of

[19]The evolution in the number of French flows is depicted in Figure C.2.

[20]Note that the unit value index, which the literature uses as an indicator of either price or quality competitiveness has increased by 21% over the period. This is consistent with Khandelwal (2010) whose results suggest sectoral unit values are poor indicators of either prices or qualities.

French exports. The evolution of quality is compared to the price index (expressed in the currency of the importer), over the whole sample (panel (a)) and over the "intensive" sub-sample that abstracts from entries and exits (panel (b)). The left panel corresponds to the results based on the CES assumption while translog preferences are assumed in the right panel. Once again, results are very similar whatever the preference assumption. They show a monotonous improvement in the quality of French exports over the period, both at the intensive and at the extensive margins. Prices, on the other hand, are much more volatile, and correlated with exchange rate fluctuations (see Figure C.3 in the Appendix).[21]

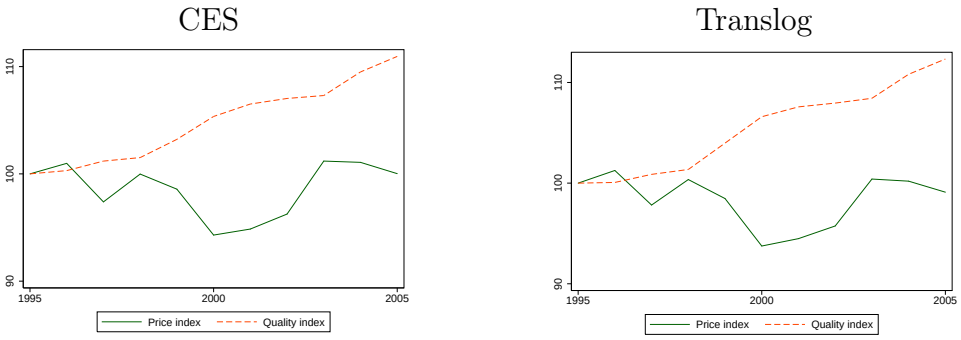
To be sure that our measure of quality is not too specific to the method present above, we compare the quality indices with quality indices computed from another method. The method borrows from Khandelwal et al. (2011) to estimate the relative quality of individual firms and products. Then, it aggregates the information at the HS6 level and at the country level. The method is described in Appendix B. The correlation between the two quality indices computed at the hs6 and destination country level is 0.76. At the aggregate level, the correlation is more than 0.9. Figure C.1 plots the quality index over the period 1995-2005 and the alternative quality index named "KSW" on the graph. We see how close the two indices are, suggesting that our measure of quality is not too specific to the method we have chosen.

These aggregate evolutions hide a strong degree of heterogeneity, however, as shown by the large distribution of quality growth rates around the mean (first row of each panel in Table D.1). Despite the average upward trend, the quality of the French

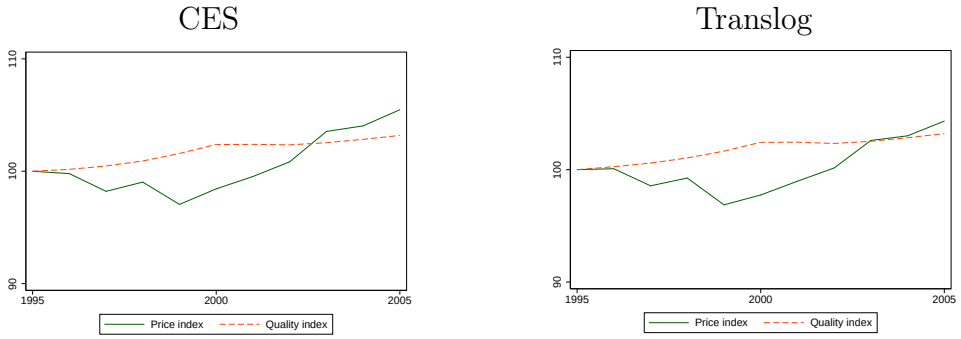
[21] Between 1995 and 2000, export prices decreased by 6%, in part because of the depreciation of the effective exchange rate (3.7% over the period). After 2000 however, the price index started increasing while the euro was appreciating (+4.7% between 2000 and 2005 when the effective exchange rate appreciates by 7.8%). The correlation between the price and exchange rate index is equal to -.87 in our data (-.79 at the intensive margin).

Figure 1: Evolution of the Aggregate Price and Quality of French Exports

(a) Whole sample



(b) Intensive margin



Notes: The multilateral quality index is obtained from an aggregation of sectoral and country-specific quality indices (Q_{kct}). The aggregation weights are either the Sato-Vartia ones under the CES assumption (left panel) or the Tornqvist ones under the translog assumption (right panel). The multilateral price index aggregates the corresponding ideal price indices. The "Intensive margin" sample is defined has the set of firms present in the considered market over two consecutive years. Price indices are corrected from exchange rate fluctuations affecting the price of French products in the destination market (source: *IMF-IFS*).

export basket thus reduces in about 40% of the 1,453 destination markets we consider. The variance decomposition based on the sector- and country-specific quality indices reveals that more than 75% of the total sum of squares is due to determinants that have the double geographic *and* sectoral dimension (see Table D.2). However, our results suggest that quality changes are also affected by determinants that are market-specific within a given sector.

To further illustrate the heterogeneity of quality changes and the way it affects export performances, we then compute the following decomposition of export growth, in value term:

$$\Delta \ln \mathrm{V}_t = \Delta \ln \mathrm{Qy}_t + \Delta \ln \pi(p_t) + \Delta \ln \mathrm{Q}_t, \tag{1}$$

In equation (1), $\Delta \ln \mathrm{V}_t$, $\Delta \ln \mathrm{Qy}_t$, $\Delta \ln \pi(p_t)$ and $\Delta \ln \mathrm{Q}_t$ respectively denote the growth rates of the export value, the export quantity, the price of exports and the quality of exports. This says that an increase in the value of French exports can be explained by French firms exporting a larger quantity, by their prices increasing, or by demand being reallocated in favor of more expensive, better qualities. Based on this equation, Figure 2 decomposes the export growth by destination country (panel a) and by sector (panel b).[22] The size of the quality component reflects the magnitude of quality changes over the 1995-2005 period. Its *relative* size with respect to the overall growth rate of exports further conveys information on the contribution of quality to export performances. This contribution is especially important for richer countries, notably Germany, Japan and Switzerland. At the other side of the spectrum, quality is relatively less important in explaining France's export performance in poorer countries like Poland, Spain, Portugal and Greece. For these countries, the growth of exports is

[22]For sake of conciseness, panel a is restricted to France's 14 main partners. Results covering the rest of the sample are available upon request.

mainly due to French firms increasing the quantity they export. At the industry level, quality is especially important in explaining the growth of French exports in electrical machineries, other machineries, footwear, leather and glass products. In these sectors, the quality component explains more than 50% of export growth.

Incidentally, those sectors have also encountered tough competitive pressures from low-wage countries. For instance, the quality content of leather products increased tremendously (by 25% over the period 1995-2005. See Figure C.4 in Appendix) while the penetration of low-wage countries raised by 20 percentage points.[23] In a micro-analysis, the INSEE (the French statistical institute) explains that since 1995, while a few big name brands have pushed French exports of leather products up, low/medium-quality producers in the sector have been severely hit by low-cost's Asian competition.[24] This example supports our intuition that higher quality firms (the big brand names) are relatively less exposed to low-wage countries competition. This heterogeneity is the source of aggregate quality upgrading. Next section provides more systematic evidence based on the information on exports' quality changes and low-wage countries' competition for a wide range of industries and markets.

4.2 Determinants of Quality Changes

4.2.1 Low-Wage Countries' Competition

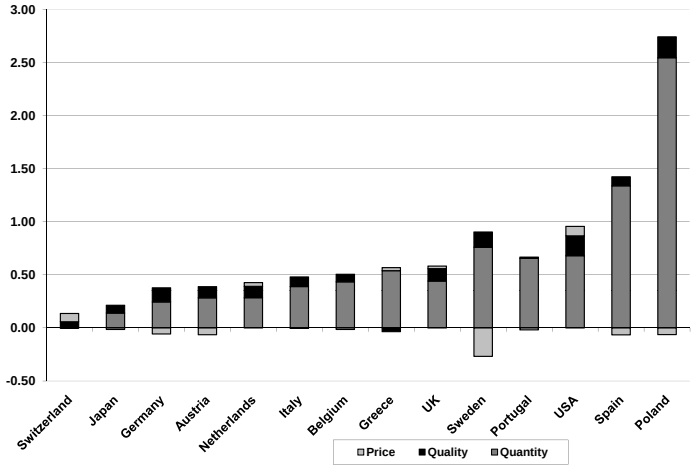
This sections investigates whether the quality upgrading measured in the data is a consequence of the increasing penetration of low-wage countries in world exports. We

[23] We won't do a narrative of each sector, but the evolution of quality in the different ISIC rev2 3 digit sector can be found in Figure C.4. Note that leather products, but also footwear products or machinery experienced a boom in the quality content of their exports. In the mean time, we know those sectors faced a intense competition from LWC countries.

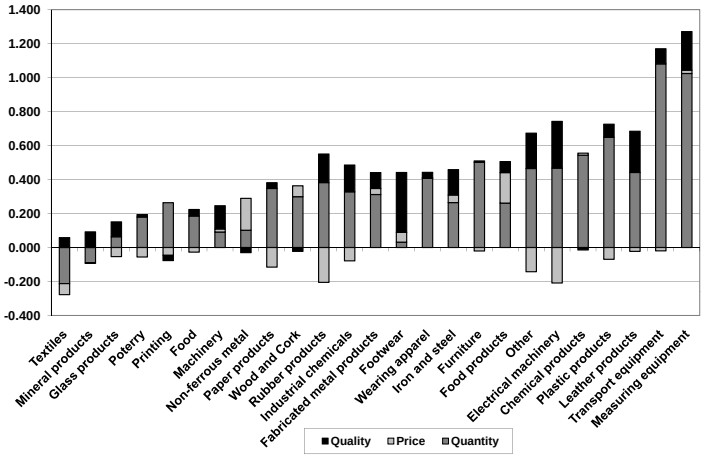
[24] See the SESSI report on the French fashion industry:
www.insee.fr/sessi/publications/dossiers_sect/pdf/mode.pdf (page 29).

Figure 2: Decomposition of Changes in the Value of Exports

(a) By country



(b) By sector



Notes: The decomposition is based on equation (1), computed at the hs6 level for each destination market. Data are then aggregated at the country level (panel (a)) and at the sectoral level (panel (b)) using Tornqvist weights. Each bar measures the growth rate of French exports (in value) between 1995 and 2005. The growth rate is decomposed into a price, a quantity and a quality components. The relative size of the quality component conveys information on the importance of quality upgrading in explaining French export performances.

use the heterogeneity in the intensity of quality changes across sectors and destination countries and ask how it relates to measures of the quality competition.

Our first measure of "quality competition" relies on the growing penetration of goods produced in low-wage countries in France's export markets. As mentioned in the introduction, the share of low-wage countries in world trade has dramatically increased over the last two decades, from less than 8% of world exports in 1995 to more than 16% in 2005.[25] If low-wage countries produce lower qualities on average, it must be true that the increased penetration of their products exerts competitive pressures on French exporters that induce a quality upgrading.

As preliminary evidence, Figure 3 plots the change in the quality of French sectoral exports against the change in low-wage countries' market share.[26]. It shows a positive relationship between quality upgrading and increased competition from low-wage countries, for the whole sample (panel (a)), as well as for the sub-sample of intensive trade flows (panel (b)). This suggests that the mean quality of French exports increases more over the period in those industries that are more exposed to low-wage countries.
We now use regression analyses to ask whether the previous correlation reflects a causal impact from changes in competitive pressures exerted by low-wage countries to the quality of French exports in each destination market. Our baseline estimated equation is

$$\Delta_{95-05} \ln Qlty_{kc} = \alpha \ \Delta_{95-05} Msh_{kc}^{lwc} + X_{kc} + \epsilon_{kc}, \tag{2}$$

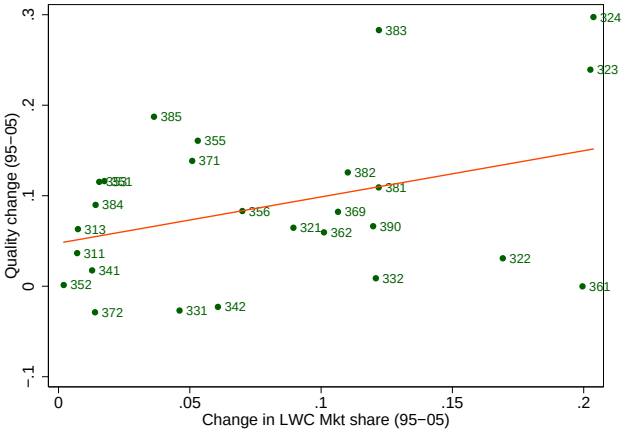
where k and c refer to the sector and the destination country, respectively, and Δ_{95-05}

[25] We follow Bernard et al. (2006) and define low-wage countries as countries which GDP per capita is less than 5% of the US one. Market shares data are averaged over France's export markets considered in the empirical exercise. They are computed using the information on bilateral trade flows of the UN-ComTrade database. Alone, China accounts for two thirds of the increase.

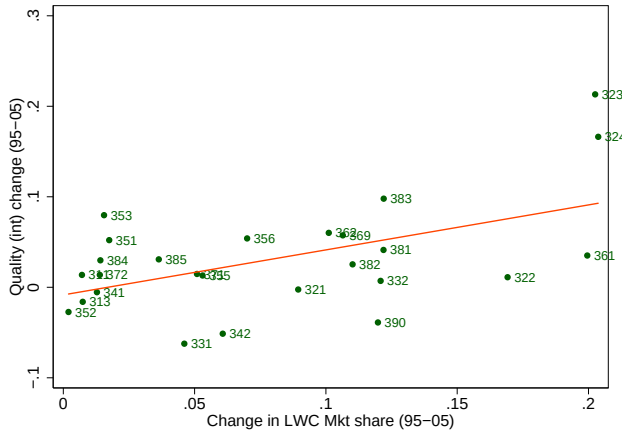
[26] Both measures are averages across destination markets

Figure 3: Quality & Low-Wage Countries' Competition, Across Industries

(a) Whole sample



(b) Intensive sample



Notes: The change in low-wage countries' market shares is a weighted average that reflects the composition of France's trade. It is computed as $\Delta_{95-05}Mks_k^{lwc} = \sum_c w_{kc}^{fra}\Delta_{95-05}Mks_{kc}^{lwc}$ where w_{kc}^{fra} is the weight of country c in French exports for sector k and $\Delta_{95-05}Mks_{kc}^{lwc}$ is the change in low-wage countries' market share in sector k and country c. For the whole sample an OLS estimation gives

$$\Delta_{95-05}lnQlty_k = \underset{(0.26)}{0.51^b}\Delta_{95-05}Mks_k^{lwc} + \underset{(0.02)}{0.04^b}$$

with a R^2 of 0.14. For the intensive sample we obtain

$$\Delta_{95-05}lnQlty_k = \underset{(0.16)}{0.50^a}\Delta_{95-05}Mks_k^{lwc} - \underset{(0.02)}{0.16}$$

with a R^2 of 0.34. ^{a} and ^{b} denote significance at the 1 and 5% level, respectively.

denotes the first difference between 1995 and 2005. $\Delta_{95-05} \ln Qlty_{kc}$ is the log change in the quality of French exports toward country c in sector k over the period 1995-2005. $\Delta_{95-05} Mks_{kc}^{lwc}$ is the variation in low-wage countries' market share. Finally, X_{kc} is a vector of controls. The most basic regression uses country-specific fixed effects to control for all macroeconomic evolutions that may explain an aggregate improvement in the demand for quality expressed by market c. For instance, these effects capture the possibility that the country becomes richer, which tends to increase its aggregate demand of high-quality goods. Some regressions also include sectoral fixed effects that control for overall quality changes in some specific sectors, due for instance to technological improvements or composition effects on the supply side. With country *and* sector fixed effects, the α coefficient is identified *within* sectors *between* countries, which is quite demanding. Finally, some regressions include additional control variables that have the sector and country dimensions. The variance decomposition of Table D.2 indeed underlines the impact of sector *and* market-specific determinants in explaining the heterogeneity in quality changes.

A potential caveat of the previous regression framework is that changes in market shares may be endogenous to the evolution in the mean quality of French exports because of reverse causality or omitted variables. Reverse causality may arise if positive changes in the quality composition of French exports allow low-wage countries' firms to increase their market shares abroad. Omitted variables may also create endogeneity if these determinants of quality changes are also correlated with low-wage countries' market shares.

To reduce the risk of reverse causality, low-wage countries' market shares are computed

using as reference the rest of the world less French exports:

$$Mks^{i}_{kct} \equiv \frac{IMP_{ikct}}{\sum_{l \neq France} IMP_{lkct}} \text{ and } Mks^{lwc}_{kct} = \sum_{i \in lwc} Mks^{i}_{kct},$$

where IMP_{lkct} is the value of good k country c imports from l at time t. Based on the assumption that the evolution of these market shares is exogenous to France's quality changes, we estimate equation (2) using OLS.

Changes in low-wage countries' market shares may still be endogenous, however. We thus run a set of 2SLS estimations. Namely, we estimate predicted values for changes in low-wage countries' market shares using two instruments. The first one measures changes in the market share of the considered emerging country in other destinations (i.e. it averages Mks^{i}_{kdt} over all destinations d but c). This instrument conveys information about the aggregate "performance" of the low-wage country in sector k over the period under consideration. Since the variable does not use information on sales in country c, it is independent from changes in the market structure of that country, notably due to France increasing the quality of its exports. In comparison with the instrumented variable, the within-sector/cross-country variability of the instrument is small, however. To improve the fit of the first stage regression, we thus use a second instrument that measures the relative proximity of the country to the destination market. It is constructed as

$$RelDist_{ick} = \frac{Dist_{ic}}{\frac{1}{N_{ck}} \sum_{l=1}^{N_{ck}} Dist_{lc}},$$

where i and c are the low-wage country and the destination market we consider, respectively. $Dist_{ic}$ is the distance between i and c and N_{ck} is the number of countries

serving country c in good k.[27] The exporter's proximity to the destination country is a good predictor of its initial market share. Since the level increase in market shares is negatively correlated to the initial market share, this instrument should be negatively correlated with the instrumented variable. Results for the first-stage regressions are reported in Table D.3 in Appendix.

Results are presented in Tables 1 and 2. Namely, Table 1 displays estimated coefficients obtained when the only control variables are fixed effects while Table 2 adds other control variables. The first three columns in Table 1 correspond to estimates based on the whole sample while the next three use quality indices measured from intensive flows. Coefficients estimated on the whole sample (columns (1)-(3)) are all positive and significant which means that the quality growth of exports is more pronounced in those markets where the penetration of low-wage countries has increased the most. In quantitative terms, a one standard deviation in market shares is associated with an increase in the mean quality of exports of about 4%. This result is consistent with Schott (2008)'s argument suggesting that the increasing penetration of low-wage countries in world trade induces developed countries to specialize in higher qualities. This continues to hold true when changes in market shares are instrumented, as in column (2). More importantly, the impact of low-wage countries' competition is quantitatively the same when identified in the country dimension, with sector fixed effects used as controls as in column (3). In that case, the coefficient is less significant, which is not surprising given that the degrees of freedom are strongly reduced, but its magnitude is almost unchanged.

The descriptive statistics presented in section 4.1 underlined the important contribu-

[27] The distance variable is a population weighted mean of city-to-city bilateral distances, downloaded from the CEPII's website ($http://www.cepii.fr/anglaisgraph/bdd/distances.htm$).

Table 1: Quality and Low-Wage Countries' Market Shares

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. var: Δ_{95-05} ln Quality					
Δ_{95-05} LWC Market share	0.366[a]	0.459[b]	0.343[c]	0.120	0.173	0.058
	(0.134)	(0.209)	(0.186)	(0.091)	(0.176)	(0.115)
Observations	1,170	1,169	1,170	1,170	1,169	1,170
R^2	0.065	0.061	0.115	0.069	0.068	0.094
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	No	No	Yes	No	No	Yes
Estimation Method	OLS	IV	OLS	OLS	IV	OLS
Sample	Whole	Whole	Whole	Intensive	Intensive	Intensive
Countries	All	All	All	All	All	All
Aggregation Method	CES	CES	CES	CES	CES	CES

Notes: Robust standard errors in parentheses. [a] $p < 0.01$, [b] $p < 0.05$, [c] $p < 0.1$.
The dependent variable is the log difference of the quality index between 1995 and 2005, computed at the ISIC (revision 2) level for each destination country. "Δ_{95-05} LWC Market share" denotes the 1995-2005 change in market shares for low-wage countries. The IV procedure uses as instruments for the change in market shares the country's relative distance to the destination country and the change in its world share of sectoral exports. All market shares are computed excluding France.

Table 2: Quality and Low-Wage Countries' Market Shares: Robustness

	(1)	(2)	(3)	(4)	(5)
	Dep. var: Δ_{95-05} ln Quality				
Δ_{95-05} LWC Market share	0.332^a	0.374^a	0.373^a	0.357^a	0.368^a
	(0.124)	(0.134)	(0.143)	(0.134)	(0.134)
Quality ladder			0.005^c		
			(0.003)		
Δ_{95-05} log(Herfindahl Index)				-0.007	
				(0.034)	
Δ# *varieties*					0.081^b
					(0.038)
Observations	1170	1170	1123	1170	1170
R^2	0.065	0.066	0.068	0.066	0.073
Country Dummies	Yes	Yes	Yes	Yes	Yes
Sector Dummies	No	No	No	No	No
Estimation Method	OLS	OLS	OLS	OLS	OLS
Sample	Whole	Whole	Whole	Whole	Whole
Countries	All	All	All	All	All
Aggregation Method	Translog	CES	CES	CES	CES

Notes: Robust standard errors in parentheses. ^{a} $p < 0.01$, ^{b} $p < 0.05$, ^{c} $p < 0.1$.
The dependent variable is the log difference of the quality index between 1995 and 2005, computed at the ISIC (revision 2) level for each destination country. "Δ_{95-05} LWC Market share" denote the 1995-2005 change in market shares for low-wage countries. The quality ladder is an indicator of vertical differentiation estimated at the ISIC level by Khandelwal (2010). The Herfindahl index is computed for each destination and sector from trade data of bilateral exports to this destination. We consider the change in the Herfindahl index between 1995 and 2005. Δ# *varieties* is the variation in the number of varieties composing the sectoral export basket which quality is measured. All market shares are computed excluding France.

tion of extensive margin adjustments in driving aggregate quality changes. We now ask whether the positive effect of low-wage countries' competition still prevails once quality changes are solely measured at the intensive margin. More specifically, Columns (4)-(6) in Table 1 reproduce the exact same estimations using quality indices computed on the sub-sample of intensive flows. Estimated coefficients are much lower than the ones obtained on the whole sample and turn non-significant whatever the specification. These results suggest that the impact of low-wage countries' competition on the aggregate quality of French exports mainly works through extensive adjustments.

Table D.4 in Appendix tests the robustness of these results to the sample of countries we consider. We replicate the regressions of Table 1, focusing on France's 14 main partners, namely Austria, Belgium, Germany, Greece, Italy, Japan, Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, the UK and the USA. In comparison with the whole sample, this focuses on countries i) that are relatively homogenous in terms of development and wealth and ii) where a lot of French firms do export. This robustness check forces us to moderate some of the previous interpretations. Results obtained on the whole set of export flows are qualitatively similar (columns (1)-(3)). The impact of low-wage countries increasing their market share is still positive and significant, except with sectoral fixed effects but this is due to the very small country dimension available for the identification. However, the coefficient obtained with the set of quality indices computed from intensive trade flows is now positive and of the same magnitude as the coefficient accounting for extensive adjustments (compare column (1) and (4) in Table D.4). This suggests that competition from low-wage countries does induce extensive *and* intensive reallocation patterns across firms in more developed countries.

Table 2 explores the sensitivity of the previous results to our measure of quality and the

inclusion of additional control variables. Columns (1) and (2) thus compare OLS results obtained with quality indices assuming preferences are translog (column (1)) and those computed using a CES assumption (column (2)). Results are not significantly different. In columns (3) to (6), we introduce other control variables. We first consider the influence of vertical differentiation. Intuitively, we expect quality changes to be more pronounced in sectors that are more differentiated in terms of quality since the scope of potential adjustments is then larger. Neglecting the impact of vertical differentiation may induce spurious correlation in Table 1 if those sectors that are more differentiated are also the ones where market shares of low-wage countries increased the most. We account for this possibility in Column (3) of Table 2 using as control the indicator of vertical differentiation estimated by Khandelwal (2010).[28] As expected, this indicator enters the estimation with a positive sign, even though the effect is quantitatively small. However, its presence does not affect our main result that increased penetration of low-wage countries induces the quality content of French exports to go up.

Column (4) of Table 2 then controls for a measure of the Herfindahl index computed for each sector and country using trade data.[29] The variable is meant to capture the degree of competition faced by French firms in their export market. In particular, quality changes may be driven by the overall market becoming more concentrated. If it is the case, the impact of low-wage countries increasing their market share will be in part driven by the consequence it has in terms of the general market structure rather

[28] Khandelwal uses a cross-country identification method to estimate the mean quality of a country's exports in the US, at the highly disaggregated product-level. He then assimilates the maximum quality gap across exporting countries within a given sector to a measure of quality differentiation. A longer "quality ladder" thus corresponds to a sector that is more prone to vertical differentiation.

[29] The Herfindahl index is computed using COMTRADE export data and the following formula:

$$Herf_{kc} \equiv \sum_i {Msh^i_{ck}}^2$$

where Msh^i_{ck} is the market share of country i in the total imports of country c in sector k.

than the within-industry specialization. This does not seem to be the case, however. The impact of a change in the Herfindahl index is found non-significant. Moreover, the coefficient on low-wage countries' market share remains unchanged.

Finally, Column (5) in Table 2 controls for the change in the number of varieties exported by France in the market under consideration. To some extent, this accounts for the magnitude of extensive margin effects captured in the quality index. This variable also captures changes in the intensity of competition between French firms, that may impact the quality composition of the country's exports. The variable has a positive and significant effect on quality changes: new firms participate in the quality upgrading of the French export basket. However, this is not the whole story since the impact of low-wage countries' competition is still positive and significant once changes in the number of French suppliers are accounted for.[30]

The impact of low-wage countries increasing their market share on the quality pattern of French exports thus seems quite robust. Using these estimates, it is possible to quantitatively assess the magnitude of quality changes that result from low-wage countries' competition. To that aim, we compute the predicted change in quality from estimated coefficients and observed adjustments in market shares. Between 1995 and 2005, observed changes in low-wage countries' market shares are predicted to increase the quality of France's exports by 2%. Alone, China is responsible for a 1.7 percentage point increase in quality. This means that more than 15% of the quality growth of French exports is explained by tougher competition from China.

[30]We also tried interacting the previously described control variables with the change in low-wage countries' market shares. Results, available upon request, were never significant though.

4.2.2 Other Countries' Competition

Over the period 1995-2005, China, and more generally low-wage countries, have increased their market share in almost all sectors. Therefore, the previously described results cannot explain why France has experienced a decrease in the quality composition of its exports to some destinations or sectors. In our model, the only way the mean quality of Northern exports can decrease is if they face increased competition from high-quality firms. For instance, it may be that French exporters are exposed to competitive pressures from German firms in some markets (say Eastern European countries). Given that German firms are well-known to produce high-quality goods, such competitive pressures are not expected to drive quality up in France's exports. These markets may instead be relatively more difficult for high-quality French producers, in which case the aggregate quality of exports may decrease.

To consider this possibility, we build a second measure of "quality competition" that accounts for competition from high-wage countries. In each sector and destination we identify the country which experienced the highest market share increase (measured as the difference between its market shares in 1995 and 2005). This country is the "main competitor". We then build two dummy variables indicating whether this competitor is a high-wage or a low-wage country.[31] We expect the impact of competitive pressures on quality to be different when exerted by low-wage countries, that presumably produce low-quality goods, or by high-wage countries, that are more likely to export high-quality

[31] High-wage country are those with a GDP per capita higher than 90% of the US one. GDP per capita data are taken from the World Bank's *World Development Indicators*, and market shares are computed using ComTrade import flows declarations.

varieties. To test this intuition, we estimate the following equation:

$$\Delta_{95-05} \ln Qlty_{kc} = \alpha \, \mathbb{1}_{lwc} MainComp_{kc} + \beta \, \mathbb{1}_{hwc} MainComp_{kc} + X_{kc} + \epsilon_{kc}, \quad (3)$$

where $\Delta_{95-05} \ln Qlty_{kc}$ is the change in quality, $\mathbb{1}_{lwc} MainComp_{kc}$ is a dummy variable equal to one if the main competitor is a low-wage country, $\mathbb{1}_{hwc} MainComp_{kc}$ is a dummy variable equal to one if the main competitor is a high-wage country, and X_{kc} are control variables.

Results are presented in Table 3. Considering the whole sample first (columns 1-2), we find that, when the main partner is a low-wage country, the impact of competition on quality is positive. This is consistent with previous results. Moreover, the negative coefficient obtained for competition exerted by high-wage countries means that the opposite mechanism is also at play in the data. Namely, more competition from a high-wage country reduces the quality content of exports. This result holds true with and without sector fixed effects (compare columns 1 and 2).

Once again, these results are mostly driven by the extensive margin of trade. When the analysis is restricted to the intensive sample as in columns (3)-(4) of Table 3, the impact of competition from high-wage countries turns out non-significant and the magnitude of the coefficient on competition from low-wage countries is reduced by half.

Overall these results suggests that i) the direction of quality changes depends on the nature of competition faced by French firms in foreign markets, and ii) the quality upgrading we observe in the data is essentially driven by low-wage countries' competition.

Table 3: Quality and Competition from High and Low-Wage Countries

	(1)	(2)	(3)	(4)
	Dep. var: Δ_{95-05} ln Quality			
Main Comp. high-wage cty	-0.080^b	-0.097^b	0.002	0.014
	(0.039)	(0.037)	(0.027)	(0.031)
Main Comp. low-wage cty	0.062^b	0.062^b	0.039^b	0.037^c
	(0.025)	(0.027)	(0.017)	(0.019)
Observations	1170	1170	1170	1170
R^2	0.066	0.117	0.071	0.097
Country Dummies	Yes	Yes	Yes	Yes
Sector Dummies	No	Yes	No	Yes
Estimation Method	OLS	OLS	OLS	OLS
Sample	Whole	Whole	Intensive	Intensive
Countries	All	All	All	All
Aggregation Method	CES	CES	CES	CES

Notes: Robust standard errors in parentheses. ^{a} $p < 0.01$, ^{b} $p < 0.05$, ^{c} $p < 0.1$. The dependent variable is the log difference of the quality index between 1995 and 2005, computed at the ISIC (revision 2) level for each destination country."Main Comp high-wage cty " is a dummy equal to one if the main competitor is a high-wage country. "Main Comp low-wage cty " is a dummy equal to one if the main competitor is a low-wage country.

5 Conclusion

In a world of within-product specialization along the quality dimension, competition in international markets has an heterogeneous impact on vertically differentiated producers located in a given country. Competitive pressures exerted by standardized good producers in low-wage countries are felt more strongly by low-quality producers than by high-quality firms located in rich countries. This asymmetry triggers a reallocation of demand within countries between producing firms.

Our paper discusses the impact that the asymmetry has on the quality composition of a country's exports. Using a simple model of vertical differentiation, we show that increasing competition from low-quality producers should induce a quality upgrading in rich countries' aggregate exports. We evaluate the pertinence of this mechanism using bilateral export data covering the universe of French manufacturing firms.

We show that the quality of the French export basket has increased by more than 11% between 1995 and 2005. Quality upgrading is particularly pronounced in sectors and countries where French firms face increasing competitive pressures from low-quality producers. Interestingly, higher competition from high-wage countries lead to a decrease in the quality content of French exports. The flight to quality is consistent with within-industry specialization along the vertical dimension.

The quality upgrading identified in the data has important consequences, notably from a policy standpoint. The fear of Chinese products dominating the world production of manufacturing goods has been an important concern in most developed countries over the past two decades. Evidence in favor of within-industry specialization however suggests one way for countries to maintain their market share in world exports while

increasing the value added content of their exports. Investing in high-quality production should indeed help countries to insulate from the competition of low-wage countries.

A Solution of the Model

The best response functions for the high, medium and low-quality producers are defined as

$$\begin{aligned} BR_H &= \frac{c_H}{2} + \frac{1}{2\tau_H}\left[\tau_M p_M + \alpha \sup\right] \\ BR_M &= \frac{c_M}{2} + \frac{1}{2\tau_M}\left[\alpha\tau_L p_L + (1-\alpha)\tau_H p_H\right] \\ BR_L &= \frac{c_L}{2} + \frac{1}{2\tau_L}\left[\tau_M p_M - (1-\alpha)\inf\right]. \end{aligned}$$

The Nash equilibrium yields the following optimal prices:

$$\begin{aligned} p_H &= \frac{2}{3}c_H - \frac{\alpha}{6}c_H + \frac{\tau_M}{3\tau_H}c_M + \frac{\alpha\tau_L}{6\tau_H}c_L + \frac{\alpha(4-\alpha)}{6\tau_H}\sup - \frac{\alpha(1-\alpha)}{6\tau_H}\inf \\ p_M &= \frac{2}{3}c_M + \frac{(1-\alpha)\tau_H}{3\tau_M}c_H + \frac{\alpha\tau_L}{3\tau_M}c_L + \frac{\alpha(1-\alpha)}{3\tau_M}(\sup - \inf) \\ p_L &= \frac{2}{3}c_L - \frac{1-\alpha}{6}c_L + \frac{\tau_M}{3\tau_L}c_M + \frac{(1-\alpha)\tau_H}{6\tau_L}c_H + \frac{\alpha(1-\alpha)}{6\tau_L}\sup - \frac{(1-\alpha)(3+\alpha)}{6\tau_L}\inf. \end{aligned}$$

Prices equal marginal cost plus a markup. Markups positively depend on the costs of the firm's competitors as well as the size of the market (implicitely defined by sup and inf). Markups negatively depend on the own cost of the firm: Firms incompletely pass their cost through prices. The magnitude of cost pass-through depends on the market power the firm benefits from thanks to vertical differentiation.

Integrating this into the demand functions, one obtains the equilibrium sales of each firm, as a function of trade costs, marginal costs and the income distribution parame-

ters:

$$D_H = -\frac{2+\alpha}{6\alpha}\tau_H c_H + \frac{1}{6}\tau_L c_L + \frac{1}{3\alpha}\tau_M c_M + \frac{1-\alpha}{6}(\sup - \inf) + \frac{1}{2}\sup \quad \text{(A.1)}$$

$$D_M = -\frac{1}{3\alpha(1-\alpha)}\tau_M c_M + \frac{1}{3(1-\alpha)}\tau_L c_L + \frac{1}{3\alpha}\tau_H c_H + \frac{1}{3}(\sup - \inf) \quad \text{(A.2)}$$

$$D_L = -\frac{3-\alpha}{6(1-\alpha)}\tau_L c_L + \frac{1}{3(1-\alpha)}\tau_M c_M + \frac{1}{6}\tau_H c_H + \frac{\alpha}{6}(\sup - \inf) - \frac{1}{2}\inf . \quad \text{(A.3)}$$

Case 1: The Southern firm produces the lowest quality: Consider the case in which the lowest quality (L) is produced by the Southern firm while the two Northern firms respectively produce the medium and high qualities. Starting from a situation in which demands addressed to each firm are all strictly positive, one can show that a reduction in the ad-valorem cost faced by the Southern firm ($\Delta\tau^* = \Delta\tau_L < 0$)) reduces the demand addressed to each Northern firm, but the demand loss is stronger for the medium quality producer:

$$0 < \frac{dD_H}{d\tau^*} = \frac{c_L}{6} \quad < \quad \frac{dD_M}{d\tau^*} = \frac{c_L}{3(1-\alpha)}.$$

Under some circonstances, one or both firms can even be pushed out of the market. This happens if the trade cost drop is large enough in which case ex-post sales are negative. Calling $\Delta\tau^*$ the absolute drop in the South ad-valorem cost, this means, respectively for the medium- and the high-quality firms:

$$D_M(\tau^* - \Delta\tau^*, \tau, c_L, c_M, c_H, \sup, \inf, \alpha) < 0$$

$$D_H(\tau^* - \Delta\tau^*, \tau, c_L, c_M, c_H, \sup, \inf, \alpha) < 0.$$

Using the demand functions (A.1)-(A.2), we find that, following the price shock, the medium-quality firm exits the market if the drop in transport costs is larger than

$$\bar{\Delta\tau^*}^M = \tau^* - \frac{\tau c_M}{\alpha c_L} + \frac{(1-\alpha)\tau c_H}{\alpha c_L} + \frac{(1-\alpha)(\sup - \inf)}{c_L},$$

while the high-quality firm exits if the drop exceeds

$$\bar{\Delta\tau^*}^H = \tau^* + \frac{2\tau c_M}{\alpha c_L} - \frac{(2+\alpha)\tau c_H}{\alpha c_L} + \frac{(1-\alpha)(\sup - \inf)}{c_L} + \frac{3\sup}{c_L}.$$

Following a trade cost reduction, the medium-quality producer is the first one to exit the market if:

$$\bar{\Delta\tau^*}^H > \bar{\Delta\tau^*}^M$$
$$\Leftrightarrow \quad \tau(c_H - c_M) < \alpha \sup,$$

i.e., if the high-quality firm has a large "exclusive demand" (large sup), if the cost differential is moderated ($c_H - c_M$ is low enough) or if the two Northern qualities are not strong substitute (α is high).

Case 2: The Southern firm produces the medium quality: Consider now the situation in which the Southern firm is endowed with the median quality and benefits from a trade cost reduction ($\Delta\tau^* = \Delta\tau_M < 0$). Once again, both Northern firms suffer from a sales drop as a result of the Southern firm becoming more competitive:

$$\frac{dD_H}{d\tau^*} = \frac{c_M}{3\alpha} \quad \text{and} \quad \frac{dD_L}{d\tau^*} = \frac{c_M}{3(1-\alpha)}$$

For the shock to redistribute Northern market shares in favor of the high-quality firm, it has to be true that

$$\begin{aligned} & \frac{dD_H}{d\tau^*} < \frac{dD_L}{d\tau^*} \\ \Rightarrow \quad & \alpha > \frac{1}{2}. \end{aligned}$$

The redistribution thus benefits the high-quality producer if the Southern firm is closer to the low-quality firm in terms of the quality level of its product.

A large fall in the Southern firm trade cost may again induce extensive margin adjustments. This happens if

$$\begin{aligned} D_L(\tau^* - \Delta\tau^*, \tau, c_L, c_M, c_H, \sup, \inf, \alpha) &< 0 \\ D_H(\tau^* - \Delta\tau^*, \tau, c_L, c_M, c_H, \sup, \inf, \alpha) &< 0. \end{aligned}$$

The low-quality French producer exits the market if the trade cost drop exceeds

$$\bar{\Delta\tau^*}^L = \tau^* - \frac{(3-\alpha)\tau c_L}{2c_M} + \frac{(1-\alpha)\tau c_H}{2c_M} + \frac{\alpha(1-\alpha)}{2c_M}(\sup - \inf) - \frac{3(1-\alpha)}{2c_M}\inf,$$

while the high-quality producer is pushed out of the market if $\Delta\tau^*$ is larger than

$$\bar{\Delta\tau^*}^H = \tau^* - \frac{(2+\alpha)\tau c_H}{2c_M} + \frac{\alpha\tau c_L}{2c_M} + \frac{\alpha(1-\alpha)}{2c_M}(\sup - \inf) + \frac{3\alpha}{2c_M}\sup.$$

Following a trade cost reduction, the low-quality Northern producer is the first one to

exit the market if

$$\begin{aligned} & \bar{\Delta\tau^*}^H > \bar{\Delta\tau^*}^L \\ \Leftrightarrow \quad & \tau(c_H - c_L) < \alpha \sup + (1-\alpha) \inf \\ \Leftrightarrow \quad & \alpha > \frac{\tau(c_H - c_L) - L}{\sup - \inf}. \end{aligned}$$

Again, if the Southern firm is close enough from the low-quality producer in the North (i.e., if α is large enough), this firm is more likely to exit the market than its high-quality competitor.

Case 3: The Southern firm produces the high-quality: Following the price shock ($\Delta\tau^* = \Delta\tau_H < 0$), both Northern firms suffer from a drop in their sales:

$$\frac{dD_M}{d\tau^*} = \frac{c_H}{3\alpha} > 0 \quad \text{and} \quad \frac{dD_L}{d\tau^*} = \frac{c_H}{6} > 0.$$

However, the medium-quality firm ($i = M$) is more strongly affected as $\frac{dD_M}{d\tau^*} > \frac{dD_L}{d\tau^*}$.

The fall in Southern trade costs induces adjustments at the extensive margin if

$$\begin{aligned} D_L(\tau, \tau^* - \Delta\tau^*, c_L, c_M, c_H, \sup, \inf, \alpha) &< 0 \\ D_M(\tau, \tau^* - \Delta\tau^*, c_L, c_M, c_H, \sup, \inf, \alpha) &< 0. \end{aligned}$$

The medium-quality producer exits the market if the trade cost drop exceeds

$$\bar{\Delta\tau^*}^M = \tau^* - \frac{\tau c_M}{(1-\alpha)c_H} + \frac{\alpha\tau c_L}{(1-\alpha)c_H} + \frac{\alpha}{c_H}(\sup - \inf).$$

The low-quality firm is pushed out of the market if it exceeds

$$\bar{\Delta\tau^*}^L = \tau^* + \frac{2\tau c_M}{(1-\alpha)c_H} - \frac{(3-\alpha)\tau c_L}{(1-\alpha)c_H} + \frac{\alpha}{c_H}(\sup - \inf) - \frac{3}{c_H}\inf .$$

Following a trade cost reduction, the medium-quality French producer is the first one to exit the market if

$$\begin{aligned} & \bar{\Delta\tau^*}^L > \bar{\Delta\tau^*}^M \\ \Leftrightarrow \quad & \tau(c_M - c_L) > (1-\alpha)\inf . \end{aligned}$$

The medium-quality firm exits first if the market for the low-quality firm is sufficiently large (inf small), if the two Northern qualities are not close substitutes (α large) or if the cost gap between the firms is not too small.

B Alternative quality index

The "KSW" quality index is computed as follows. First, we follow Khandelwal et al. (2011) and estimate relative quality at the firm, product, destination and time level. To do so, we start from the simple demand equation for a product in a standard CES model with quality:

$$Q_{ft} = P_{ft}^{-\sigma} \Lambda_{ft}^{\sigma-1} I_t^{\sigma-1} Y_t \tag{B.1}$$

where Q is the quantity produced by firm f at time t for country j, P is its price, Λ the quality it produces, I is the price index in the economy, Y is the revenue in the economy, and σ is the elasticity of substitution. Taking the logs (lower case letters are

the logs of capital letters), and re-arranging yields:

$$q_{fjt} - \sigma p_{fjt} = (\sigma - 1)\lambda_{fjt} + (\sigma - 1)i_{jt} + y_{jt} \tag{B.2}$$

One knows both q and p. Following KSW, one can also calibrate σ to 4. A within transformation (for instance a regression of the left hand side on destination×year fixed effects) allows one to get rid of $((\sigma - 1)i_{jt} + y_{jt})$. The residual is $(\sigma - 1)(\lambda_{fjt} - \lambda_{.jt})$. Where $\lambda_{.jt}$ is the average quality sold in destination j at time t. This provides us with a relative measure of quality for each firm, product, destination and year.

Then I aggregate it using the across term of a Foster et al. (2008) decomposition. The Foster Haltiwanger Syverson (FHS) aggregation formula is the following:

$$\Delta\lambda_{.jt} = \sum_{f\in I}(\bar{\theta}_{fj}\Delta\lambda_{fjt}) + \sum_{f\in I}(\Delta\theta_{fjt}(\bar{\lambda}_{fj} - \bar{\lambda}_{.j})) \tag{B.3}$$

$$+ \sum f \in N(\theta_{fjt}\lambda_{fjt} - \bar{\lambda}_{.j}) - \sum f \in X(\theta_{fjt-1}\lambda_{fjt-1} - \bar{\lambda}_{.j}) \tag{B.4}$$

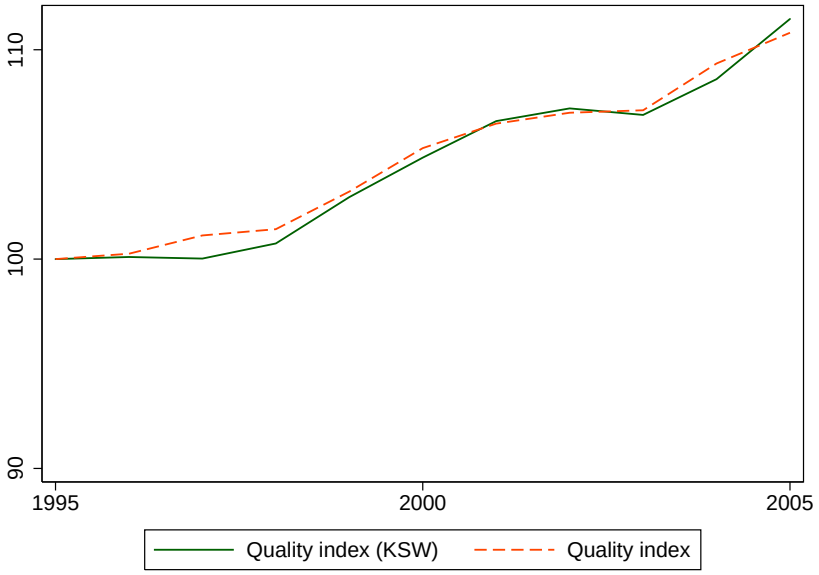
$$\tag{B.5}$$

where the LHS term is the change in the average quality between t and $t-1$, the first RHS term is the within-firm change in quality, the second RHS term is the reallocation across incumbents, the third term is the relative quality of entrants, and the last term is the relative quality of exiting firms. The aggregate quality sold in country j at date t is $\lambda_{.jt}$. θ is the value market-share of firm f, in country j at time t. The upper bar $\bar{x}$ denotes simple average over two years. I is the group of incumbent firms, N the group of entrants, and X the group of exiting firms. We see that our measure of relative quality allows us to compute the composition terms (terms 2, 3, 4 on the RHS), but it does not allows us to compute the within-firm quality change.

This yields quality changes at the product level for every destination over the period 1995-2005. They are first compared at the product level with the quality index described in the paper and computed at the same level. Then, product-level changes are aggregated using a standard Tornqvist formula.

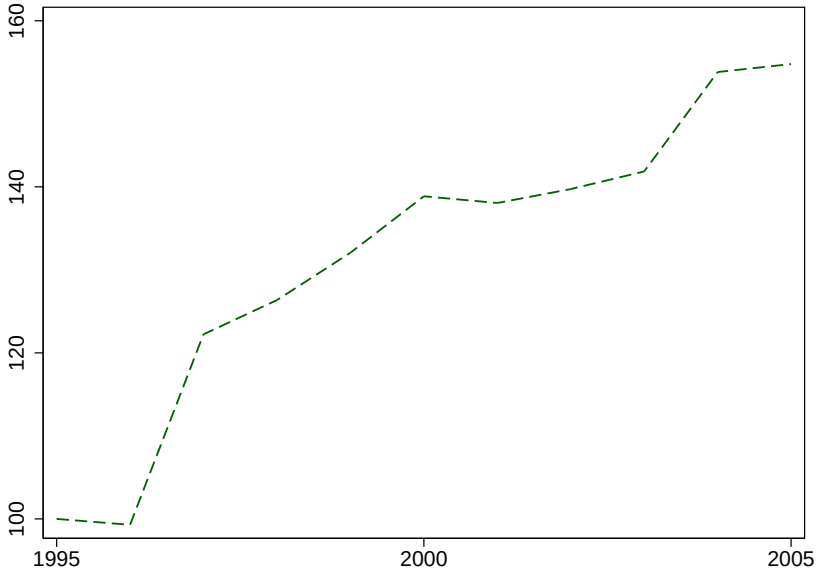
C Figures

Figure C.1: Changes in the quality composition of French exports, a comparison of methods



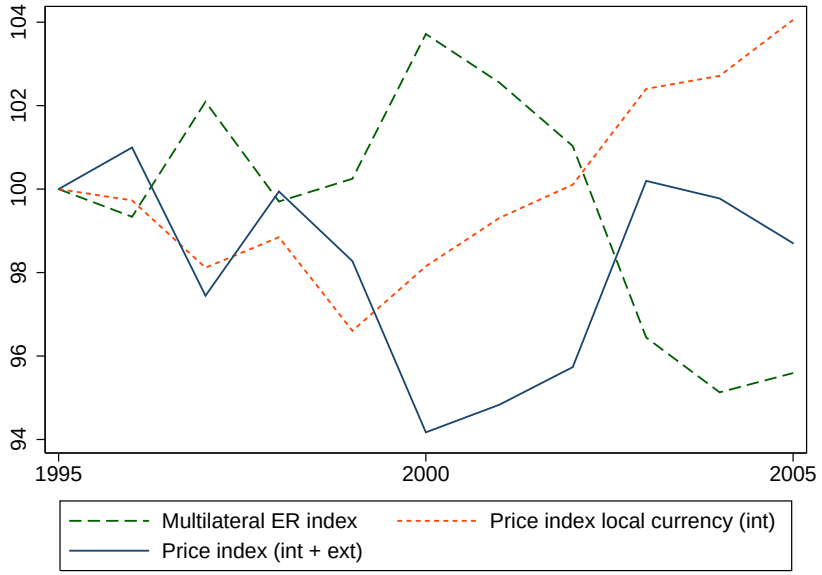
The figure plots the aggregate quality index computed using the Boorstein Feenstra method and the aggregate index computed using an alternative method based on insights from Khandelwal, Schott, and Wei (KWS) method. The two indices measures quality changes driven by a reallocation of market shares across firms. In particular, the "KSW" index does not include within firm quality changes. The correlation is 0.99.

Figure C.2: Evolution in the Number of French Export Flows



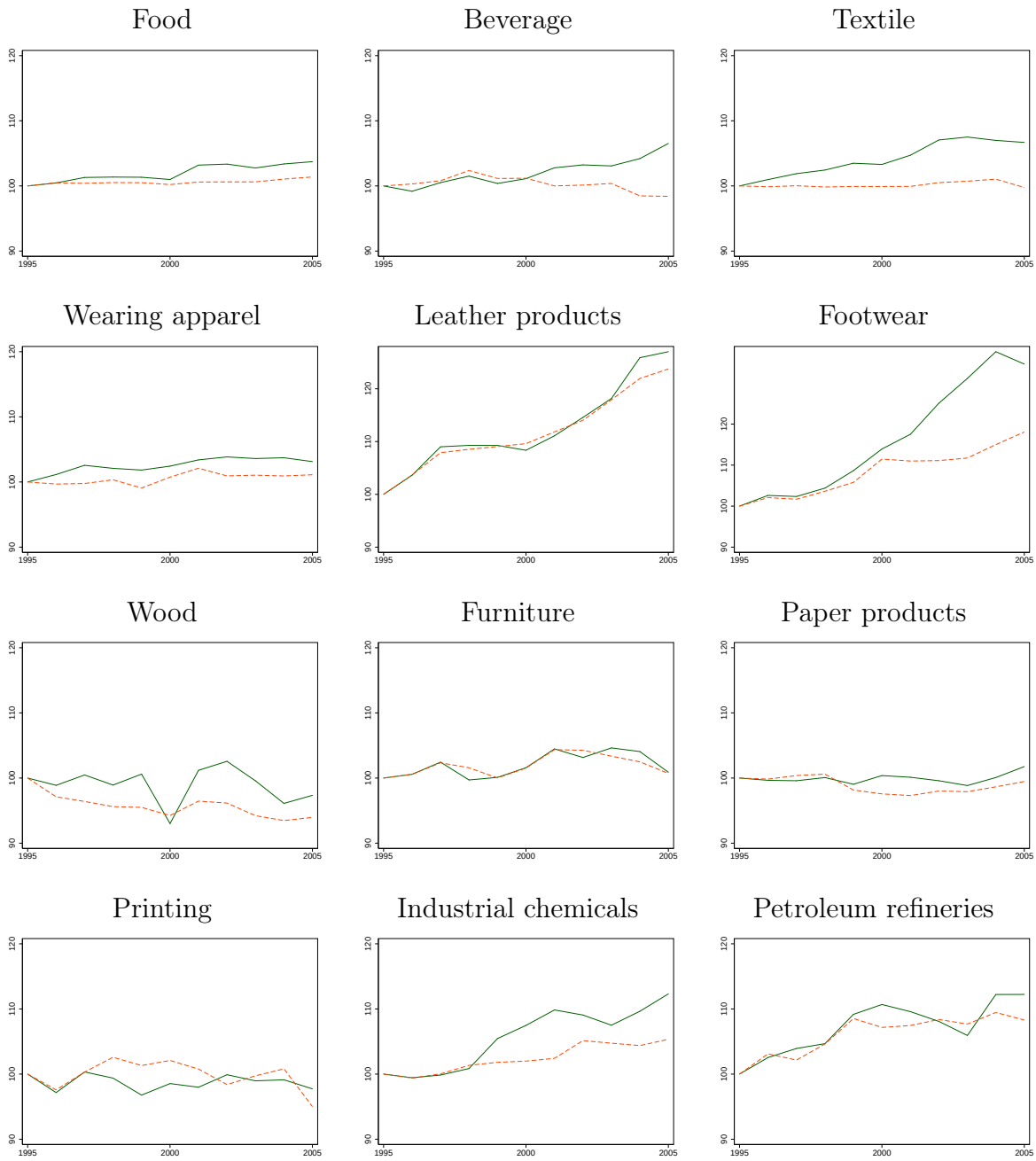
Notes: The dashed line depicts the (net) flow of entries, normalized to 100 in 1995.

Figure C.3: Correlation of Local Currency Prices and the Effective Exchange Rate



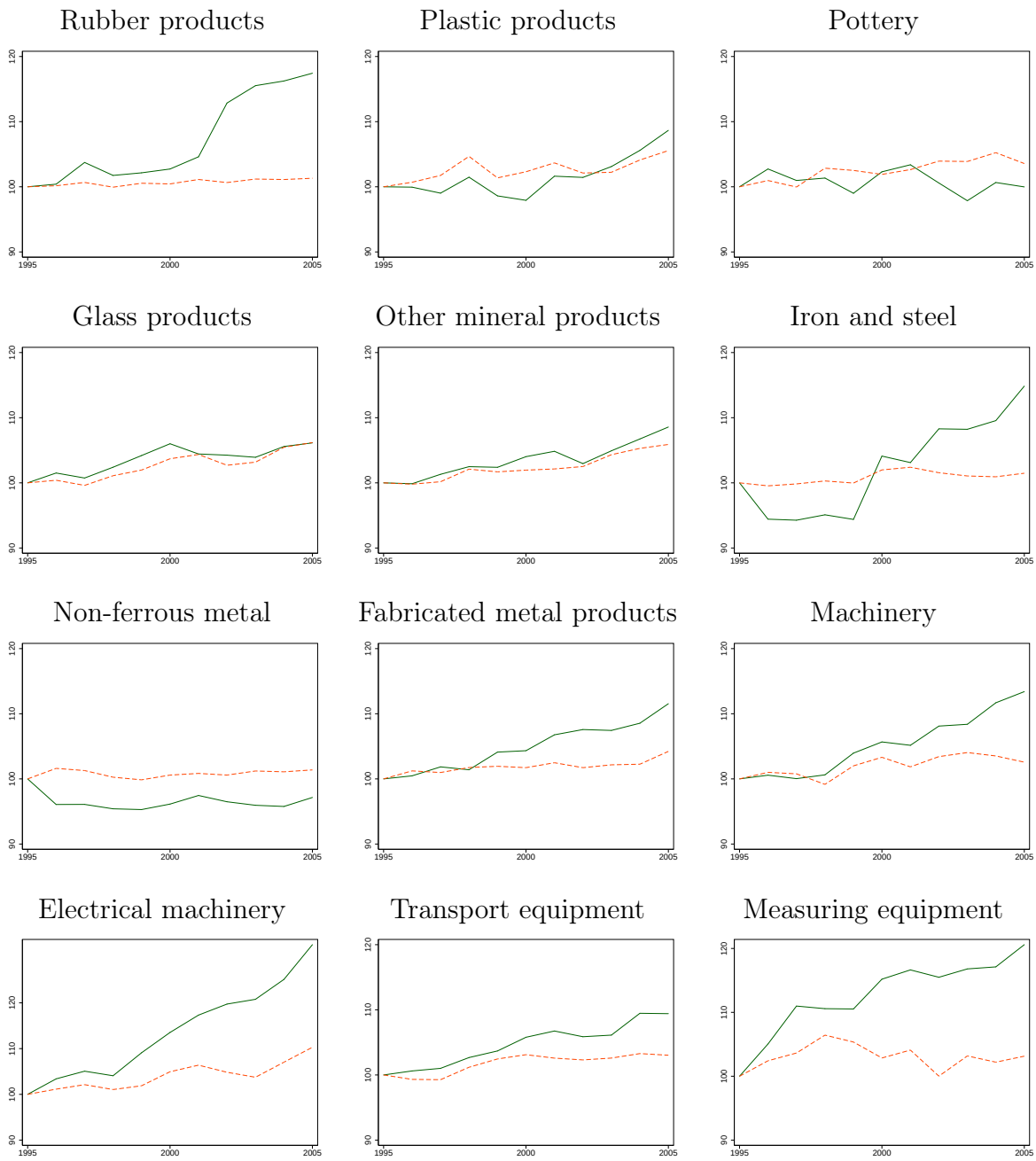
Notes: The solid and dotted lines correspond to the measured evolution of prices, computed over the whole sample (solid line) and the intensive sample (dotted line). They are compared to the evolution in France's effective nominal exchange rate (dashed line). The effective exchange rate is computed using bilateral exchange rates taken from the *IMF-IFS* database and trade weights from *UN-ComTrade*.

Figure C.4: Evolution of quality, by sector



Notes: Quality indices calculated, by sector, over the whole sample of export flows (solid line) and the sub-sample of intensive flows (dashed line).

Figure C.4: Evolution of quality, by sector (Continued)



Notes: Quality indices calculated, by sector, over the whole sample of export flows (solid line) and the sub-sample of intensive flows (dashed line).

D Tables

Table D.1: Summary Statistics

Variable	Mean	Std. Dev.	pctle 5	pctle 95	N
CES indices					
Quality (Int + Ext)	118.2	73.9	52.2	211.1	1,453
Quality (Int)	106.8	53.4	63.4	154.2	1,453
Price (Int + Ext)	107.5	39.7	61.6	173.7	1,453
Price (Int)	111.4	33.7	71.9	169.1	1,453
Unit Value (Int + Ext)	121.2	80.0	53.9	225.9	1,453
Unit Value (Int)	117.5	58.0	60.9	203.9	1,453
Translog indices					
Quality (Int + Ext)	118.5	86.4	54.8	213.6	1,453
Quality (Int)	105.2	41.6	66.3	149.9	1,453
Price (Int + Ext)	108.0	44.4	59.5	181.0	1,453
Price (Int)	110.4	30.7	74.5	162.9	1,453
Unit Value (Int + Ext)	118.7	69.5	57.5	205.4	1,453
Unit Value (Int)	115.3	50.3	62.7	190.7	1,453

Notes: These summary statistics are computed over the distribution of sector- and destination-specific indices for 2005 ($Q_{kc,05}$ with $Q_{kc,1995} = 100$). Sectors are defined in the ISIC revision 2 nomenclature. The decomposition is either performed on the whole sample ("Int + Ext" rows) or on the subsample of intensive flows ("Int" rows). Interpretation: Over 1995-2005, the mean growth rate of quality, averaged across markets and sectors, is equal to 18.2%. The corresponding average price increase is equal to 7.5%. In the meantime, unit values were increasing by 21.2%.

Table D.2: Variance Decomposition

Source	Partial SS	dof	MS	F	Prob > F
CES					
Model	42573.5	38	1120.4	2.38	.000
Country FE	7020.9	13	540.1	1.15	.318
Sector FE	35552.6	25	1422.1	3.02	.000
Residual	152917.1	325	470.5		
Total	195490.5	363	538.5		
Translog					
Model	47210.1724	38	1242.4	2.07	.000
Country FE	10389.6	13	799.2	1.33	.191
Sector FE	36820.5	25	1472.8	2.46	.000
Residual	194662.4	325	599.0		
Total	241872.6	363	666.3		

Notes: Variance decomposition obtained from the following regression:

$$Q_{kc2005} = \sum_{k} \delta_k FE_k + \sum_{c} \alpha_c FE_c + \varepsilon_{kc}$$

where Q_{kc2005} is the 2005 quality index computed for the ISIC sector k in destination market c, $\{FE_k\}$ is a set of sector fixed effects and $\{FE_c\}$ a vector of country fixed effects.

Table D.3: First Stage Regressions

	(1)	(2)	(3)
	Dep. Var: Δ Market Share		
Δ Mks global	0.804^a	0.614^a	0.718^a
	(0.049)	(0.079)	(0.060)
Relative distance	-0.002^a	-0.000^c	-0.065^a
	(0.000)	(0.000)	(0.009)
Country sample	All LWCs	All LWCs but China	China
Observations	13213	12813	400
R^2	0.475	0.191	0.391
F-stat	102.2	22.7	94.9

Notes: Robust standard errors in parentheses with ^{a} $p < 0.01$, ^{b} $p < 0.05$ and ^{c} $p < 0.1$.
The change in low-wage countries' market shares for sector k and destination c is explained by the total change in the country's market share in sector k, computed over all destination countries but c, ("Δ mks global") and the distance between the country and c, in relative term with respect to the "mean" exporter to that destination ("Relative distance"). In columns 2 and 3, the regression is run separately for China and for other low-wage countries.

Table D.4: Quality and Low-Wage Countries' Market Shares, Restricted Sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. var: Δ_{95-05} ln Quality					
Δ_{95-05} LWC Market share	0.261^{b}	0.436^{b}	-0.003	0.325^{a}	0.167	0.192
	(0.131)	(0.195)	(0.197)	(0.112)	(0.163)	(0.163)
Observations	364	364	364	364	364	364
R^2	0.045	0.045	0.208	0.072	0.050	0.182
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	No	No	Yes	No	No	Yes
Estimation Method	OLS	IV	OLS	OLS	IV	OLS
Sample	Whole	Whole	Whole	Intensive	Intensive	Intensive
Countries	Top14	Top14	Top14	Top14	Top14	Top14
Aggregation Method	CES	CES	CES	CES	CES	CES

Notes: Robust standard errors in parentheses. ^{a} $p < 0.01$, ^{b} $p < 0.05$, ^{c} $p < 0.1$.
The dependent variable is the log difference of the quality index between 1995 and 2005, computed at the ISIC (revision 2) level for each destination country. "Δ_{95-05} LWC Market share" denote the 1995-2005 change in market shares for low-wage countries. The IV procedure uses as instruments for the change in market shares the country's relative distance to the destination country and the change in its world share of sectoral exports. All market shares are computed excluding France.

Chapter 4

Globalization of Inflation: Micro Evidence on the Imported Input Channel

1 Introduction

Domestic production involves a substantial amount of imported inputs. Manufacturing industries exhibit shares of foreign inputs ranging from 20 to 67% of total costs.[1] For this reason, vertical production linkages are crucial in explaining the international transmission of shocks in open macroeconomics.[2]In relation to this issue, the intensive use of imported inputs calls into question the sensitivity of domestic prices to foreign ones. The strength of these effects depends on the extent to which changes in imported costs are transmitted to domestic prices. Despite its central role, direct evidence on

[1]See Goldberg et al. (2010). These figures are averages across OECD countries.

[2]di Giovanni and Levchenko (2010) found vertical linkages accounts for 30% of trade-induced business cycle correlation.

this transmission at the firm level is very scarce.

In order to fill this gap, this paper investigates how movements in the price of imported inputs are passed on to domestic output prices.

This analysis relies on a novel dataset that reports monthly individual quotes for the price of imported inputs as well as production prices. Namely, we matched at the firm level the micro prices collected by INSEE (the French statistical agency) in order to compute the French price indices for production, imports and exports. Thus, we observed the production prices of goods sold in the French market and abroad for approximately 500 manufacturing firms, and the price of their imported inputs. We documented four main results. First, on average, the elasticity of domestic prices to the prices of imported inputs is 12%. One key reason for the incompleteness of this transfer is related to the share of imported inputs used in the production process. However, there is an important heterogeneity across sectors that remains unexplained. Second, the level of transmission is much lower among firms that import inputs from a related party. Third, movements in imported costs are passed on to the same extent to both domestic and export prices. Finally, we show that, on average, 9% of the volatility in production prices at the sector level is driven by imported cost shocks relating to the costs of inputs. Once again, there is significant heterogeneity across sectors, with the volatility explained by imported input prices ranging between 0 and 40%.

In order to measure firm-specific imported input price shocks, we averaged out import prices at the firm level. This provided us with a measure of imported costs. Changes in firms' imported costs and in their production prices were observed for every period, thereby allowing us to estimate the elasticity of price changes with regard to changes in imported costs. As prices are sticky, we estimated the level of pass-through which is conditional on observing a change in the output price. After controlling for competitors'

prices, labor costs, sectoral production prospects and unobserved firm characteristics, we found that after a 10% jump in imported costs, domestic prices increase by 2.5%. Intuitively, the pass-through of firms' imported costs depends on the share of imports in total costs. We confirmed this using sector-level information from input-output tables. Interestingly, we did not find that output prices react asymmetrically to increases or decreases in imported costs. We also compared the pass-through of imported prices for arm-length transactions and intragroup transactions. The estimated degree of elasticity is significantly lower (and even non-significant in some specifications) for intragroup import prices.

Next, we checked the robustness of our results to the potential endogeneity of imported costs. Typically, a higher degree of demand for the output may lead to an increase in demand for inputs, driving the price of both inputs and output up. In our regressions, we controlled for changes in sectoral characteristics, including changes in sectoral demand. However, we did not have information concerning firm-specific demand. We argue that any instrumentation strategy would require firm-specific instruments. As we could not build such firm-specific instruments, we followed a different strategy and focused on input prices that we consider to be exogenous to the firm. In order to do so, we used the nature of the transaction associated with every import price that is reported in our dataset. In particular, we assumed that the prices of inputs that importing firms declare as not being specific to one supplier are exogenous. Our assumption is that if a firm can import a given input from different suppliers, this means that the good is highly standardized. In addition, we can reasonably assume that the price of such internationally traded goods will not be affected by changes in the demands of a given firm.[3] By exploring exogenous input price changes, we found an elasticity of domestic

[3]In the same vein, we could focus on goods that are classified as non-differentiated, according to the Rauch classification. These good are less likely to react to firm-specific changes in demand.

prices to imported input prices of 12%.

Furthermore, our data report not only domestic but also export prices. Focusing on firms that sell their products both domestically and abroad, we asked whether imported costs are passed on in different ways in different markets. Differences could exist because of the presence of exchange rates, differences in market shares or differences in the competitive pressure faced by firms. In our sample, we did not find any significant differences in pass-through between domestic and export prices.

Finally, we attempted to generate a more macro view of our micro estimates. In other words, we asked what share of the volatility of sectoral prices can be explained by imported input prices. On average, 9% of the volatility in sectoral prices is explained by imported inputs. However, this hides significant variance across sectors. Specifically, in the manufacturing of chemicals and chemical products, imported inputs account for 40% of price volatility. By contrast, for basic pharmaceutical products, changes in the price of imported inputs do not explain the sectoral volatility of prices at all.

Literature review. This paper forms part of the burgeoning literature on individual prices (Dhyne et al., 2005; Bils and Klenow, 2004; Nakamura and Steinsson, 2008). While these papers focus on the dynamics of price changes, our paper deals with the determinants of those price changes. In this respect, this paper is related to the work of Fougere et al. (2010), who look at the impact of changes in the minimum wage on restaurant prices. It is also closely linked to the works of (Nakamura and Zerom, 2010) and (Goldberg and Hellerstein, 2007), who perform structural estimations of the determinants of incomplete pass-through in the coffee and beer industries respectively. In contrast to these papers, we study firm-specific import cost shocks for a wide range of industries.

In addition to their scope (the entire manufacturing industry), our data present several other advantages. First, very few datasets combine information about production and import prices at the firm level. Information on import prices at the firm level is often approximated by unit values, based on custom data. In addition to the drawbacks linked to the quality of unit values, such data do not provide information on domestic prices or domestic unit values.[4] Second, while studies based on data regarding individual production prices exist, to our knowledge, these data have never been merged with information about the price of imports at the firm level. Third, the data allow us to disentangle intra-firm prices from arm-length transactions, which cannot be done in studies using aggregate sectoral data. The distinction we have drawn between intragroup prices and arm-length prices relates our work to that of (Neiman, 2010) and (Bernard et al., 2010).

Most of the literature on cost pass-through usually focuses on exchange rate pass-through (Goldberg and Hellerstein, 2007). This offers several advantages. In particular, exchange rates are often viewed as exogenous shocks, and they are widely available and apply to most trade prices. However, they present two main drawbacks in comparison to the use of firm-specific imported input price changes. First, exchange rates have a direct impact on trade prices. However, the dynamics of trade prices and domestic prices may be different (Schoenle, 2010), and therefore the pass-through estimated from trade prices may not be similar to the cost pass-through of domestic prices. Second, the exchange rate is a particular cost. Firms may insure against it through formal insurance or through their sourcing strategies. Therefore, conclusions about exchange rate pass-through may not apply to other costs, such as the cost of intermediate inputs. Our paper is also in line with recent empirical works linking globalization and infla-

[4]Trade data are recorded at very low levels of aggregation, which allows researchers to compute unit values. There is no counterpart for domestic production.

tion. For instance, using sectoral data, (Goldberg et al., 2010) evaluate the relative importance of the channels through which domestic inflation responds to movements in exchange rates and import prices. Through a calibration exercise, they show that the imported cost channel is the most important, with imported inputs explaining about two third of the sensitivity of domestic prices to foreign prices. (Auer and Fischer, 2010) analyze the specific impact of imports from China on sectoral inflation in the US. They found that imports from China exert a downward pressure on US sectoral inflation. In the same vein, (Benigno and Faia, 2010) show that greater international pressure has a positive impact on pass-through. Instead of looking at the impact of changes in market shares on domestic prices at the sector level, we analyzed the impact of imported input prices on domestic prices at the firm level.[5]

Finally, this paper contributes to the recent trade literature which focuses on imports at the firm level. Most of this literature has underlined the beneficial impact of imported intermediate inputs on firms' productivity (Amiti and Konings, 2007; Goldberg et al., 2010). In the same vein, Gopinath and Neiman (2011) use micro data to explore the mechanisms of trade adjustment during the Argentine crisis and to simulate the impact of an imported input cost shock on aggregate TFP. In this paper, we provide new evidence of the pricing behavior of importing firms and the transmission of imported cost shocks, using monthly information on individual prices and costs.

The paper proceeds as follows. The next section describes the data. Section 3 presents both aggregate facts and evidence on the dynamics of individual prices. Section 4 describes the empirical strategy. Section 5 displays the results. Section 6 examines the aggregate implications of the results. Finally, Section 7 outlines the conclusions.

[5]Note that our data do not provide any information on the origin of imports. Therefore, the specific impact of China or other low-wage countries on production prices cannot be studied.

2 Data

We use three datasets in this paper. The first, OPISE, is a confidential dataset provided by INSEE that reports the series of individual production prices and import prices that are used to construct the French Producer Price Index, the French Import Price Index and the French Export Price Index. This dataset has previously been used by Gautier (2008). The author provides empirical evidence on the frequency and the size of production price changes over the period 1995-2005.

The second dataset combines domestic and export French price indices at different levels of disaggregation, as well as information on labor costs and production prospects at the sector level. All of this information can be extracted from the INSEE website.

Third, we use the French input-output matrix for 2005 to measure the share of imported costs into production at the sectoral level.[6]

2.1 OPISE

Information on individual prices was taken from the OPISE database, which was built by INSEE in order to construct the French Producer Price Index (PPI). INSEE surveys around 5500 firms and collects approximately 34,000 individual prices every month. Both manufacturing and service sectors are surveyed. We used data on manufacturing only, which represent 4300 firms and 30,000 individual prices. With regard to manufacturing, three types of price are collected: the prices of goods produced in France and sold on the domestic market (which are referred to as domestic prices); the prices of goods produced in France and sold in foreign markets (which are referred to as export prices) and import prices. We obtained information for the period from January 2005 to August 2010.

[6]Input-output matrices are available on the OECD website.

Coverage. The selection of individual prices collected by INSEE is carried out in two steps. The first step consists of selecting the firms to be surveyed. Statistical engineers study the structure of each industry in the domestic, export and import markets. Using the EAE database (a French survey which describes the total sales of firms, by industry, in the domestic and foreign markets), statistical engineers select the largest firms in the industry. They select firms with cumulative sales which account for more than 70% of the industry. In 2005, the coverage of the survey for the manufacturing industries is 98% (in terms of sales) for domestic prices and at 90% for export prices.

Bias. By construction, the survey is representative of the pricing behavior of the largest firms. This may be an issue if we want to find systematic patterns in the pricing of firms. I guess the problem is lessened in the analysis for two reasons. First, the French Producer Price Index is computed using this sample of firms. Therefore, if we want to understand empirically the determinant of prices changes driving inflation we must focus on this reduced sample of firms. Second, we focus on importing firms. Evidence on the behavior of importing firms tend to suggest that importers are relatively large firms (eg. Blaum et al. (2010) on French firm-level data). Hence, the sample of firms considered in the analysis is likely to be representative of the pricing behavior of French importers.

Individual prices. The second step is to choose the individual prices to survey. The policy of INSEE is to survey the price of representative transactions. Representative transactions are chosen during a personal visit from an engineer-pollster. The following points are taken into consideration: the relative importance of the various goods produced by the firm; the transactions which are the most representative of price changes; and how to obtain comparable information on transactions over time. If the firm has

the same pricing policy for all of its products and all of its transactions, then only one representative transaction will be collected. However, if the pricing policy depends on the product or the market being served, several prices will be collected each month. During the visit, some extra information is compiled by the pollster, such as a description of the product, the nature of the transaction, the currency used and the value of sales. For instance, INSEE differentiates between intragroup and arm-length transactions. Intragroup transactions refer to transaction occurring between parties owned at more than 50% by the same enterprise. This distinction exists for import and export prices only, while domestic prices relating to intragroup transactions are not collected. These details are updated every five years. The individual weights of series in the PPI are computed from the sales declared during the visit and change every five years as well.

The goal of this survey is to collect individual time series data regarding prices and then aggregate them in order to construct the PPI. Therefore, it is important to have time series of individual prices. Time series of individual prices and the study of representative transactions are often hard to reconcile. In fact, transactions defined as the sale of one given product to a given customer do not occur every month and often disappear quickly. Therefore, the reported prices are sometimes mix prices. Mix prices refer to a mix of different products which are sold to a given buyer, or more generally a mix of the same product sold to different buyers. For import and export prices, the price can be a country mix. This type of mix refers to cases in which the good is imported/exported at different prices from/to different destinations but by/to the same supplier/buyer.

In our data, these different types of mix are indicated for each series. We grouped the series into two types. First, pure prices, country mix prices and product mix prices

were grouped together. These transactions are specific to a certain buyer and a certain supplier. The second series does not reflect the price of a specific transaction between a buyer and a supplier. We used this distinction to classify import prices. Namely, we argue that if firms report that a transaction is not specific to a certain supplier; this means that the imported good is sufficiently standardized. In such cases, the buyer does not have to build a specific relationship with the supplier.

Price collection At the end of each month, firms are invited to indicate the price of the selected transactions by mail (55%) or via the Internet (45%).[7] The average monthly rate of response is 85%. Firms that do not report individual prices are subject to judiciary pursuits. If price reports are considered to be "outliers", pollsters telephone the firms and check the reasons behind the difference between the reported price and the price reported in the previous month.

Prices. Individual production prices are mill prices reported net of VAT and include sales and discounts. The price reported for products sold on foreign markets is the free on board (FOB) price. The price of imported goods takes into account costs, insurance and freight. For import and export prices, we do not know the precise origin/destination of the transaction. However, we know for some imports and exports whether the destination/country of origin is in the European Union. Finally, for reasons of confidentiality, we do not have access to the true price level. All series are multiplied by a constant (which is different for each series). This is not a problem, as in our specifications, we consider price changes, which are unaffected by the constant shifts in price levels.

[7]There is not a two-step procedure as there is for BLS data in which firms are first asked whether or not they changed their price.

2.2 Sectoral and aggregate data

Our estimation strategy makes use of several control variables at the sector level. In order to control for competitors' prices, we built a sectoral price index that excludes firms' own prices from our data. In order to take into account changes in the demand addressed to the firms, we used the sectoral production index provided by INSEE at the two-digit level of the NACE nomenclature. We further controlled for labor costs, at the same level of disaggregation, which were also provided by INSEE. Under certain specifications, we controlled for 'the share of the total output made up of imported inputs at the sectoral level. This information came from the input-output OECD tables for 2005. At times, we also used the sectoral Herfindalh index.[8]

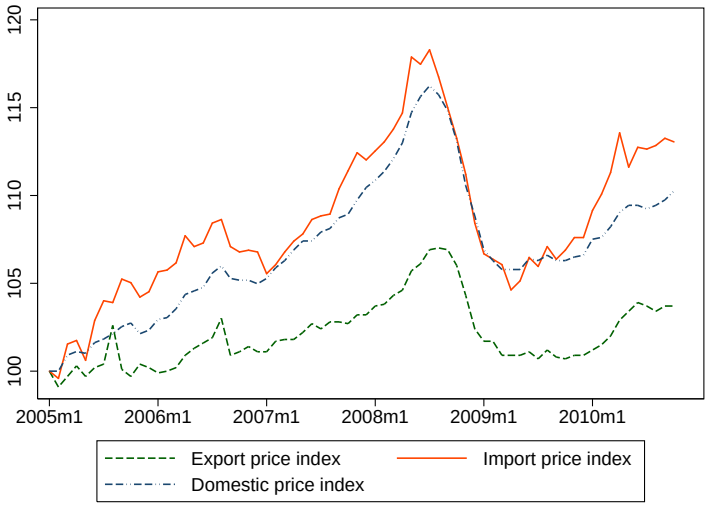
3 Stylized Facts

3.1 Aggregate data

In order to provide an idea of the inflationary environment in the French manufacturing industry, we begin by documenting the trend in aggregate prices over the period 2005-2010. Figure 1 plots the evolution of the import, export and domestic price indices for France. All three series are computed from prices in euro. We can see that the three series are positively correlated. Interestingly, the export price series exhibits a lower degree of volatility than the import and domestic series. For the three series, we can observe a striking drop in prices in mid-2008, when the full effects of the 2008 crisis were felt in France. Figure 2 plots the relative export price index against the nominal effective exchange rate (NEER). The relative export price index is computed as the ratio of export price changes to domestic price changes. The NEER was devised by

[8] I thank Claire Lelarge for providing me with this index.

Figure 1: French domestic and trade price indices



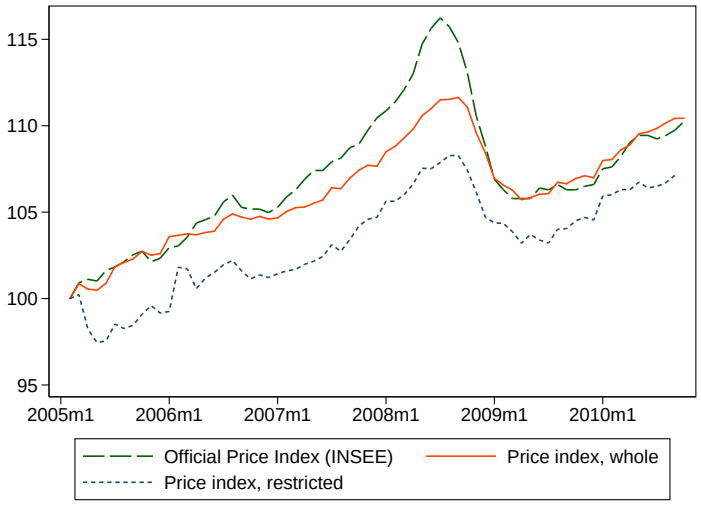
Source: INSEE.

the Bank of International Settlement. It is computed as the trade-weighted average of bilateral nominal exchange rates. We can see a strong negative correlation between the two series, suggesting that the real price of exports decreases in response to appreciation of the euro against other currencies. Figure 3 compares the official price index with the price index computed using our data and the weights reported in the dataset. More specifically, the price index is computed using the entire data sample, but also using the prices for the restricted sample of firms that reported both production prices and import prices. This latter sample is the one used in our empirical analysis. We observed a strong correlation between the three series. The correlation coefficient between the reconstructed indices and the official price index is 0.95 for the index which uses the entire dataset and 0.9 for the index built from the restricted sample. We also investigated the correlation between the official indices and the reconstructed indices at the industry level. The correlation between the official sectoral indices and

Figure 2: Real export prices and nominal exchange rate

Source: The nominal effective exchange rate is from the Bank of International Settlements. For France, it is computed over 58 countries as a weighted average of bilateral exchange rates of the euro using the Turner and Vant dack weighting scheme. See: *http* : *//www.bis.org/statistics/eer/index.htm*. The real export price is computed as the ratio of export to domestic price indices. These two indices are from the INSEE.

Figure 3: Official vs reconstructed price indices



This figure compares inflation in the manufacturing industry measured by the INSEE with the inflation we obtain using our individual data. The dashed line is the price index computed from all the whole dataset. The dotted line is the price index computed from the sample of firms reporting both production prices and import prices.

the indices built from the whole sample has a coefficient of 0.8. This drops to 0.6 for the sample restricted to firms reporting both domestic and import prices. This lower correlation is mainly driven by the furniture industry, which exhibits a very small correlation of 0.2.

3.2 Item level data

We obtained access to the universe of manufactured products surveyed by INSEE from January 2005 to September 2010, i.e., 1,332,033 observations. We excluded series which lasted for less than 12 months. We also excluded all observations for which we did not

have information about the sectoral classification of the product.[9]

We were left with 1,063,961 observations. Around 60% of the observations referred to domestic prices, 20% were export prices and the remaining 20% were import prices. It is worth noting that 9% and 25% of export and import prices respectively corresponded to intragroup transactions. Table 1 presents the average number of observations per month which were available for each year in our sample. We can see that the number of domestic prices increased by 40%, the number of export prices multiplied by 2.8 and the number of import prices multiplied by four.

Table 1: Average monthly number of observations

Year	Domestic	Exports	Imports	Total
2005	6,961	1,435	915	9,310
2006	8,521	2,351	2,501	13,373
2007	9,716	3,207	3,083	16,006
2008	10,650	3,938	3,695	18,283
2009	10,694	4,263	4,064	19,021
2010	9,459	3,823	3,612	16,895

Notes: This table reports the average number of observations collected every month for years 2005 to 2010. We disentangle observations for prices of good produced in France and sold in France (domestic), goods produced in France and sold abroad (exports) and goods produced abroad and sold in France (imports). The last column is the sum of the three others.

The dataset consists of 27,547 price series, reported by 4456 firms. Among these firms, 37% reported domestic prices only, 22% reported import prices only and more than 9% reported the price of their imports and their domestic prices. More than half also reported their export prices (see Table 2). Firms reporting domestic prices did so for

[9]There was a change in the nomenclature in 2008. We were able to obtain information about the CPF4 2008 revision of surveyed prices for 89% of observations.

an average of 4.3 products. The average number of exported and imported products was 3.4 and 3.7 respectively (see Table 3). The maximum period for which we observed a price was 69 months. The average number of months for which we observed a price was 42 for domestic prices, 34 for export prices and 35 for import prices.

Table 2: What prices do firms report?

Status	# of obs.	Percent
Domestic only	1,310	35.07
Exports only	107	2.86
Imports only	699	18.71
Dom.& Exp.	1,040	27.84
Dom. & Imp.	216	5.78
Imp. & Exp.	36	0.96
Dom. & Imp. & Exp.	327	8.76
Total:	3,735	100

Notes: This table reports the number and the share of firms that report domestic, export and import prices.

Table 3: Number of products per firms

Status	P10	P90	Median	Mean	Standard Deviation
Domestic	1	9	3	4.5	4.4
Exports	1	7	2	3.5	3.4
Imports	1	8	3	4.0	5.2

Notes: This table reports the 10th and 90th percentiles, the median, the mean and the standard deviation of the number of products reported by firms reporting domestic, import or export prices.

Table 4 presents the currency used in the transactions for the different trade prices. One can see that the vast majority of both import and export transactions are in euro.

Table 4: Currency of transactions

	Exports		Imports	
Currency	Euro area	Rest of the world	Euro area	Rest of the world
EUR	0.92	0.03	0.86	0.80
USD	0.03	0.09	0.04	0.08
Other	0.00	0.02	0.02	0.01
Non reported	0.06	0.87	0.09	0.12

Notes: This table reports the share of export and import transactions denominated in Euro, in US Dollar, and in other currencies in our sample. Observations for which we do not have information are classified as "non reported".

Table 5 documents the frequency and the implied duration of price changes. The frequency is a simple average of frequencies computed at the item level. The implied duration is the inverse of the frequency. These frequencies are provided at the sector level for domestic, export and import prices. Two facts emerge from this table. First, we can observe an important heterogeneity in the frequency of price changes across sectors. For instance, prices change on average every 1.3 months for food products and every 22 months for basic pharmaceutical products. This heterogeneity is in line with previous studies (see Nakamura & Steinsson 2008). Second, by comparing the sectors in which prices were reported for domestic, import and export prices, we can see that, on average, export and import prices are stickier than domestic prices. This is particularly true when considering durable products.

Figure 4 plots the monthly proportion of price changes over time. We can see that the proportion of positive price changes is slightly higher than the proportion of negative changes. Interestingly the share of price changes appears to be stable over time,

suggesting that, at the aggregate level, prices are staggered. It is worth noting that we can observe a strong seasonal pattern in the dynamics of individual prices. At the beginning of each year, the share of price changes increases. These price changes are mostly positive.

4 Empirical strategy

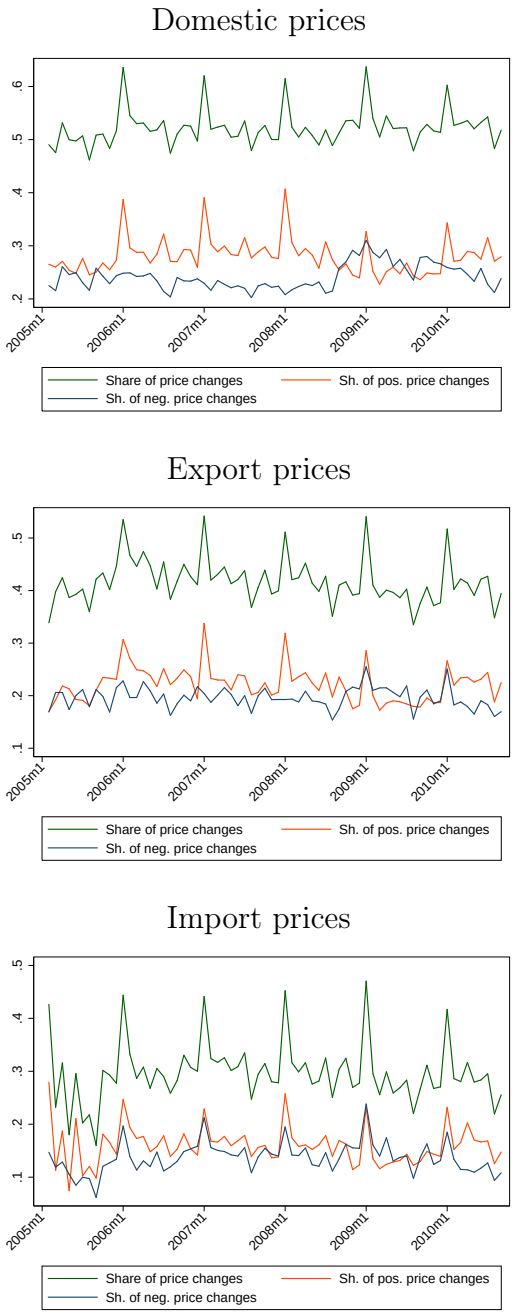
4.1 Measuring the sensitivity of domestic prices to imported input prices

This section details the strategy we used to measure the sensitivity of domestic prices to imported input prices. In order to estimate this elasticity, we ran the standard pass-through regression, which is traditionally used to quantify exchange rate pass-through. As our prices exhibited substantial stickiness, we followed on from the work of Gopinath and Rigobon (2008) by measuring pass-through which is conditional on observing a change in the price of output. Therefore, changes in the dependent variables are explained by changes in our explanatory variables since the last output price change. The main determinants of price change are labor costs, input price, competitor' prices and production. Competitors' prices are a proxy for both competition and the price of domestic intermediate inputs. Actually, most of inputs used by firms are produced by firms belonging to the same industry. We estimate that the following equation:

$$\Delta_{t,\tau} p_{fkpt} = \alpha \Delta_{t,\tau} z_{ft} + \beta \Delta_{t,\tau} X_{kt} + T_t u_{fkp} + \epsilon_{fkpt} \tag{1}$$

where f, k, p, t represent the firm, its sector, its product and the period respectively. The period $[t - \tau, t]$ is the period which has elapsed since the previous price change.

Figure 4: Share of price changes over time



The graphs plots the monthly share of price changes, positive price changes and negative price changes for domestic sales, exports, and imports. The first month (01/2005) of the sample is dropped because changes cannot be computed.

$\Delta_{t,\tau}Y$ is the change in variable Y between the dates t and $t-\tau$. p is the logarithm of the output price, z is the logarithm of the price of imported inputs, X is a vector of control variables, T is a time dummy and u is a firm-product fixed effect.

Pass-through is complete if changes in imported costs are transferred in their entirety to output prices, e.g., if α is equal to one. For several basic reasons, we do not expect this pass- through to be equal to one. First, the extent of pass-through should be limited by the share of imported inputs entering into the production process. For instance, if imported inputs account for 25% of a firm's costs, we do not expect more than 25% of changes in imported costs to be passed on to prices. In order to measure this effect, we interact the change in imported input prices with the share of imported inputs in the firm's industry.[10] The regression therefore becomes:

$$\Delta_{t,\tau}p_{fkpt} = \alpha\Delta_{t,\tau}log(z_{ft}) \times io_k + \eta io_k + \beta\Delta_{t,\tau}X_{kt} + u_{fkp} + \epsilon_{fkpt}$$

where io is the share of imported inputs used in industry k. The sensitivity of output prices to input prices depends on the share of imported inputs used in the industry, which is given by α. This channel is close to the local cost channel emphasized by the exchange rate pass-through literature.

Another channel that could reduce or increase pass-through is the substitution of foreign with domestic inputs and vice versa. In particular, if the price of imported inputs increases, firms could substitute them with domestic ones. This mechanically reduces pass-through. Conversely, if the prices of imported inputs decrease, firms could substitute their domestic inputs with foreign ones, which is expected to increase pass-through. Therefore, this substitution effect has an asymmetrical impact on pass-through: imported input price increases are transmitted to a lesser degree than in a configuration

[10] We have no information on the share of imported inputs at the firm level.

without substitution, and imported input price decreases are transmitted to a greater extent. A basic test of this effect is therefore to measure whether prices react asymmetrically to price increases and decreases.

Pass-through may also be reduced if firms adjust their markups following a change in their costs. A basic way to account for this effect is to control for the level of competition in the industry. We have done so in some specifications by combining the Herfindahl index with the input price changes. We expect the degree of pass-through to be lower in industries with a strong level of competition.

The final traditional channel which explains incomplete pass-through is non-constant marginal costs. If a change in the price of inputs is associated with a change in the quantities of output produced by the firm, and if the firm experiences increasing marginal costs, then this could affect the pass-through. The impact of this channel on the degree of pass-through is unclear in our case.

Our data distinguish between the production prices of goods produced in France and sold in France, and goods produced in France and sold abroad. We call the latter export prices. One way to contrast the transfer of input price changes to domestic and export prices is to run regression (2) on domestic and export prices separately. However, differences in the estimated coefficients may be due to differences in firms' pricing behaviors, but also to composition effects. In particular, not all firms export, and exporting firms do not sell the same bundle of products on the domestic and export markets. In order to deal with such between-firm composition effects, we proceeded in two steps. First, we aggregated prices at the four-digit sector level for each firm. We did so in order to be sure that we were comparing price changes for firms selling the same type of goods domestically and abroad. Second, we focused on firms selling the

same type of goods in both the domestic and foreign markets. Then, we estimated:

$$\Delta_{t,\tau} p^m_{fkt} = \alpha \left(\Delta_{t,\tau} z_{ft}\right) + \alpha_{exp} \left(1 - D\right) \left(\Delta_{t,\tau} z_{ft}\right) + \beta \Delta_{t,\tau} X^m_{kt} + u_{fk} + \epsilon_{fkt} \qquad (2)$$

Where the superscript m indicate whether the price is for a good sold domestically or abroad and D is a dummy equal to one if it is a domestic price. The average effect of a change in imported costs is given by α. The difference in the effect on domestic and export prices is given by α_{exp}.

4.2 Endogeneity

Within our specifications, endogeneity may arise because of an omitted variable. In particular, an idiosyncratic demand shock to the firm may affect the price of both inputs and outputs. On the one hand, following a positive demand shock, a firm should increase its output price. On the other hand, this increase in demand for output should induce higher profits and an increase in the demand for inputs. Therefore, input prices could increase for two reasons. First, if the price of inputs is set after a bilateral bargain is struck between the supplier and the firm, higher profits may lead to an increase in the price of inputs, as long as the supplier has some bargaining power. The second mechanism simply states that the firm's demand for input increases, which increases the price of input.

In such cases, failure to take into account this omitted variable would lead to an upward bias in our pass-through estimate. It is worth noting that other mechanisms suggest that, in fact, we are facing a downward bias. In particular, the increase in demand for inputs may lead to lower prices for these inputs if some forms of second-degree price discrimination occur. The firm demands more input, bargains over the price of this

input, and finally manages to get a lower price per unit because it buys more units.

Importantly, the mechanisms which lead to an upward bias suggest some specificity in the relationship between buyers and sellers. If the input is standardized: (i) no bargaining occurs between the supplier and the buyer that could induce a price increase after an increase in demand for the input; and (ii) the idiosyncratic increase in demand from the buyer is not likely to raise the price of a standardized input. Therefore, our strategy for getting rid of endogeneity is to focus on inputs that do not involve any specific link between the buyer and the seller. We consider that changes in the price of these inputs may be considered as exogenous for the firm.

In order to do so, we need to disentangle specific and non-specific transactions. Statistical agencies want to follow the price of representative transactions (i.e., the same product traded between the same two parties every month). Nevertheless, particularly for imports, firms sometimes report that they import the same product from a different supplier every month, or from different suppliers every month. This means that these products are fairly well standardized, and that there is no specific relationship between the supplier and the buyer. Thus, changes in the price of those inputs may be considered as exogenous to firms. Fortunately, INSEE reports whether or not the transaction is specific to a supplier. Therefore, we focused on the sample of inputs which were imported through non-supplier-specific transactions. We believe that, for this sample, changes in the price of imported inputs are exogenous to firms.

An alternative way to focus on inputs which undergo exogenous changes in price is to use the Rauch classification. This classification categorizes goods into three types: differentiated products; reference prices and homogenous goods. We expect price changes for reference and homogenous inputs to be exogenous to firms.

Another methodology that could be used to deal with endogeneity is to find an instru-

ment correlated with changes in input prices. It appears to be very difficult to build valid instruments from our dataset. The best instrument we devised would have been both firm- and time-specific. The only variable in our database that is firm-specific and which is not correlated directly with output prices is the lagged values of import price changes. However, in our data, changes in input price are barely correlated with their lagged values. We therefore chose to use sector- and time-specific instruments. However, these instruments (such as exchange rate movements) also affect competitors' input prices and, in turn, competitors' output prices. Therefore, our instruments would affect output price not only through the input price, but also through competitors' prices. This significantly limits the validity of this type of instrument. For this reason, we decided to focus on inputs for which we considered price changes to be exogenous.

5 Results

5.1 Imported costs pass-through into domestic prices

Initial results. The main results are displayed in Tables 6 and 7. These tables report the results for imported inputs for arm-length transactions and exogenous arm-length transactions respectively.

In the first columns, changes in output prices are explained by changes in firms' imported input prices (since the previous output price change) and sector-period fixed effects. For each period, they measure changes in firms' environment that are sector-specific. In all regressions, reported standard errors are clustered in the firm×period dimension, which is the dimension of the main explanatory variable. The first column of Table 6 shows that 29% of changes in imported costs are transferred to domestic

prices. This effect is significant at the 1% level. This finding holds when considering non-specific "exogenous" arm-length transactions (Table 7, column 1). The coefficient is lower but highly significant (0.13). This suggests an upward bias when considering non-exogenous changes in cost.

Columns 2 to 4 of Tables 6 and 7 introduce sector-specific determinants of price changes. Namely, we added changes in competitors' prices, labor costs and production (columns 2 and 3), as well as changes in competitors' imported costs (column 4). All of these specifications include product×firm fixed effects and period fixed effects. As expected, competitors' prices have a strong positive and significant effect on output prices in all of our specifications. The effect of labor costs is positive but never significant. This can be explained by the fact that an important source of wage variation is changes in the minimum wage, which is set at the national level. This variation is therefore captured by our period fixed effects. Changes in our index of production have a very low coefficient that is never significantly different from zero. For arm-length domestic prices (Table 6, column 2), the estimated elasticity of prices to imported costs is close to 0.24. For what we refer to as exogenous arm-length changes in import prices, the effect is much smaller than in the previous specification. Namely, we found that 13% of imported input price changes are passed on to domestic prices.

In the different specifications, the estimated elasticity of competitors' prices is twice as large as the elasticity of price changes to imported inputs. In order to avoid misinterpretations of this gap in magnitude between the two coefficients, we display in column 3 of Tables 6 and 7 the results of regressions of the same variables but which have been standardized. Thus, we can interpret the coefficients as reflecting the impact of one standard deviation of the explanatory variables on the explained variable. When considering all arm-length transactions, we found that almost 14% of one standard

deviation in imported prices is passed on to domestic prices. Interestingly, 14% of one standard deviation in competitors' prices is passed on to domestic prices, reversing the magnitude of the previous coefficients. However, this is not robust to the sample of exogenous price changes. In this case, 5.9% of one standard deviation of imported costs is passed on to domestic prices, compared to 13.6% for competitors' prices.
In the fourth column of these tables, we controlled for the change in competitors' import prices. This variable is not significant and does not influence the other coefficients.

Arm-length vs intra-group transactions. Previous estimates have focused on arm-length transactions. Nevertheless, a large part of international trade occurs within firms. We reproduced previous estimates, but focused on changes in the prices of imports from related parties. When controlling for sectoral fixed effects, it became apparent that changes in costs are not transmitted to domestic prices (Table 8, col. 1). As the sample of intra-firm transactions was vastly reduced, it may be that the very small and non-significant effect we found was due to the lack of variance, as it was all captured by the industry×period fixed effects. When this strong fixed effects structure is relaxed (columns 2-4), the coefficient becomes significant. However, the estimated effect is much smaller than for arm-length transactions. This suggests that around 6.5% of imported costs are passed on to domestic prices when the transaction occurs within related parties. A striking (and unexplained) result is the negative impact of changes in production for this sample in all of the specifications.

5.2 Heterogeneity in imported costs pass-through

Until now, we have measured the average impact of imported costs on domestic prices. However, we expect the degree of transmission to differ between industries, because

of differences in the structure of production or the nature of competition. We study this heterogeneity in the following paragraphs. The results are listed in Table 9 for all arm-length prices and in Table 10 for exogenous arm-length price changes.

Asymmetry. The first columns of Tables 9 and 10 investigate whether positive and negative import price changes are passed on to the same extent to output prices. For all arm-length transactions (Table 9, col. 1), the coefficients of both import price increases and import price decreases are positive, but the coefficient of price decreases were not precisely measured. The coefficient for price decreases is 1.5 times as large as the coefficient for price increases. However, standard errors are large, and we cannot reject the equality of the coefficients (F-stat = 1.53). For exogenous changes in import prices, both coefficients remain positive and significant. Furthermore, the gap between the two is much lower, and one cannot reject the equality of the coefficients (F-stat = 0.26). Thus, our results suggest that overall, firms pass on positive and negative cost shocks to their domestic prices to the same extent. As previously discussed, this symmetry suggests that no major substitution of imported and domestic inputs occurred.

Sector characteristics. The first sectoral characteristic for which we controlled was 'the share of total production costs made up of imported inputs. In order to do so, we pre-multiplied the changes in imported costs by the share of imported inputs in sectoral production. The second column of Table 9 presents the results for the entire sample of arm-length transactions. The estimated elasticity of domestic prices to imported input price changes multiplied by the sectoral share of imported inputs is 1.474. The standard error is large, and the coefficient is not statistically different from 1. This suggests that the aforementioned incompleteness of pass-through was driven mainly by the share of imported inputs in firms' total costs. The first column of Table 10 reports

the estimation for the sample of exogenous imported price changes. The elasticity value is 0.76, which is much higher than in the regressions which did not take into account the share of imported inputs. Overall, these results suggest that a large part of the incompleteness of the pass-through of imported costs is due to the share of imports used in the production process.

The second characteristic we wanted to control for is the structure of competition. We did so by interacting changes in imported costs with the Herfindahl index of the sector. The third columns of Tables 9 and 10 both show that the effect is not significant. This suggests that the structure of sectoral competition does not affect the pass-through of imported costs into domestic prices.

Sensitivity to the frequency of price changes. Gopinath and Itskhoki (2010) show that exchange rate pass-through is higher for goods which undergo frequent price changes. We tested whether or not such a correlation could be found in our data. We also investigated whether or not pass-through depends on the frequency of changes to the price of the imported inputs. We computed the frequency of price changes at the item level, dividing the number of price changes by the number of observations in the series. These frequencies were then interacted with imported costs changes.

In Table 9, columns 4 and 5 present the results for all arm-length prices. The coefficients of these interaction terms are positive, but only the coefficient of the frequency of input price changes is significant. This suggests that: (i) firms which change their prices more often do not pass on a larger share of changes to imported costs; but (ii) firms tend to pass on a larger share of cost changes when the price of their inputs changes more frequently. However, the coefficients are much smaller and no more significant when focusing on the sample of exogenous price changes (Table 10, columns 4 and 5).

Heterogeneity across industries Table 11 lists the coefficients of the imported inputs we estimated for different sectors, depending on the type of import (arm-length, exogenous, intra-firm). A first glance at this table reveals that there is an important heterogeneity in the degree of transmission of imported costs to domestic prices. Overall, we can also see that the degree of transmission is much lower for intra-firm than for arm-length transactions. We will now describe the results for exogenous arm-length transactions, which are the most representative in our view. First, most of the estimated coefficients are not significant. This weak statistical significance is explained in some cases by the very low number of observations which were used to measure pass-through. This is the case in sectors in which most transactions for imports involve a specific supplier: motor vehicles, computers, electronic, optical, and pharmaceutical products. By contrast, for the chemical industry, food and beverages, electrical equipment, metal products and textiles and apparel, the level of pass-through is above 8% and the estimated coefficient is highly significant.

Table 5: Frequency and monthly duration of price changes

	Domestic		*Exports*		*Imports*	
Sector	Freq.	Dur.	Freq.	Dur.	Freq.	Dur.
Extraction of petroleum and gas					1.0	1.0
Mining of coal and lignite					0.9	1.1
Mining of metal ores					0.9	1.1
Water collection, treatment and supply	0.2	4.9				
Manuf of tobacco products	0.1	10.0			0.1	7.6
Other mining and quarrying	0.8	1.3	0.6	1.6		
Printing and reprod. of recorded media	0.1	11.3	0.1	10.4		
Repair and installation of machinery	0.1	8.2	0.3	3.2		
Electricity, gas, steam and ac supply	0.4	2.3	1.0	1.0	1.0	1.0
Basic metals	0.8	1.3	0.8	1.3	0.9	1.1
Basic pharmaceutical products	0.0	22.0	0.1	13.0	0.1	19.6
Chemicals and chemical products	0.7	1.4	0.6	1.7	0.4	2.7
Coke and refined petroleum products	0.8	1.2	1.0	1.0	0.7	1.5
Computer, electronic and optical prod.	0.4	2.3	0.4	2.8	0.3	3.0
Electrical equipment	0.7	1.3	0.3	3.9	0.3	3.8
Fabricated metal products	0.5	2.0	0.3	3.5	0.2	5.3
Furniture	0.3	3.0	0.3	3.4	0.1	17.5
Leather and related products	0.2	6.6	0.2	4.9	0.3	2.9
Machinery and equipment n.e.c.	0.3	3.8	0.2	6.0	0.1	10.9
Motor vehicles and trailers	0.2	6.4	0.1	8.1	0.2	6.2
Other non-metallic mineral products	0.7	1.4	0.5	2.0	0.2	5.3
Other transport equipment	0.2	4.7	0.2	5.9	0.1	14.4
Paper and paper products	0.5	2.2	0.6	1.8	0.3	3.8
Rubber and plastic products	0.4	2.5	0.4	2.4	0.1	10.0
Textiles	0.5	1.9	0.5	2.0	0.2	6.4
Wearing apparel	0.2	5.7	0.1	15.3	0.3	3.8
Wood products, except furniture	0.3	3.1	0.6	1.6	0.2	4.8
Beverages	0.7	1.4	0.5	2.0	0.1	13.4
Food products	0.8	1.3	0.6	1.6	0.3	3.1
Other manufacturing	0.6	1.6	0.2	4.0	0.4	2.8
Average	0.53	3.3	0.38	4.6	0.36	5.2

Notes: This table reports the frequency of price changes and the implied duration for 2 digit sectors. Frequencies are first computed at the item level, and then aggregated at the sectoral level. Implied duration is simply the inverse of the frequency. The total average frequency and duration are computed as the average of these two variables for sectors where we have information about domestic, export and import prices.

Table 6: Domestic prices and imported input prices

	(Δ log. output price)			
	(1)	(2)	(3)	(4)
Inputs	0.292***	0.238***	0.138***	0.245**
	(0.110)	(0.088)	(0.051)	(0.096)
Labor costs		0.382	0.061	0.292
		(0.299)	(0.048)	(0.358)
Comp. prices		0.322***	0.141***	0.463***
		(0.053)	(0.023)	(0.073)
Production		0.005	0.015	0.005
		(0.008)	(0.022)	(0.010)
Comp. costs				0.035
				(0.025)
Fixed effects	sect.×period		period - firm×product	
Std var.	No	No	Yes	No
Observations	33,120	33,120	33,120	25,897
R^2	0.063	0.025	0.025	0.029
rho	0.779	0.380	0.380	0.380

This table investigates the impact of imported input prices on domestic output prices i) within firm by including firm fixed effects and controlling for sector×period fixed effects (col. 1) and ii) within firm-product pairs by including firm×product fixed effects and period fixed effects (col. 2-4). It focuses on the entire sample of arm-length transactions. The dependent variable is the first difference in the logarithm of output prices computed for each product firm and month. Explanatory variables are the changes in the prices of imported inputs (*Inputs*), the change in competitors prices within 2-digit sectors (*Comp.prices*), the change in competitors' costs within 2-digit sectors (*Comp.costs*), the change in labor cost and the change in sectoral production (*production*). A *YES* line *Stdvar.* means that variables have been standardized. Changes in explanatory variables are changes since the last price change. Standard errors (in parenthesis) are clustered in the firm×period dimension. ^{c}, ^{b}, ^{a} indicate significance at 10%, 5% and 1%.

Table 7: Domestic prices and *exogenous* imported input prices

	(Δ log. output price)			
	(1)	(2)	(3)	(4)
Inputs	0.131***	0.128***	0.059***	0.116***
	(0.030)	(0.026)	(0.012)	(0.029)
Labor costs		0.362	0.058	0.261
		(0.342)	(0.055)	(0.409)
Comp. prices		0.312***	0.136***	0.479***
		(0.055)	(0.024)	(0.075)
Production		-0.004	-0.011	-0.008
		(0.006)	(0.016)	(0.007)
Comp. costs				0.024
				(0.026)
Fixed effects	sect.×period		period - firm×product	
Std var.	No	No	Yes	No
Observations	25,144	25,144	25,144	19,292
R^2	0.021	0.027	0.027	0.036
rho	0.592	0.462	0.462	0.487

This table investigates the impact of imported input prices on domestic output prices i) within firm by including firm fixed effects and controlling for sector×period fixed effects (col. 1) and ii) within firm-product pairs by including firm×product fixed effects and period fixed effects (col. 2-4). It focuses on the entire sample of arm-length transactions that we consider as exogenous for the firm. The dependent variable is the first difference in the logarithm of output prices computed for each product firm and month. Explanatory variables are the changes in the prices of imported inputs (*Inputs*), the change in competitors prices within 2-digit sectors (*Comp.prices*), the change in competitors' costs within 2-digit sectors (*Comp.costs*), the change in labor cost and the change in sectoral production (*production*). A *YES* line *Stdvar.* means that variables have been standardized. Changes in explanatory variables are changes since the last price change. Standard errors (in parenthesis) are clustered in the firm×period dimension. ^{c}, ^{b}, ^{a} indicate significance at 10%, 5% and 1%.

Table 8: Domestic prices and imported input prices, related parties

	(Δ log. output price)			
	(1)	(2)	(3)	(4)
Inputs	-0.018	0.065*	0.024*	0.054
	(0.031)	(0.034)	(0.013)	(0.036)
Labor costs		0.264	0.042	-0.046
		(0.360)	(0.057)	(0.368)
Comp. prices		0.480***	0.210***	0.381***
		(0.112)	(0.049)	(0.119)
Production		-0.024**	-0.066**	-0.033**
		(0.011)	(0.031)	(0.013)
Comp. costs				0.100*
				(0.059)
Fixed effects	sect.×period		period - firm×product	
Std var.	No	No	Yes	No
Observations	12,296	12,296	12,296	9,674
R^2	0.007	0.034	0.034	0.028
rho	0.401	0.248	0.248	0.233

This table investigates the impact of imported input prices on domestic output prices i) within firm by including firm fixed effects and controlling for sector×period fixed effects (col. 1) and ii) within firm-product pairs by including firm×product fixed effects and period fixed effects (col. 2-4). It focuses on imports from related parties. The dependent variable is the first difference in the logarithm of output prices computed for each product firm and month. Explanatory variables are the changes in the prices of imported inputs (*Inputs*), the change in competitors prices within 2-digit sectors (*Comp.prices*), the change in competitors costs within 2-digit sectors (*Comp.costs*), the change in labor cost and the change in sectoral production (*production*). Positive and negative changes in imported inputs prices are disentangle in variables $Max(0, Inputs)$ and $Min(0, Inputs)$. A YES line *Stdvar.* means that variables have been standardized. Changes in explanatory variables are changes since the last price change. Standard errors (in parenthesis) are clustered in the firm×period dimension. *, **, *** indicate significance at 10%, 5% and 1%.

Table 9: Domestic prices and imported input prices, interaction terms.

	(Δ log. output price)				
	(1)	(2)	(3)	(4)	(5)
Max(0,Inputs)	0.188**				
	(0.076)				
Min(Inputs,0)	0.291				
	(0.182)				
Sh. IO × Inputs		1.474***			
		(0.553)			
Inputs			0.343**	0.107	-0.033
			(0.149)	(0.070)	(0.084)
HHI × Inputs			-1.043		
			(0.805)		
Freq(Outputs) × Inputs				0.164	
				(0.170)	
Freq(Inputs) × Inputs					0.403*
					(0.234)
Fixed effects	period - firm×product				
Observations	33,120	31,363	29,171	33,120	33,120
R^2	0.025	0.026	0.024	0.025	0.028
rho	0.380	0.372	0.394	0.380	0.382

This table investigates the impact of imported input prices on domestic output prices within firm-product pairs by including firm×product fixed effects and period fixed effects. It focuses on arm-length transactions. The dependent variable is the first difference in the logarithm of output prices computed for each product firm and month. Explanatory variables are the changes in the prices of imported inputs ($Inputs$), the changes in imported input's prices interacted with the share of imported inputs in total costs at the sectoral level ($Sh.IO$), with the sectoral Herfindahl index (HHI), and the frequency of output and input price changes ($Freq(Outputs)$ and $Freq(Inputs)$). In the first column, we separate out positive and negative changes in imported inputs prices: variables $Max(0, Inputs)$ and $Min(0, Inputs)$. We also control for the change in competitors' costs within 2-digit sectors, the change in labor cost and the change in sectoral production. Changes in explanatory variables are changes since the last price change. Standard errors (in parenthesis) are clustered in the firm×period dimension. *, **, *** indicate significance at 10%, 5% and 1%.

Table 10: Domestic prices and *exogenous* imported input prices, interaction terms.

	(Δ log. output price)				
	(1)	(2)	(3)	(4)	(5)
Max(0,Inputs)	0.136***				
	(0.039)				
Min(Inputs,0)	0.117**				
	(0.049)				
Sh. IO × Inputs		0.755***			
		(0.178)			
Inputs			0.109***	0.187***	0.104
			(0.042)	(0.065)	(0.065)
HHI × Inputs			0.373		
			(0.363)		
Freq(Outputs) × Inputs				-0.079	
				(0.082)	
Freq(Inputs) × Inputs					0.041
					(0.088)
Fixed effects	period - firm×product				
Observations	25,144	23,877	21,775	25,144	25,144
R^2	0.027	0.025	0.021	0.028	0.027
rho	0.462	0.447	0.494	0.462	0.462

This table investigates the impact of imported input prices on domestic output prices within firm-product pairs by including firm×product fixed effects and period fixed effects. It focuses on arm-length transactions with exogenous prices changes. The dependent variable is the first difference in the logarithm of output prices computed for each product firm and month. Explanatory variables are the changes in the prices of imported inputs ($Inputs$), the changes in imported input's prices interacted with the share of imported inputs in total costs at the sectoral level ($Sh.IO$), with the sectoral Herfindahl index (HHI), and the frequency of output and input price changes ($Freq(Outputs)$ and $Freq(Inputs)$). In the first column, we separate out positive and negative changes in imported inputs prices: variables $Max(0, Inputs)$ and $Min(0, Inputs)$. We also control for the change in competitors' costs within 2-digit sectors, the change in labor cost and the change in sectoral production. Changes in explanatory variables are changes since the last price change. Standard errors (in parenthesis) are clustered in the firm×period dimension. *, **, *** indicate significance at 10%, 5% and 1%.

Table 11: Output prices and imported inputs prices, by industry

	Explained variable: $\Delta log(output\ price)$									
Type of transaction:	*Arm-length*			*Arm-length*			*Intra-firm*			
Type of price changes:	*All*			*Exogenous*			*All*			
Variable:	Input price	std	Obs.	Input price	std	Obs.	Input price	std	Obs.	share IO
Industry										
Textile and apparel	**0.65**	0.17	3878	**0.24**	0.11	1762	0	0	62	0.21
Motor vehicles, trailers and semi-trailers	0.51	0.46	361	**-0.88**	0.29	41	0	0	29	0.25
Electrical equipment	**0.11**	0.06	4506	**0.13**	0.07	3325	0.06	0.06	1697	0.21
Rubber and plastic products	0.09	0.06	3432	-0.03	0.07	1927	0.03	0.05	1054	0.26
Food and beverage	**0.08**	0.03	11559	**0.09**	0.04	7718	0.20	0.15	3740	0.08
Wood and paper	**0.07**	0.03	1401	0.03	0.04	908	-1.21	0.77	84	0.11
Chemical industry	**0.07**	0.03	8568	**0.15**	0.05	4134	**0.20**	0.07	2975	0.22
Metal products	0.03	0.04	4721	**0.14**	0.07	2057	0.01	0.08	992	0.15
Machinery and equipment n.e.c.	-0.06	0.06	4774	-0.07	0.09	1986	**-0.09**	0.05	975	0.16
Computer, electronic and optical products	**-0.40**	0.22	462	0.00	0.00	19	-0.05	0.59	123	0.21
Pharmaceutical	-0.52	0.44	87	-0.38	0.39	79	0.49	0.26	106	

Changes in output price are explained by the changes in the price of imported inputs either for (intragroup or for arm-length transactions) since the last domestic price changes. Controls: wages, production, competitor prices. Fixed effect: period and firms. Note that we run two separate regressions: one for arm-length transactions and the others for intragroup transactions.

5.3 Imported costs pass-through domestic vs export prices

Previous estimates have investigated the way in which imported price changes are passed on to domestic prices. However, firms use inputs to produce goods which are sold in the local market but also to produce goods which are sold in foreign markets. Domestic and foreign markets differ for several reasons: the presence of exchange rates for non-euro countries; the intensity of competition; differences in market shares etc. For these reasons, we could expect firms to transmit changes in their costs into domestic and export prices in different ways. This forms the subject of Tables 12 and 13. In the first column, we measure pass-through in the entire sample, including both domestic and export prices. As we aggregated firms' prices at the firm and four-digit sector levels, this regression provided us with a way of checking that this aggregation would not produce totally different results. In the two tables, the estimated coefficients are in line with previous estimates. In the second column, we restricted the sample to firms that produce goods for the domestic and foreign markets. Our strategy of identification required us to focus on this type of firm. The coefficients have the same magnitude as in the first column. Then, we interacted input price changes with the dummy that is equal to one for exported prices (columns 3, 4 and 5). We also controlled for the change in NEER (column 4) and for the interaction between the NEER, the change in input prices and the export dummy (column 5). The only significant interaction is the interaction between changes in the price of imported inputs and the dummy for exports in Table 13. However, when considering exogenous input price changes, the coefficient becomes non-significant and very small. This suggests that firms pass on imported cost to their domestic and export prices to the same extent.

Table 12: Domestic and export prices, and imported input prices

	(Δ log. output price)				
	(1)	(2)	(3)	(4)	(5)
Inputs	0.202***	0.214***	0.291***	0.291***	0.291***
	(0.049)	(0.062)	(0.102)	(0.102)	(0.102)
Comp. prices	0.567***	0.582***	0.574***	0.573***	0.573***
	(0.050)	(0.066)	(0.065)	(0.065)	(0.065)
Production	-0.004	-0.000	-0.000	-0.000	-0.000
	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)
Labor costs	0.594**	0.536**	0.528**	0.545***	0.551***
	(0.276)	(0.218)	(0.207)	(0.206)	(0.202)
Export × Inputs			-0.184*	-0.185*	-0.186*
			(0.106)	(0.106)	(0.106)
NEER				-0.145	-0.144
				(0.216)	(0.215)
Export × Inputs × NEER					0.580
					(3.412)
Fixed effects	period - firm				
Sample	All	serve domestic and export markets			
Observations	12322	7091	7091	7091	7091
rho	0.157	0.074	0.074	0.075	0.071

This table investigates the difference in transmission of imported input prices to domestic and export output prices within firm-product pairs by including firm×product fixed effects and period fixed effects. It focuses on arm-length transactions. The dependent variable is the first difference in the logarithm of output prices computed for each sector, firm, and month. Explanatory variables are the changes in the prices of imported inputs (*Inputs*), the change in labor costs (*labor*), the change in sectoral production (*Production*), the change in competitors' costs (*Comp.costs*), the change in the nominal effective exchange rate ($NEER$) faced by exporters, a dummy equal to one if the output price is exported, and interactions between these variables. Changes in explanatory variables are changes since the last price change. Robust standard errors in parenthesis. *, **, *** indicates significance at 10%, 5% and 1%.

Table 13: Domestic and export prices, and exogenous imported input prices

	(Δ log. output price)				
	(1)	(2)	(3)	(4)	(5)
Inputs	0.126***	0.097***	0.097***	0.097***	0.105***
	(0.024)	(0.021)	(0.031)	(0.031)	(0.031)
Comp. prices	0.502***	0.463***	0.463***	0.462***	0.460***
	(0.047)	(0.043)	(0.043)	(0.043)	(0.043)
Production	-0.007	-0.003	-0.003	-0.003	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Labor costs	0.554*	0.472**	0.478**	0.490**	0.495***
	(0.320)	(0.194)	(0.193)	(0.191)	(0.150)
Export × Inputs			0.001	0.001	-0.006
			(0.041)	(0.041)	(0.041)
NEER				-0.067	-0.071
				(0.127)	(0.123)
Export × Inputs × NEER					-2.668
					(3.552)
Fixed effects	period - firm				
Sample	All	serve domestic and export markets			
Observations	9,192	5,305	5,305	5,305	5,305
rho	0.076	0.043	0.034	0.030	0.000

This table investigates the difference in transmission of imported input prices to domestic and export output prices within firm-product pairs by including firm×product fixed effects and period fixed effects. It focuses on exogenous price changes in arm-length transactions. The dependent variable is the first difference in the logarithm of output prices computed for each sector, firm, and month. Explanatory variables are the changes in the prices of imported inputs (*Inputs*), the change in labor costs (*labor*), the change in sectoral production (*Production*), the change in competitors' costs (*Comp.costs*), the change in the nominal effective exchange rate (*NEER*) faced by exporters, a dummy equal to one if the output price is exported, and interactions between these variables. Changes in explanatory variables are changes since the last price change. Robust standard errors in parenthesis. *, **, *** indicates significance at 10%, 5% and 1%.

5.4 Comparison with the literature

While our paper examines the transmission of import prices to domestic ones, the literature focuses on exchange rate pass-through. Most papers study ERPT to import or export prices. Some papers give insight on ERPT to domestic prices.[11] However, to my knowledge, there is no paper documenting the sensitivity of production prices to imported input costs at the firm level.[12]

While there is no comparable estimation in the literature, one can try to provide a benchmark. Namely, one can ask what would be the sensitivity of the producer price to imported inputs if the whole imported cost shock was passed on domestic prices. To do it ones needs information on the share of import inputs in total costs, and the proportion of arm-length transaction among imported inputs. Golbderg & Campa (2010) find that the share of imported inputs in total costs 20% on average in the manufacturing industry. Bernard et al (2010) find that 46% of imports occur between related party. From this figure, the share of arm-length transaction in total imported inputs is about 11% ($1-0.46\times0.2$). Which is almost exactly the elasticity we estimate. This back of the envelop computation suggests that the transmission of imported input price changes into producer prices is total, conditional on the share of inputs used in the production process.

Last, our distinction between arm-length and intra-firm transaction is also made by

[11] ERPT into domestic prices is the sum of the sensitivity of import prices to ER and the sensitivity of domestic prices to import prices. By comparing ERPT into import and domestic prices, one can find the sensitivity of domestic prices to import prices. (McCarthy, 2007) documents the ERPT to aggregate import prices and producers prices for 9 industrialized countries, including France. For France he finds that after 3 months the ERPT is almost one for import prices and is not different from zero for production prices. From this first paper it seems that changes in import prices driven by ER are not passed on producer prices. This is very different from what we find. However, the data McCarthy uses (quarterly data, from 1976 to 1998) limit the relevance of a comparison with our results. I did not find any other studies allowing such decomposition in the literature

[12] The only exception are Goldberg & Hellerstein (2010) and Nakamura & Zerom (2010), but they focus on the beer and coffee industries.

Neiman (2010) and Hellerstein and Villas-Boas (2010). Both find the ERPT is higher for imports occurring between related parties. While the focus is not on ERPT, the findings in chapter 4 go in the opposite direction. Namely, the transmission of import price changes to domestic ones is found to be lower for intra-firm transactions.

6 Aggregate implications

6.1 Strategy

Individual price changes are mainly a result of idiosyncratic shocks. The low R^2 obtained for our various specifications confirms this theory. However, we could expect these idiosyncratic shocks to cancel each other out in the aggregate data (Bergin et al., 2010). At the sector level, we could therefore expect that a larger proportion of price volatility would be explained by measurable variables. In particular, in this section, we discuss what proportion of sectoral price volatility can be explained by imported input prices. In order to address this issue, we proceeded in three steps. First, we estimated the elasticity of output prices with regard to imported input costs by industry using our firm-level data. Second, if a change in the output price was observed, we computed the predicted size of this output price change which was driven solely by a change in imported costs. Therefore, we found micro output price changes in each period, and counterfactual price changes predicted by import price movements. In a third step, we built two sectoral indices using actual and predicted price changes. Then, we measured the share of sectoral price changes that is related to movements in the price of imported inputs. Namely, we regressed the sectoral price index on the predicted-by-imports sectoral price index. The R^2 of this regression provides us with a measure of the variance in sectoral domestic prices which is explained by imported inputs.

6.2 Findings

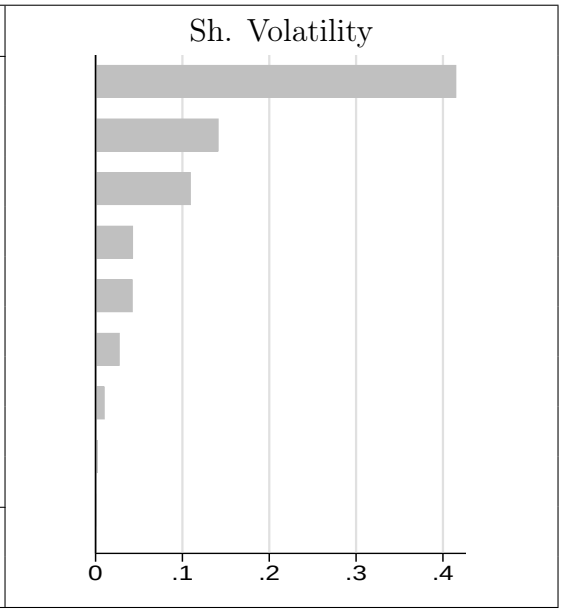
The results are presented in Figure 5. As in our sectoral estimations of the pass-through of imported costs, we observed important heterogeneity in the proportion of price volatility which was explained by imported inputs. The average share of the variance in price (measured by the R^2) explained by imported inputs is 0.09, but this is driven mainly by chemical products, for which imported inputs explained 41% of price volatility. In sectors such as rubber and plastic products and wood and paper products, import prices also contribute to a substantial share of sector volatility (more than 10%). In the other industries, the contribution of imported prices is much smaller. A glance at the data suggests that the very minor contribution of the price of imported inputs to sectoral inflation is explained by the substantial stickiness of import prices. It appears that production prices change more frequently than import prices. Therefore, a large proportion of price changes cannot be explained using those import prices. More precisely, in the data, import price changes are 70% less frequent than domestic price changes. When focusing on the sample of exogenous price changes, 80% of import prices are stickier than domestic prices.

7 Conclusion

This paper investigates the transmission of imported costs to domestic prices using highly detailed data on imported input prices and production prices at the firm level. On average, 12% of imported input price shocks are passed on to domestic prices. However, there is a significant heterogeneity in the degree of pass-through among industries. One explanation for this heterogeneity is that industries vary in their use of imported inputs. However, a large part of this heterogeneity remains unexplained. Interestingly,

Figure 5: Share of the volatility of domestic prices explained by imported inputs

Vol.	Sh. IO	*Manufacturing of:*
0.41	0.22	Chemical products
0.14	0.26	Rubber and plastic products
0.11	0.11	Wood and paper
0.04	0.15	Metal products
0.04	0.08	Food and beverage
0.03	0.21	Electrical equipment
0.01	0.21	Textile and apparel
0	0.16	Machinery and equipment n.e.c.
0		Pharmaceutical
Mean:	*Mean:*	
0.09	0.16	



This table lists the share of sectoral price volatility explained by imported input prices. The share is measured by the R^2 of a regression of the monthly sectoral price index on the monthly predicted-by-import prices sectoral price index. R^2 are listed in the first column and plotted in the fourth one. The second column gives the share of imported inputs used in production in every sector. The third column indicates the label of the sectors we consider.

we did not find any evidence of heterogeneity in pass-through for domestic and export prices. This suggests that local demand conditions are not that important for explaining cost pass-through. We have also shown that price changes in transactions which occur between related parties are much less likely to be passed on to domestic prices. This suggests that the inflationary pressure of imports also depends on whether or not the import occurs within firms' boundaries.

We ended our analysis by showing that, on average, 9% of sectoral price volatility is explained by the volatility of imported costs. Once again, there is a strong heterogeneity across sectors. In addition to the proportion of total costs made up of imported inputs, the volatility of demand and local costs is another mechanism that can explain this heterogeneity. If the price of local costs or the demand is highly volatile in relative to import prices, they may become the driving force behind domestic prices, muting the sensitivity of production price to imported costs.

General Conclusion

My ambition in that work was to shed new lights on four important questions in international economics; namely, the effect of distance on firms' pricing policy, the impact of the Euro on European economic integration, the consequences of low-wage countries competition on firms in developed economies, and the effect of imported inputs on domestic inflation. Along the four chapters, I have taken the option to examine these questions using firm-level data, and more particularly, using information on trade prices.

I hope this work contributes to four different aspects of the international economic literature. First, Chapters 1, 2, and 4 provide new insights on the pricing policy of importing and exporting firms. Chapter 1 finds that firms charge higher net of transport costs prices on exports to more distant countries. This finding goes against the prediction of almost all the textbook models of international trade. It suggests that, when facing high transport costs, firms prefer conserving their margin rather than their volumes. Chapter 2 shows that firms reduced their level of price discrimination toward euro countries, after the creation of the single currency. Furthermore, large firms have been more strongly affected by the euro. Chapter 4 suggests that conditional on the share of imported inputs in total costs changes in the price imported inputs are almost entirely passed on to domestic prices.

While the major part of the trade literature has focused on the reaction of volumes, the present thesis i) points out that firms also adjust their prices and the quality of their products to changes in their economic environment, and ii) gives qualitative and quantitative results on the way they adjust their prices. As illustrated in Chapter 1 for instance, those price adjustment may have important implications for consumer's welfare.

Second, Chapters 2 and 3 maintain the importance of the heterogeneity of firms in their reaction following aggregate economic shocks. Chapter 2 stresses the heterogenous impact of the creation of the euro on the price discrimination of French exporters. Namely, large firms have reduced more their price discrimination toward Euro countries than smaller firms. Since large firms account for a larger proportion of sales, taking into account this heterogeneity is important to measure the aggregate impact of the Euro on price dispersion. Chapter 3 shows that low-quality firms have been more impacted by the rise in competition from low-wage countries. This has triggered a reallocation of sales from low- to high-quality firms. As a result the quality content of French exports has increased.

Thus, both chapters point to the asymmetric impact macroeconomic shocks can have on firms belonging to the same country and the same industry. Furthermore, they demonstrate that this heterogeneity shape macro outcomes.

Third, Chapters 3 and 4 suggest that some old models may explain this new facts. Chapter 1 demonstrates that the positive impact of distance on prices may be rationalized in a CES model with additive transport costs rather than iceberg ones. While per unit additive costs have been abandoned over years, it seems they offer a good explanation for this fact, and may have important welfare implications. This is confirmed by the recent work by Irarrazabal et al. (2010).

Chapter 3 validates the importance of accounting for the heterogeneity in terms of quality across firms. The proposed model, based on Gabszewicz and Thisse (1979), is very stylized but it implies patterns of substitution across products and of reallocation across firms that are richer that in recent trade models accounting for quality.[13]
The structure of transport costs and the quality of goods produced on the economy explain some patterns of trade and have important implications for consumers, workers, and firms. It seems these two ingredients should be added in more general models, at the cost of some tractability.

Last, Chapters 2, 3, 4 provide new insights on policy relevant topics. The effects of the Euro, and the effectiveness of the single currency to deepen economic integration, are closely discussed within political and academic context. In the first chapter, we find that the Euro has significantly reduced price dispersion within the Euro area. Importantly, we are the first to show that the effect has been felt more strongly by large firms, implying that the effect is stronger than previously thought. This means that the introduction of the single currency has contributed to deepen the European economic integration.
The fear of Chinese products dominating the world production of manufacturing goods has been an important concern in most developed countries over the past two decades. Peter Schott (2004, 2008), Bloom et al. (2009) and others have shown that considering the specialization of countries in high-quality / innovative products is key to figuring out the implications of this new competition. In Chapter 3, we provide strong evidence suggesting that competition for LWC has driven a reallocation of sales from low- to high-quality producers, increasing the overall quality of French exports. Evidence in

[13]The recent paper by Auer and Sauré (2011) is a notable exception. It provides a many firms general equilibrium model encompassing our very simple framework, and gives insightful predictions concerning quality, growth and innovation.

favor of within-industry specialization suggests one way for countries to maintain their market share in world exports, while increasing the quality content of their exports. Investing in high-quality production should indeed help countries to insulate themselves from low-wage foreign competition.

The debate around the impact of globalization on inflation is raging in Europe and in the US. Some structural studies have shown that the main channel through which movement in foreign exchange rates or foreign costs affect domestic prices are imported inputs (Goldberg and Campa, 2010). Chapter 4 contributes to this debate by providing the first evidence on this imported input channel at the firm level. Our principal finding is that the sensitivity of domestic prices to foreing inputs is about equal to the share of imported inputs in total costs. However, while this share is relatively important, in most industries the dynamic of prices is not significantly driven by imported inputs.

Our work obviously has some drawbacks, let me point out the more prominent ones. In the first chapter, there are two main concerns, both related to the data. First transport costs rather than distance should be used to explain price differences across countries. Actually, it is more likely that firms react to transport costs; distance being a proxy for those costs. Hopefully, better data about transport costs will allow one to get more precise estimates. Second, unit values computed at the firm and product level are also proxy for prices. This raises some problem in the interpretation of the results. In particular, it is hard to say whether spatial differences in unit values across countries are due to markups or quality differences. More structural estimates should allow us to bring insights on this question.

In the second chapter, the main problem relies on the interpretation of the results. In this respect developing a model consistent with this empirical fact would give some additional insights. While the mechanisms explaining heterogeneity are described in

this chapter, sketching a complete model would allow to draw additional predictions and to validate or reject our intuition. Second, if the model relates price dispersion to welfare, it could provide more concrete figures about the welfare impact of the deeper integration revealed by the data.

The main issue in the third chapter is that we neglect within-firm quality changes. The chapter acknowledgedly focuses on quality upgrading driven by a reallocation of sales across firms of different quality. However, it would be nice compare this source of quality upgrading with the quality upgrading due to firms' reaction - in terms of innovation - to low-wage countries competition.

The last chapter is more preliminary. A dimension I would like to explore more in detail is the aggregate implications of imported inputs. This chapter suggests that in most sectors the volatility of domestic prices is not driven by imported inputs. Understanding why is some sectors imported inputs are much more important would provide insights on the condition under which imported inputs matter for domestic inflation.

I end up this thesis with more quenstions than answers. Here are some of the points I would like to explore in the near future.

First, as pointed out above, I have not managed in this work to disentangle markups and quality from firm-level unit values. This could be achieve using the same data as the ones used here and estimating a structural model. Another direction that could be used is to focus on a specific industry in which quality is closely related to measurable characteristics. Computers, televisions, or cars are such industry. Through hedonic price techniques we could infer what is attributable to changes in quality and what is due to markups. A last way to look at this question is to focus on identical goods, for which we are absolutely confident that there is not differences in terms of quality. From such data, one could investigate how markup changes. Comparing price dispersion to

unit values dispersion would be a way to measure what part of the dispersion in firm-level unit values is attributable to markups and what part is due to costs or quality differentials.

The second dimension I would like to investigate deal with the consequences of the specialization in terms of quality of developed countries. This specialization is at work as shown by Hallak and Sivadasan (2009); Bloom et al. (2009) and in the third Chapter of this thesis. But its macroeconomics consequences have not been subject to a lot of studies. In this respect, there are two questions I plan to explore. First, does the response of trade to changes in demand depend on the quality content of traded goods? And second, what are the consequences in terms of macroeconomics volatility of the quality upgrading process occurring in developed countries? More specifically, I want to investigate how firms might be differently affected in terms of exports (and potentially employment) by a demand shock according to the quality they produce, and in turns how the vertical specialization of a country might impact on the volatility of its output and employment.

A last question I would like to examine more in details is the heterogeneous adjustment of prices following a shock. Chapters 2-3 point out the heterogenous responses of firms following specific macroeconomic shocks (the creation of euro in Chapter 2, and the emergence of low-wage countries in chapter 3). In Chapter 4, I have used highly detailed data on domestic prices. In producing stylized facts on this dataset, I figured out how heterogenous were price changes across firms. I would like to use this latter dataset to explore the role of firms' pricing behavior heterogeneity in shaping the response of aggregate prices to a macroeconomic shock.

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Note de synthèse

L'environnement économique international est en permanente évolution. Ces changements soulèvent de nombreuses questions tant dans les cercles politiques que dans les cercles académiques. Cette thèse se propose d'étudier quatre questions importantes, qui seront introduites dans les prochains paragraphes. Dans le sillage des faits économiques, le champs de l'économie internationale évolue lui aussi. Une revue rapide des avancements dans la compréhension, la vision, et la modélisation de l'économie internationale permettra d'introduire le parti qui a été choisi dans cette thèse pour répondre aux questions posées.

Après cette introduction, nous préciserons les problématiques développées dans ce travail et nous en décrirons les principales conclusions. Enfin, nous porterons un regard plus détaillé sur chacun des quatre chapitres qui composent cette thèse.

Evolutions de l'environnement économique international. L'émergence de la Chine est probablement le bouleversement le plus important de ces vingt dernières années. Les performances économiques spectaculaires du pays le plus peuplé du monde sont à l'origine de nombreuses craintes dans les pays développés.[14] Une question souvent

[14]La Chine est devenue en 2010 la seconde économie la plus puissante du monde. Depuis 1980, son PIB a été multiplié par 18. La Chine est également le premier exportateur mondial et le second importateur mondial. Voir Feenstra et Wei (2010) pour étude poussée sur l'intégration de la Chine dans l'économie mondiale.

posée aux économistes concerne l'impact de la Chine - et plus généralement des pays à bas salaires - sur l'industrie des pays développés. Il apparaît clairement que le nombre d'employés dans l'industries manufacturière a chuté depuis le début des années 1980. Les études les plus récentes montrent que la concurrence des pays à bas salaire (ainsi que le progrès technique) a contribué à ce déclin.[15] Cependant, il convient de noter qu'en dépit de ce climat morose, certaines entreprises sont parvenues à tirer leur épingle du jeu. L'industrie de la mode en France illustre parfaitement ce point. Alors que la plupart des entreprises souffrent de la concurrence des pays asiatiques, les entreprises de luxe de ce secteur ont connu une hausse soutenue de leurs ventes en France et à l'export. C'est cet aspect asymétrique de la concurrence des pays à bas salaires sur les entreprises des pays développés que nous explorons dans le troisième chapitre de cette thèse.

Les Européens ont connu un changement radical à la fin du XX^{eme} siècle: la création de l'euro. Le lancement de la monnaie unique en 1999 peut être vu comme la plus importante expérience de politique économique menée dans le monde (Baldwin 2006). Le passage à l'Euro a soulevé de nombreuses questions de la part des entreprises et des consommateurs. L'euro est-il responsable d'une hausse générale des prix? L'euro pénalise-t-il la compétitivité des entreprises françaises? Au delà de ces questions importantes, il faut rappeler que le principal objectif de la monnaie unique était de renforcer l'intégration économique européenne. Le second chapitre de cette thèse cherche à évaluer le succès de cette réforme. Il s'intéresse en particulier à l'impact de l'introduction de la monnaie unique sur le degré d'intégration économique des pays de la zone euro.

Certaines transformations sont plus subtiles, voire indolores. Elles apparaissent aux yeux du monde à l'occasion de certains événements très particuliers. La fragmentation

[15] Voir Sachs et Shatz (1994) ou Bernard et al. (2006).

des chaînes de production s'apparente à ces transformations. Trop peu d'études portent sur la question, mais toutes mettent en avant l'importance croissante de la fragmentation des chaînes de production entre les états.[16] Ces liens entre les entreprises et leurs fournisseurs sont indispensables pour expliquer les dessins du commerce mondial et pour comprendre la transmission internationale des chocs économiques. La mise à l'arrêt des chaînes de production aux Etats-Unis et en Europe à la suite du séisme au Japon est une conséquence visible de cette nouvelle organisation de la production.
Une question importante pour les banques centrales concerne les effets de cette dépendance accrue des pays aux biens intermédiaires étrangers sur l'inflation domestique. Le quatrième chapitre examine l'impact des biens intermédiaires importés sur la dynamique des prix domestiques.

Il faut concéder que certains aspects de l'environnement économique international n'ont pas changé. Par exemple, l'effet de la distance sur les flux de commerce est resté surprenamment fort au cours du siècle dernier.[17] Pourtant, cela devait changer. En effet, la facilitation des transports et le développement des infrastructures auraient du contribuer à atténuer l'impact de la distance. Des dizaines d'études rapportent les effets négatifs de la distance sur les volumes échangés et sur les décisions d'exportation des entreprises. La distance est également une barrière forte pour les migrations, les investissements trans-frontaliers et les flux financiers. Une dimension spécifique qui n'a pas encore été analysée - bien qu'elle soit importante pour les consommateurs - relève de l'impact de la distance sur les stratégies de prix des entreprises. Cette question est examinée dans le premier chapitre.

[16] Hummels et al. (2001) sont parmi les premiers à avoir décrit ces "changements considérables dans la nature du commerce international". Ils ont montrés en particulier qu'en 1990 près d'un bien exporté sur 5 était produit à partir des biens intermédiaires importés, soit 30% de plus qu'en 1970.

[17] Voir Disdier et Head (2008) pour une méta-analyse démontrant l'effet fort et persistent de la distance sur les flux de commerce au cours du temps.

L'économie internationale change. Dans le sillage de l'économie réelle, le champ de l'économie internationale évolue. Les changements de vision, de compréhension et de modélisation du commerce international sont tirés par trois forces principales: i) de nouveaux faits empiriques, ii) le développement de nouveaux outils théoriques et empiriques dans d'autres champs de l'économie, et iii) des changements technologiques. Notre vision du commerce international a considérablement changé ces quarante dernières années. La principale évolution a été initié par Paul Krugman et d'autres, à la fin des années 1970. A cette époque, un fait empirique posait problème à ces chercheurs. Plus précisément, Balassa (1996) et Grubel et Lloyd (1971) ont montré que les pays échangeaient des biens similaires, ce qui allait à l'encontre des prédictions des théories classiques du commerce international.[18] Le talent du Prix Nobel 2008 et le développement de modèles avec rendement d'échelle croissant en économie industrielle, ont permis aux économistes de développer de nouveaux modèles, en accord avec ces données.

Un second changement s'est produit au cours des années 1990. Comme le remarquent Bernard et al. (2011), l'intérêt s'est détourné des industries et des pays vers les firmes et les produits. Cette transformation a été rendue possible par la mise à disposition de données sur le commerce mondial au niveau des produits ou des entreprises, mais aussi par le développement de logiciels de calcul capables d'exploiter ces données.

Les micro-données ont apporté des idées neuves sur l'hétérogénéité des entreprises en terme de taille, de productivité, ou de participation aux exportations.[19] Les résultats principaux de ces études sont que seule une très faible partie des entreprises exporte, et que ces entreprises exportatrices sont significativement plus grandes, plus riches et plus productives que les autres. A la même période, dans d'autres champs tel que

[18] Les modèles de HOS et de Ricardo prédisent en effet que le commerce s'effectue entre industries. En d'autres termes, les pays se spécialisent dans certaines industries et échangent des biens issue de cette production. Le commerce est alors appelé inter industriel.

[19] VOir Bernard et al. (2011) pour une revue de littérature.

la macroéconomie, les chercheurs ont commencé à introduire de l'hétérogénéité entre les firmes dans leur modèle. A partir de nouveaux faits stylisés, en s'appuyant sur les modèles développés en macroéconomie, Meltiz (2003) a proposé un modèle avec hétérogénéité et sélection des firmes sur les marchés domestiques et étrangers, cohérent avec les faits stylisés évoqués plus haut. Le modèle propose un cadre pour étudier la réallocation des ressources au sein d'une industrie dans un contexte d'ouverture internationale. Ce modèle a été utilisé intensivement ces 10 dernières années.

D'autres faits stylisés, basés sur des données au niveau produit, ont également renouvelé notre vision du commerce international. L'étude de ces données a confirmé que les pays échangent des biens similaires et a apporté des informations supplémentaires. Premièrement, il apparaît que non seulement les pays riches mais aussi les pays en développement échangent des biens similaires. La Chine en est un exemple frappant. Le panier de biens qu'elle exporte vers les Etats-Unis est à 90% similaire au panier exporté par l'Allemagne vers les Etats-Unis. Les données permettent également de mettre en évidence que bien que la Chine et l'Allemagne exportent des biens similaires vers les Etats-Unis, la qualité de ces biens est très différente.

Prix, qualité et commerce international. La plupart des papiers empiriques en commerce international portent sur la valeur ou le volume des flux de commerce. Cette approche présente deux limites. Premièrement, la plupart des modèles partagent des prédictions similaires concernant la valeur ou les volumes des flux de commerce. Se focaliser sur un de ces deux éléments uniquement ne permet de discriminer entre les modèles. Deuxièmement, regarder les volumes ou les quantités ne permet pas d'appréhender la qualité qui semble pourtant un aspect crucial du commerce international.

Dans les années 1990, plusieurs chercheurs ont commencé à étudier les prix du com-

merce. Les valeurs unitaires sont calculées comme le ratio de la valeur d'un flux divisé par sa quantité. Les valeurs unitaires étaient alors calculées à partir de bases de commerce international décrivant les flux de commerce bilatéraux classés en 5000 à 10000 produits selon les bases de données et les nomenclatures. Ces valeurs unitaires sont des approximations de prix. Elles sont en fait des prix moyens. A partir de données désagrégées au niveau produit, les chercheurs ont mis en lumière différents faits stylisés remettant en question les modèles traditionnels et confirmant le rôle de la qualité pour comprendre les tendances du commerce international. Les premiers faits stylisés ont été mentionnés plus haut: les pays échangent des biens similaires, mais vendent ces biens à des prix très différents.[20] Ceci remet en cause la vision des années 1980 selon laquelle les pays échangeraient des biens similaires, et suggère plutôt que les pays produisent les mêmes types de biens mais se spécialisent dans différents niveaux de qualité. La seconde vague de faits stylisés se rapporte à l'impact de la distance sur les prix moyens. Les premiers modèles de commerce avec firmes hétérogènes prédisent que seules les firmes les plus productives, fixant les prix les plus bas, parviennent à exporter vers les marchés les plus difficiles et les plus lointains. Les données montrent le contraire. Ce sont les firmes vendant aux prix les plus élevés qui parviennent à exporter vers les marchés difficiles. Les différences de qualité semblent donc être une dimension importante de l'hétérogénéité entre les entreprises.

L'étude de données de prix a également permis aux chercheurs de mesurer le degré d'intégration économique des pays. En particulier, l'étude des écarts de prix d'un bien entre plusieurs pays a permis d'éclairer les effets des frontières, des taux de change, ou de la proximité culturelle sur le degré d'intégration économique des pays.

Enfin, les travaux sur la transmission des variations de change sont probablement ceux

[20] Voir Schott (2004) et Fontagné et al. (2008).

qui ont le plus fait appel aux données de prix individuelles. Jusqu'à très récemment encore, les papiers portant sur ce sujet utilisaient soit des prix très détaillés mais pour une industrie spécifique, soit des données moins précises mais couvrant un spectre plus large. Plus récemment, les chercheurs ont commencé à utiliser des données d'entreprises voir des données de prix avec une couverture importante de l'économie.[21] Une direction intéressante de recherche proposée par Berman et al. (2011) a été de mettre en évidence l'hétérogénéité des réponses des firmes à la suite de variations de change, et de montrer les conséquences au niveau global de cette hétérogénéité au niveau le plus fin.

Le parti adopté dans cette thèse est d'utiliser l'information sur les prix pour éclairer les quatre questions introduites plus haut; c'est à dire l'impact de la distance sur les stratégies de prix des entreprises, l'effet de l'euro sur le degré d'intégration des économies européennes, les conséquences de la concurrence des pays à bas salaires sur les entreprises des pays développés, et l'effet des biens intermédiaires importés sur l'inflation domestique.

Pour les analyses empiriques, des données individuelles d'entreprises sont utilisées. L'hétérogénéité des réactions des entreprises est examinée avec attention. En outre, à partir des résultats obtenus au niveau fin, tout est fait pour donner au lecteur une idée de la significativité économique des résultats et pour mettre à jour leurs implications agrégées.

Dans les différents chapitres de ce travail, nous procédons à un aller-retour entre la théorie et les données. En effet, les analyses empiriques sont guidées par les cadres théoriques les plus récents. De surcroît, les résultats empiriques sont comparés aux prédictions théoriques, ce qui permet de discriminer entre les modèles et d'offrir des perspectives pour les modélisations futures.

[21] Voir Gopinath et Rigobon (2008) par exemple.

Questions et conclusions

Je présente maintenant les questions développées dans cette thèse et les conclusions qui peuvent être tirées de ce travail. Chacun des chapitres est ensuite décrit plus en détail.

Quatre questions sont traitées dans cette thèses.

1. De nombreuses études ont mis en évidence l'impact prépondérant de la distance sur les activités économiques, et en particulier sur les flux de commerce et les décisions d'exportation des entreprises. Une dimension qui a été laissée de côté empiriquement concerne l'impact de la distance sur les prix au niveau de l'entreprise. Dans le premier chapitre, la question de l'impact de la distance sur les stratégies de prix des entreprises est posée.

2. L'introduction de la monnaie unique en Europe a présenté un changement important pour les firmes et les consommateurs. Le débat sur l'impact économique de la monnaie unique demeure. Dans le second Chapitre, co-écrit avec Isabelle Méjean, nous cherchons à évaluer si la création de l'euro a approfondi l'intégration économique européenne.

3. La croissance de la Chine et des pays à bas salaires soulève de nombreuses questions dans les pays développés. Dans le troisième chapitre, co-écrit avec Isabelle Méjean, nous examinons les conséquences de la concurrence des pays à bas salaire sur le contenu en qualité des exportations françaises.

4. La fragmentation internationale des chaînes de production, et l'utilisation intensive de biens intermédiaires importés montrent la dépendance accrue des pays. Cette dépendance favorise les transmissions internationales des chocs. Dans le

Chapitre 4, je cherche à mesurer comment les firmes ajustent leur prix domestiques, en réponse aux changements de prix de leurs biens intermédiaires importés.

Les principales conclusions de ce travail sont les suivantes.

1. Les entreprises fixent des prix (nets de coûts de transport) plus élevés lorsqu'elles exportent vers des destinations lointaines. Une part importante de la prime payée par les consommateurs les plus éloignés est due à ce comportement des entreprises, le reste est du aux coûts de transport plus élevés. L'impact positif de la distance sur les prix des exportations peut être rationalisé dans un modèle avec des coûts de transport additifs, au lieu de la structure multiplicative standard (iceberg).

2. L'euro a réduit la dispersion des prix dans l'Union Monétaire. L'euro a eu un effet relativement plus important sur les plus grandes entreprises. Comme ces entreprises représentent une part disproportionnée des ventes, l'effet de l'euro sur la dispersion agrégée des prix est renforcé.

3. Entre 1995 et 2005, le contenu en qualité des exportations françaises a augmenté de 11% au travers d'une réallocation des parts de marché des entreprises produisant des biens de basse qualité vers les entreprises produisant des biens de haute qualité. Cette réallocation est la conséquence de la pression concurrentielle accrue des pays à bas salaires.

4. Une hausse de 10% du prix des biens intermédiaires importés conduit les entreprises a augmenter leur prix de 1,2%. La sensibilité des prix domestiques aux biens intermédiaires importés dépend de manière cruciale de la proportion de biens importés utilisée dans le processus de production. Les changements de prix de biens intermédiaires importés depuis une filiale n'ont pas d'effets sur les prix do-

mestiques. Enfin, il apparaît que les changements de prix des biens intermédiaires n'expliquent qu'une petite partie de la dynamique des prix domestiques.

Résumé des chapitres

Distance et stratégie de prix des entreprises exportatrices. La récente mise à disposition de données d'entreprises à remis en cause les modèles de commerce international existants. L'hypothèse standard d'homogénéité des entreprises (Krugman 1980), est rejetée par les données, et relâcher cette hypothèses offre des implications nouvelles quant à l'allocation des ressources dans l'économie. Les travaux empiriques majeurs ont en effet mis en évidence l'hétérogénéité des entreprises tant par leur taille ou leur décision d'exporter ou non, que par les volumes qu'elles exportent ou le nombre de produits qu'elles vendent.[22] De ces études ressort qu'un élément déterminant des décisions relatives à l'exportation est la distance qui sépare l'entreprise de son partenaire. A partir de ces nouveaux faits stylisés, les théoriciens du commerce international ont développé de nouveaux modèles expliquant la sélection dans les marchés étrangers des firmes - et des produits vendus par ces firmes.[23]

Les stratégies de prix adoptés par les entreprises exportatrices demeurent une dimension inexplorée - empiriquement et dans une moindre mesure théoriquement - par cette littérature. En particulier, alors que l'effet des coûts de transport sur les décisions des entreprises a été largement étudié, leur impact sur les prix a beaucoup moins attiré l'attention. Dans les principaux modèles de commerce international les stratégies de prix sont d'ailleurs évacuées pour favoriser la maniabilité de ces modèles.[24] Une partie

[22] Voir Bernard et al. (2007), Bernard et al. (2010) et Eaton et al. (2004).
[23] Voir Melitz (2003), Melitz Ottaviano (2008), Eaton et al. (2011) et Bernard et al. (2010).
[24] Dans les modèles avec demande CES, concurrence monopolistique et coûts de transport iceberg

de littérature a néanmoins proposé un cadre alternatif dans lequel les marges et les prix des entreprises dépendent des caractéristiques du marché de destination. Une prédiction de ces modèles est que les firmes fixent des prix (nets de coûts de transport) plus bas vers les destinations les plus lointaines. Cependant, cette prédiction n'a jamais été testée.

Dans le premier chapitre de cette thèse, nous proposons une étude empirique et théorique de l'impact de la distance sur les stratégies de prix des entreprises. A partir de données individuelles d'entreprises décrivant les valeurs et les quantités - détaillées pour près de 8000 produits - exportés vers chaque destination par l'ensemble des entreprises françaises en 2003, il est montré que les entreprises fixent des valeurs unitaires plus élevées vers les destinations les plus lointaines. Ce résultat n'est pas sensibles à l'inclusion de différentes variables de contrôle, ni au choix de l'échantillons de pays de destinations. Les travaux parallèles de Manova et Zang (2011), de Bastos et Silva (2010) et de Gorg et al. (2010) mettent eux aussi en évidence l'impact positif de la distance sur les prix à partir de données d'entrerpises pour la Chine, le Portugal, et la Hongrie respectivement.

L'impact positif de la distance sur les prix fixés par les entreprises semble donc être une régularité qui ne se restreint pas aux données françaises. Qui plus est, il apparaît dans le chapitre 1 que l'impact de la distance sur les prix a des conséquences économiques significatives. En effet, pour les consommateurs éloignés, les prix sont plus élevés pour deux raisons. La première, évidente, est que les coûts de transport sont plus élevés. La seconde est que les entreprises fixent des prix nets de coûts de transport plus haut. Démonstration est faite dans le chapitre 1 que le second canal est le plus important pour expliquer les primes payées par les consommateurs les plus éloignés.

(Krugman 1980, Melitz 2003) les entreprises fixent le même prix net de coûts de transport vers l'ensemble des marchés qu'elles servent.

D'un point de vue théorique, ce résultat est aussi particulièrement intéressant. En effet, presqu'aucun modèle ne prédit ce lien positif entre valeurs unitaires des exportations au niveau de l'entreprise et distance. Le fait que les entreprises fixent des prix plus élevés peut s'expliquer principalement de deux manières: i) les firmes fixent des marges plus hautes, ii) les firmes vendent des biens de relativement plus haute qualité, ce qui entraîne une hausse des marges et des coûts et donc des prix. Ces deux phénomènes sont cohérents avec l'effet Alchian Allen (1964) qui stipule que la demande relative des biens les plus chers augmente avec les coûts de transport si ces derniers ne sont pas proportionnels au niveau des prix des biens exportés. Plus généralement, nous montrons qu'une condition cruciale pour modéliser le lien positif entre prix et distance - aussi bien via les marges que via la qualité - est la présence de coûts de transport additifs. Ceci est particulièrement intéressant car la quasi-totalité des modèles utilisent des coûts de transport multiplicatifs, qui ne permettent pas de rendre compte du fait stylisé évoqué ici.

Evaluer l'intégration économique de l'Union Monétaire Européenne au regard de la dispersion des prix. L'Union Monétaire Européenne (UME) mise en place en janvier 1999 concerne aujourd'hui 16 états membres et près de 330 millions d'individus. Cette nouvelle étape de la construction européenne visait notamment à renforcer l'intégration économique des marchés membres de l'union. Dix ans après l'introduction de l'euro, il est à présent possible de tester si les vertus annoncées de la monnaie unique se sont traduites dans les faits.

Dans cet article nous nous intéressons plus particulièrement à l'impact de l'euro sur l'intégration du marché des biens. Deux méthodes s'offrent aux économistes pour appréhender ce type d'effets. La première repose sur une étude des volumes échangés, la

seconde sur une étude de la dispersion des prix. Une plus grande intégration économique entre états devrait en principe accroître leur commerce mutuel. Différents travaux ont étudié l'impact de l'euro sur le commerce intra-zone. Si des questions méthodologiques demeurent, un consensus semble émerger, attribuant un impact positif mais faible de l'adoption de l'euro sur le commerce (Baldwin et al. 2008). Ici, nous nous concentrons sur la seconde méthodologie mesurant l'effet de l'intégration des marchés sur l'évolution de la dispersion des prix. Cette méthode repose sur une hypothèse simple - commune à de nombreux modèles macroéconomiques - la loi du prix unique (LPU). La LPU stipule que dans un marché parfaitement intégré, les prix de biens identiques (exprimés dans une même devise) devraient être uniformes, quelle que soit la localisation géographique de la transaction. Ainsi, l'ampleur des déviations à la LPU fournit un indicateur du degré d'intégration des économies

En renforçant les comportements d'arbitrage, l'union monétaire est supposée réduire la dispersion des prix à l'intérieur de la zone intégrée. Dans ce second chapitre, nous testons cette hypothèse en utilisant l'expérience naturelle de l'Union Monétaire Européenne. L'étude empirique est basée sur des données individuelles de prix à l'exportation français et une stratégie d'estimation en double différences. La variable expliquée est la dispersion des prix fixés par une firme donnée sur ses différents marchés, que nous interprétons comme une mesure de discrimination par les prix. Les résultats montrent que l'introduction de la monnaie unique a significativement réduit la dispersion des prix à l'intérieur de la zone euro, par rapport au reste de l'OCDE mais aussi par rapport aux autres membres de l'Union Européenne n'ayant pas adhéré à l'UME.

L'ampleur de cet effet est cependant assez faible de prime abord. Nous trouvons que les prix étaient 24% plus dispersé dans la zone euro que dans les autres membres de

l'UE. Cette dispersion s'est réduite de 3 points de pourcentage après le passage à l'euro. Cependant, il apparaît que les stratégies de prix sont également hétérogènes entre firmes de tailles différentes. En particulier, nous montrons que l'introduction de la monnaie unique a eu un impact relativement plus important sur la discrimination en prix des plus grandes entreprises. Hors, ces entreprises représentent une part disproportionné des ventes totales. Par conséquent, l'impact agrégé, prenant en compte cette hétérogénéité est bien plus fort. Nous montrons en effet que la dispersion des prix dans l'UME relativement au reste de l'UE s'est réduite en moyenne de 17 point de pourcentage après la création de la monnaie unique.

L'impact asymétrique de la concurrence des pays à bas salaires sur les entreprises, et ses conséquences sur la qualité des exportations françaises. Un des phénomènes qui a fait coulé le plus d'encre ces dernières années est la part croissante des pays émergents dans l'économie mondiale. Cette nouvelle concurrence et d'autant plus redoutée par les pays développés qu'il apparaît que les pays en développement produisent les mêmes types de produits qu'eux. Cependant, comme le souligne Peter Schott (2004, 2008) il semble que les pays en développement produisent des versions de plus basse qualité. Tout cela suggère que les pays se spécialisent, au sein des industries, dans la production de différents niveaux de qualité.

En plus de cette spécialisation des pays, des études récentes mettent en avant l'importance des différences de qualité, au sein des pays et des industries, entre les entreprises (voir Crozet et al. (2011) et Verhoogen (2008)). L'interaction entre les différences de qualité internationales et les différences de qualité entre entreprises d'un même pays n'a pas été beaucoup étudiée. On peut pourtant s'attendre à ce que la pression concurrentielle des pays à bas salaires affecte différemment les entreprises des pays développés selon

la qualité qu'elles produisent.

Le troisième chapitre examine de manière approfondie l'impact des pays à bas salaires sur les ventes relatives des entreprises françaises et ses conséquences sur la qualité moyenne exportée par la France. Dans un premier temps, un modèle très simplifié est mis en place pour mettre en lumière l'impact asymétrique des pays à bas salaires sur les entreprises des pays développés. L'intuition est très simple. Les pays à bas salaires produisant des biens de relativement basse qualité, les firmes les plus touchées par cette concurrence dans les pays développés sont les firmes qui produisent les biens de plus basse qualité. Par conséquent, la part des ventes des entreprises de basses qualités dans les exportations françaises diminue ce qui accroît mécaniquement la qualité moyenne exportée par la France.

Nous développons ensuite une stratégie empirique pour identifier les changements de qualité moyens liés à une réallocation des ventes des firmes de basse qualité vers les firmes de haute qualité. Nous nous appuyons en particulier sur l'indice de qualité de Boorstein et Feenstra (1987) que nous adaptons à nos données d'entreprises. Cette méthode nous permet de mesurer l'évolution de la qualité des exportations françaises pour près de 30 secteurs vers plus de 40 pays au cours de la période 1995-2005. Nous montrons qu'en moyenne la qualité des exportations françaises a augmenté de près de 11%. Cette évolution cache cependant des disparités entre les secteurs et les pays.

Nous exploitons ces disparités pour évaluer l'impact des pays à bas salaire sur la qualité moyenne vendue par la France. Les résultats confirment que la qualité des exportations françaises a augmenté le plus dans les secteurs et vers les destinations les plus exposés à la concurrence des pays à bas salaires. Ces résultats suggèrent une spécialisation importante de la France dans les biens de haute qualité, ce qui va entraîner des changements sur le marché du travail.

Globalisation de l'inflation: l'impact des biens intermédiaires importés sur la dynamique des prix domestiques. La production domestique requiert une part considérable de biens importés. Dans les secteurs manufacturiers, entre 20 et 67% des coûts totaux de production proviennent de biens importés.[25] Pour cette raison, les liens fournisseurs-producteurs sont indispensables pour comprendre la transmission internationale des chocs dans nos économies. En lien avec ce constat, la part croissante de biens intermédiaires importés questionne la sensibilité des prix domestiques aux changements de prix des biens intermédiaires étrangers. Il existe cependant très peu d'études mesurant l'impact des biens intermédiaires importés sur les prix domestiques. Le Chapitre 4 propose d'étudier ce phénomène au niveau le plus fin, c'est à dire au niveau des entreprises.

L'analyse repose sur une base de donnée construite pour cette étude. Cette base rapporte l'évolution mensuelle des prix domestiques et des prix à l'importation de plusieurs milliers de biens. Cette information est collectée par l'INSEE pour construire les indices de prix à la production, à l'import et à l'export. Nous avons pu identifier à peu près 500 firmes qui sont enquêtées par l'INSEE à la fois concernant leurs prix domestiques et le prix de leurs importations. Ceci nous permet d'évaluer la réaction des entreprises à un changement dans le coût de ses biens intermédiaires importés.

Pour évaluer quels mécanismes déterminent le degré de transmission des chocs de coûts, plusieurs spécifications sont estimées. Premièrement, le rôle joué par la part dans les coûts totaux des biens intermédiaires importés est examiné. Ensuite, l'étude porte sur le rôle de la structures de marché, et les différences de transmission des changements de biens importés vers les prix domestiques et les prix des biens exportés, dans le but d'évaluer l'importance des marges variables. Enfin, une comparaison est faite des

[25] Voir Goldberg et Campa (2010).

transmissions de changements de prix de biens importés vers les prix domestiques dans le cadre de transactions intra-firmes et des transactions entre différentes entités.

En outre, une attention toute particulière est portée à la possible endogénéité des changements de coûts des biens importés. Pour cela, nous nous focalisons sur un échantillon de transaction pour lesquelles les entreprises déclarent que le bien peut être acheté chez différents fournisseurs. Nous supposons alors que ce type de bien est assez standardisé. Par conséquent, les changements de prix de ces biens importés peuvent être considérés comme exogènes pour les entreprises.

Il y a quatre résultats principaux à cette étude. Premièrement, en moyenne, l'élasticité des biens domestiques au prix des biens intermédiaires importés est de 12%. Une grande partie de cette élasticité s'explique par la part de biens importés utilisés dans le processus de production. Cependant, il existe une hétérogénéité importante entre secteurs qui n'est pas expliquée par cela. Deuxièmement, la transmission est bien moindre lorsque les transactions se déroulent au sein de l'entreprise. Troisièmement, il semble que la structure du marché n'influence pas le degré de transmission. Enfin, nous montrons que la volatilité des prix des biens importés explique environ 9% de la volatilité des prix domestiques. Cependant, la majeure partie des dynamiques de prix individuelles n'est pas expliquée par les mouvements de prix des biens intermédiaires.

List of Figures

List of Tables

Prices and Quality in International Trade

The thesis uses information on prices to shed light on four questions. Chapter 1 provides new evidence on trade prices based on firm-level data from France. It finds firms charge higher free-on-board unit values on exports to more distant countries. This behavior explains most of the price premium paid by distant consumers, the rest being due to higher transport costs. This may be rationalized in models with additive rather than iceberg transport costs. Chapter 2 examines the impact of monetary unions on the integration of good markets. It shows the Euro has disproportionably affected large/more productive firms. Taking into account this heterogeneity, it finds a strong impact of the Euro on economic integration. Chapter 3 asks about the impact of low-wage countries' competition on the quality of high-wage countries' exports. Over 1995-2005, the mean quality of France's exports increased by 11%. Increasing pressures from low-wage countries have induced a reallocation of sales from low- to high-quality firms. Chapter 4 measures the sensitivity of domestic prices to changes in imported inputs' prices. The elasticity of domestic prices to imported inputs prices is 12%. The transmission is much lower among firms importing inputs from a related party. On average 9% of the volatility of production prices at the sectoral level is driven by changes in imported inputs' costs.

Prix, Qualité et Commerce International

Cette thèse utilise l'information sur les prix pour éclairer quatre questions. Dans le premier chapitre, nous montrons que les entreprises fixent des prix (net de couts de transport) plus élevés vers les pays les plus lointains. Ceci peut être expliqué dans des modèles de commerce avec coûts de transport additifs plutôt que multiplicatifs. Dans le second chapitre, nous évaluons l'impact des unions monétaires sur l'intégration économique. Nous montrons que l'euro a touché plus fortement les grandes entreprises. En prenant en compte cette hétérogénéité, nous trouvons un impact important de la création l'euro sur le degré d'intégration économique de la zone euro. Dans le troisième chapitre nous examinons l'impact des pays à bas salaire sur la qualité des exportations des pays développés. Entre 1995 et 2005, la qualité moyenne des exportations Française a augmenté de 11%. La pression concurrencielle des pays à bas coûts a induit une réallocation des ventes des firmes de basse qualité vers les firmes de meilleur qualité. Dans le chapitre 4, nous cherchons à mesurer la sensibilité des prix domestiques aux changements de prix de biens importés. Nous trouvons une élasticité prix des biens domestiques aux mouvements de prix de biens importés de 12%. La transmission est bien plus faible pour les biens importés entre entreprises d'un même groupe. En moyenne, 9% de la volatilité des prix domestiques au niveau sectoriel est expliqué par les mouvements de prix de biens intermédiaires importés.