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

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Abstract

We consider the impact of low-wage countries' competition on the quality content of high-wage countries' exports. We develop a new method that uses firm-level data to measure quality changes in sectoral exports. Over 1995-2005, we measure a 11% increase in the mean quality of France's aggregate exports. Quality upgrading is driven by a reallocation of demand in favor of higher quality producers. The phenomenon is significantly more pronounced in markets where the penetration of developing countries has increased while it goes the opposite direction where firms face increased competitive pressures from high-wage countries. These results are consistent with within-product specialization along the vertical dimension. They suggest that, over the period, France has specialized in the production of higher quality goods. In our data, around one fifth of the measured quality improvement in France's aggregate exports is attributable to low-wage countries' competition.

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Keywords: Firm-Level Data, Quality Heterogeneity, Low-Wage Countries' Competition, Within-product specialization.

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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 defies the neo-classical theory of international trade for at least two reasons. First, recent empirical evidence suggests that emerging economies are becoming competitive not only in labor-intensive sectors, as theory would predict, but also in capital-intensive ones (see Amiti & Freund, 2010, on Chinese data). Second, Schott (2004) shows that the US now imports the *same* products from *both* developed and developing countries, but these varieties are vertically differentiated. Hence, those Chinese goods that compete with OECD countries' are of lower quality, on average (Schott 2008, Fontagné, Gaulier & Zignago 2008). According to Schott, these patterns of international trade are inconsistent with factor-proportion specialization *across* industries but suggest specialization occurs *within* industries (Schott, 2004, 2008). 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 differentiated 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, notably China. In the meantime, competition from high income countries has the opposite impact. 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 & 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.[1,2] 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.[3] If competitive pressures instead come from a high quality producer, the mean quality that is exported is predicted to go down.

The example 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. In Schott's (2008) words, developed countries respond to competition from low-wage countries by "moving out, that is, by [...] dropping the least-sophisticated varieties from their export bundle."

The empirical exercise is conducted using firm-level data on French exports. Our measure of quality changes relies on the methodology proposed by Aw & Roberts (1986) and Boorstein & Feenstra (1987) and recently used by Harrigan & Barrows (2009) on sectoral data. Boorstein & Feenstra (1987) propose that the aggregate quality of a basket of goods is

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

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

[3] 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. **?**, Helbe & Okubo (2008), Johnson (2008), Verhoogen (2008), Kugler & Verhoogen (forthcoming), Hallak & Sivadasan (2009). In these models, quality upgrading 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. Our methodology captures quality upgrading along both adjustment margins.

measured by the mean utility its consumption induces per unit of good. Using this definition, they show how to quantify changes in the mean quality by comparing time-variations in its unit value and 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 differentiated qualities. In firm-level data, particular attention has to be paid to entry and exit 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 exhibits 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 form 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 foreign 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.[4] A change in the mix of exported products could also affect long-run growth, as discussed in Hausmann, Hwang & Rodrik (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, Jensen & Schott (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.[5] 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 (see Bloom, Draca & Van Reenen 2009, Mion, Vandenbussche & Zhu 2009, Mion & Zhu 2011). These papers show that increased competitive pressures from China makes firms adopt production processes that are more intensive in skilled and non-production workers (Mion et al. 2009,2011) 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

[4]The within-industry shift in demand away from unskilled and toward skilled workers is documented in a number of papers. See, among others, Berman, Bound & Griliches (1994) and Bernard & Jensen (1997) for the US, Strauss-Kahn (2004) and Biscourp & Kramarz (2007) for France and Machin & Reenen (1998) and Berman, Bound & Machin (1998) for a panel of developed countries. Berman et al. (1994), Machin & Reenen (1998) and Berman et al. (1998) interpret the evidence as the result of skilled-biased technological change. Results in Bernard & 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 & Kramarz (2007) and Strauss-Kahn (2004) relate the phenomenon to international trade.

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

firm-level and focus on aggregate quality upgrading driven by a reallocation of sales *across firms*. If any, 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 rest of the paper is organized 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 4. Finally, Section 5 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 & 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.[6]

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 competition 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 FOB price p_i that she chooses strategically. 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.

[6] Appendix A considers the other two possibilities, namely that the Southern firm offers the intermediate, or the high quality.

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.[7] 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 and the previously defined income thresholds. For the high, medium and low-quality producers, respectively,

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

Supply side: Firms are differentiated in terms of the quality they sell, and compete in prices. As in Gabszewicz & Thisse (1979), we assume quality is an exogenous characteristic of the firm.[8] 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 $s_M - s_L = 1 - \alpha$.

[7] 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:

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

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

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

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

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

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.[9] 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 the

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

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 Appendix A).

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. Northern firms reduce their sales 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 appendix A, 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 (**add references here**). 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 & Roberts (1986) and Boorstein & Feenstra (1987), and recently used by Harrigan & Barrows (2009). Boorstein & 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:

$$\Delta \ln \mathrm{Q}_t = \Delta \ln \mathrm{UV}_t - \Delta \ln \pi(p_t), \tag{4}$$

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 $p_t = \{p_{it}\}$.[10]

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: $\mathrm{UV}_t \approx \sum_{i=1}^{I} w_{it} p_{it}$, 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 (4).[11] The remaining changes in the composition of the consumption basket are then assigned to quality changes ($\Delta \ln \mathrm{Q}_t$). 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 & 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

[10] The decomposition is detailed in Boorstein & 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 (strong) assumption is necessary in the absence of firm-level data on non-French export flows.

[11] 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.

the case that changes in competitive pressures also induce within-firm quality adjustments. Such changes in the nature of exported goods are not captured by our measure of quality upgrading. We however suspect that they should go in the same direction as the reallocation of demand we observe. This means our measure of quality upgrading is probably a lower bound.

Finally, it has to be noted that this definition of quality changes crucially rely on the assumption that goods are vertically differentiated. If they are not, 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 that 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.[12]

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 differentiated, as well as the tobacco industry, which is very concentrated in France, and the

[12] We are thankful to Amit Khandelwal for pointing this to us.

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 is 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.[13] Since the analysis 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 & 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

[13]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 we consider produce a single product within a given hs6 category. **Multi-product firms represent X% of the total value of exports.**

compute the unit value index for good k, defined as

$$\begin{aligned}\Delta\ln(UV_{kct}) &= \Delta\ln\frac{\sum_{(p,f)\in I_{kct}} v_{fpct}}{\sum_{(p,f)\in I_{kct}} q_{fpct}} \\ &= \underbrace{\Delta\ln\frac{\sum_{(p,f)\in I_{kc}} v_{fpct}}{\sum_{(p,f)\in I_{kc}} q_{fpct}}}_{\text{Intensive component}} + \underbrace{\Delta\ln\tilde{\lambda}_{kct} - \Delta\ln\lambda_{kct}}_{\text{Extensive component}} \qquad (5)\end{aligned}$$

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

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 (5). 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 (4), 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 & 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:[14]

$$\Delta\ln\pi_{kc}(p_t) = \underbrace{\sum_{(p,f)\in I_{kc}} w_{fpct}(I_{kc})\Delta\ln(p_{fpct})}_{\text{Intensive component}} + \underbrace{\frac{1}{\sigma_k - 1}\Delta\ln\lambda_{kct}}_{\text{Extensive component}} \qquad (6)$$

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

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

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

The first component of equation (6) is the ideal price index computed over the sub-sample of intensive trade flows. The second part of equation (6) 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, namely a translog function. As shown by Feenstra & Weinstein (2010), the ideal price index with translog preferences is defined as follows

$$
\begin{aligned}
\Delta \ln \pi_{kc}(p_t) = & \underbrace{\sum_{(p,f)\in I_{kc}} \frac{1}{2}(s_{fpct}(I_{kc}) + s_{fpct-1}(I_{kc}))\Delta \ln(p_{fpct})}_{\text{Intensive component}} \\
& \underbrace{+ \frac{-1}{2\delta_k} \left\{ \sum_{(p,f)\notin I_{kc}} \left[s^2_{fpct}(I_{kct}) - s^2_{fpct-1}(I_{kct-1}) \right] \right.}_{\text{Extensive...}} \\
& \underbrace{\left. + \frac{1}{I_{kc}} \left[\left(\sum_{(p,f)\notin I_{kc}} s_{fpct}(I_{kct}) \right)^2 - \left(\sum_{(p,f)\notin I_{kc}} s_{fpct-1}(I_{kct-1}) \right)^2 \right] \right\}}_{\text{...component}}
\end{aligned} \tag{7}
$$

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

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

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, the magnitude of extensive price changes in (7) is conditional on the δ_k parameter that determines the magnitude of the own price and cross-price elasticities in the translog case (see details in Feenstra & Weinstein 2010). Based on the median estimate obtained by Feenstra & Weinstein (2010), we calibrate the value of δ_k to 0.5, whatever the sector under consideration.

The ideal price indices (6) and (7) 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 & 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, (5) and (6) or (7), we can infer a quality index from the decomposition in (4). 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 (6)) or a Tornqvist formula (when it is based on (7)). 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 1 gives summary statistics on the corresponding end-period quality indices, as well as their components. The top panel in Table 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.[15] In the meantime, firm-level export prices grew by 7.5% on average.[16]

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

[15]The evolution in the number of French flows is depicted in Figure A.1.

[16]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.

quality index, using a weighting scheme that reflects the specialization of 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 A.2 in the Appendix).[17]

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 1). Despite the average upward trend, the quality of the French 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 A.1). The important role of sector-specific determinants is consistent with the IO literature, which explains vertical differentiation by structural features related to the production technology. 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:

$$\Delta \ln \mathrm{V}_t = \Delta \ln \mathrm{Qy}_t + \Delta \ln \pi(p_t) + \Delta \ln \mathrm{Q}_t, \tag{8}$$

In equation (8), $\Delta \ln \mathrm{V}_t$, $\Delta \ln \mathrm{Qy}_t$, $\Delta \ln \pi(p_t)$ 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.

[17]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).

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).[18] 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 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 and glass products. In these sectors, the quality component explains more than 50% of export growth.

4.2 Impact of Within-Industry Specialization

4.2.1 Low-Wage Countries' Competition

In a world of within-industry specialization, the previously described increase in the quality of French exports is driven by changes in the competitive environment faced by French firms in international markets. To test whether this mechanism prevails in the data, we now 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. If countries indeed specialize within industries, it must be true that quality upgrading is stronger in those markets in which France faces stronger competitive pressures from low-quality producers.

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

[18] 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.

two decades, from less than 8% of world exports in 1995 to more than 16% in 2005.[19] 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 (averaged across destination markets) against the change in low-wage countries' market share. 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

$$\Delta_{95-05} \ln Qlty_{kc} = \alpha \; \Delta_{95-05} Msh_{kc}^{lwc} + X_{kc} + \epsilon_{kc}, \tag{9}$$

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

[19] 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.

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 A.1 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 (9) 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.[20] 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 A.2 in Appendix.

Results are presented in Tables 2 and 3. Namely, Table 2 displays estimated coefficients obtained when the only control variables are fixed effects while Table 3 adds other control variables. The first three columns in Table 2 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.

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

The descriptive statistics presented in section 4.1 underlined the important contribution 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 2 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 A.3 in Appendix tests the robustness of these results to the sample of countries we consider. We replicate the regressions of Table 2, 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 A.3). This suggests that competition from low-wage countries does induce extensive *and* intensive reallocation patterns across firms in more developed countries.

Table 3 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 2 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 3 using as control the indicator of vertical differentiation estimated by Khandelwal (2010).[21] 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 3 then controls for a measure of the Herfindahl index computed for each sector and country using trade data.[22] 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 than the within-industry specialization. This does not seem to be the case, however. The impact of the Herfindahl index is found non significant. Moreover, the coefficient on low-wage countries' market share remains unchanged.

Finally, Column (5) in Table 3 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

[21] 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.

[22] 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.

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.[23]

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 1.7%. This means that more than 15% of the quality growth of French exports is explained by tougher competition from China.

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 "easier" for low-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

[23] 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.

between its market shares in 1995 and 2005). This country is the "main competitor" and its market share change is called $\Delta_{95-05}MainComp_{kc}$. We then build two variables that interact the market share change of the main competitor with dummy variables indicating whether this competitor is a high-wage or a low-wage country.[24] We expect the impact of competitive pressures on quality to be different when exerted from low-wage countries that presumably produce low-quality goods or from high wage countries that are more likely to export high quality varieties. To test this intuition, we estimate the following equation:

$$\begin{aligned} & \Delta_{95-05} \ln Qlty_{kc} = \alpha \mathbb{1}_{lwc} \Delta_{95-05} MainComp_{kc} \\ + \quad & \beta \mathbb{1}_{hwc} \Delta_{95-05} MainComp_{kc} + X_{kc} + \epsilon_{kc}, \end{aligned} \tag{10}$$

where $\Delta_{95-05} \ln Qlty_{kc}$ is the change in quality, $\Delta_{95-05}MainComp_{kc}$ is the change in the "Main competitor"'s market share, $\mathbb{1}_{lwc}$ is a dummy variable equal to one for low-wage countries, $\mathbb{1}_{hwc}$ is a dummy variable equal to one for high wage countries, and X_{kc} are control variables.

Results are presented in Table 4. 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). Together, these results suggest that i) changes in the quality content of developed nation exports are partly driven by international competition and ii) the direction of those changes in quality depends on the nature of competition. 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 4, the impact of competition from high wage countries turns out non-significant and the magnitude of the coefficient on

[24] 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.

competition from low-wage countries is reduced by half. This confirms the role of net entries in the dynamics of specialization patterns.

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 induces 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 market shares while increasing the value added content of their exports. Investing in high-quality production should indeed provide a way for countries to insulate from the competition of low-wage countries.

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A Solution of the Model

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

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

The Nash equilibrium yields the following optimal prices:

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

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 $\overline{\theta}$ and $\underline{\theta}$). 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 parameters:

$$
\begin{aligned}
D_H &= -\frac{2+\alpha}{6\alpha}\tau_H c_H + \frac{1}{6}\tau_L c_L + \frac{1}{3\alpha}\tau_M c_M + \frac{1-\alpha}{6}(\overline{\theta}-\underline{\theta}) + \frac{1}{2}\overline{\theta} && \text{(A.1)} \\
D_M &= -\frac{1}{3\alpha(1-\alpha)}\tau_M c_M + \frac{1}{3(1-\alpha)}\tau_L c_L + \frac{1}{3\alpha}\tau_H c_H + \frac{1}{3}(\overline{\theta}-\underline{\theta}) && \text{(A.2)} \\
D_L &= -\frac{3-\alpha}{6(1-\alpha)}\tau_L c_L + \frac{1}{3(1-\alpha)}\tau_M c_M + \frac{1}{6}\tau_H c_H + \frac{\alpha}{6}(\overline{\theta}-\underline{\theta}) - \frac{1}{2}\underline{\theta}. && \text{(A.3)}
\end{aligned}
$$

<u>Case 1:</u> **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:

$$\begin{aligned} D_M(\tau^* - \Delta\tau^*, \tau, c_L, c_M, c_H, \overline{\theta}, \underline{\theta}, \alpha) &< 0 \\ D_H(\tau^* - \Delta\tau^*, \tau, c_L, c_M, c_H, \overline{\theta}, \underline{\theta}, \alpha) &< 0. \end{aligned}$$

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

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

while the high-quality firm exits if the drop exceeds

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

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

$$\begin{aligned} & \bar{\Delta\tau^*}^H > \bar{\Delta\tau^*}^M \\ \Leftrightarrow \quad & \tau(c_H - c_M) < \alpha\overline{\theta}, \end{aligned}$$

i.e., if the high quality firm has a large "exclusive demand" (large $\overline{\theta}$), 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).

<u>Case 2:</u> **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

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

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

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

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

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

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

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

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.

<u>Case 3:</u> **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

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

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

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

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

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

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

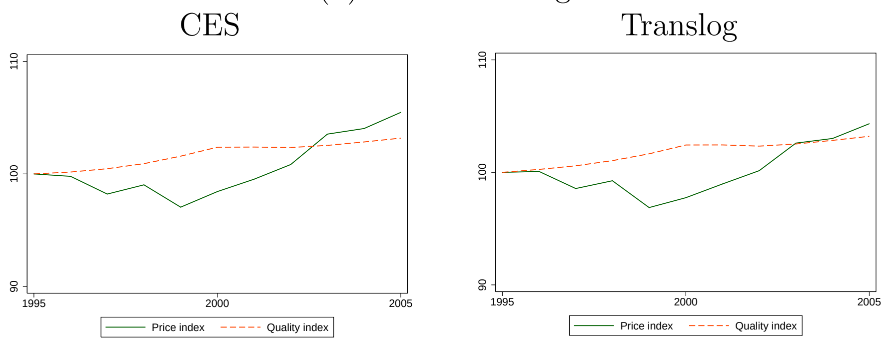
$$\begin{aligned} & \Delta\bar{\tau^*}^L > \Delta\bar{\tau^*}^M \\ \Leftrightarrow \quad & \tau(c_M - c_L) > (1-\alpha)\underline{\theta}. \end{aligned}$$

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

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*).

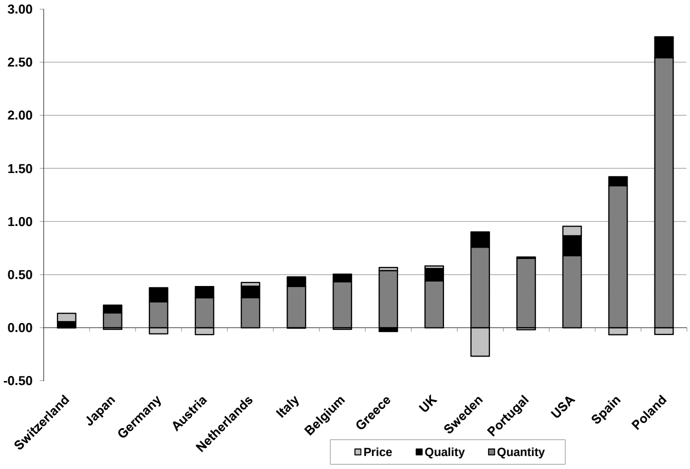
Table 1: Summary Statistics

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

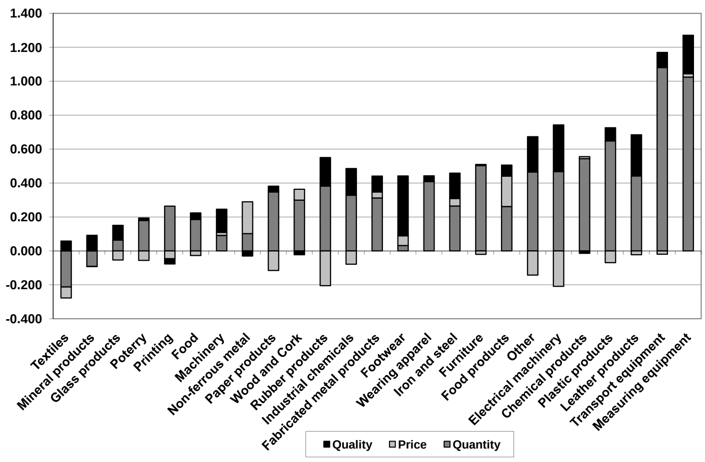
Notes: These summary statistics are computed over the distribution of sector- and destination-specific indices for 2005 ($Q_{kc,05}$ with $Q_{kc,1995} = 100$). Sectors are defined in the ISIC revision 2 nomenclature. The decomposition is either performed on the whole sample ("Int + Ext" rows) or on the 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%.

Figure 2: Decomposition of Changes in the Value of Exports

(a) By country



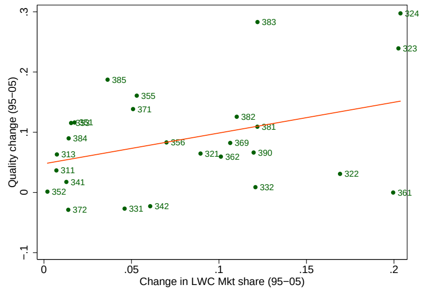
(b) By sector



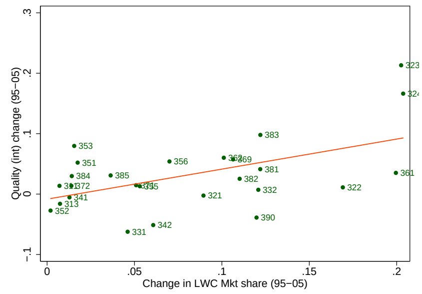
Notes: The decomposition is based on equation (8), computed at the hs6 level for each destination market. Data are then aggregated at the country level (panel (a)) and at the sectoral level (panel (b)) using Tornqvist weights. Each bar measures the growth rate of French exports (in value) between 1995 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.

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.

Table 2: 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 3: 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	0.366^a	0.373^a	0.357^a	0.368^a
	(0.124)	(0.134)	(0.143)	(0.135)	(0.134)
Quality ladder			0.005^c		
			(0.003)		
Herfindahl Index				0.109	
				(0.125)	
$\Delta\#$ *varieties*					0.081^b
					(0.038)
Observations	1170	1170	1123	1170	1170
R^2	0.065	0.066	0.068	0.067	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

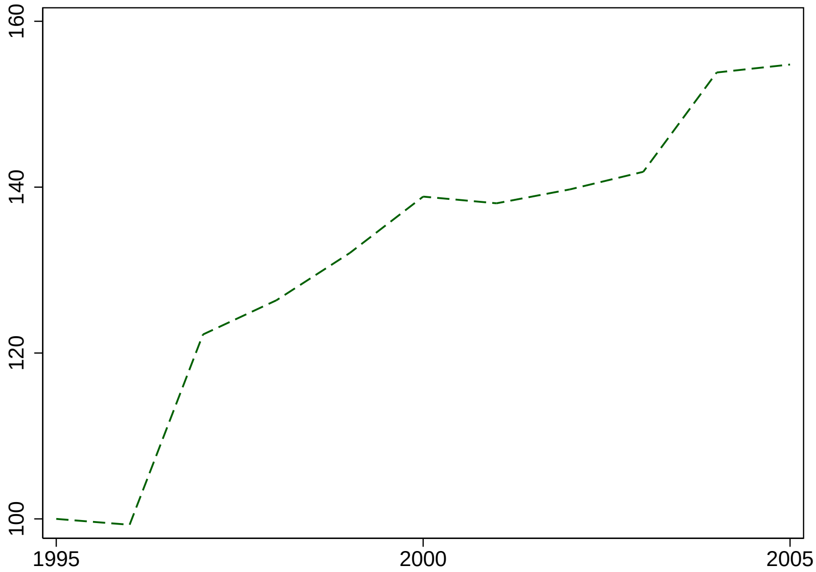
Notes: Robust standard errors in parentheses. ^{a} $p < 0.01$, ^{b} $p < 0.05$, ^{c} $p < 0.1$. The dependent variable is the log difference of the quality index between 1995 and 2005, computed at the ISIC (revision 2) level for each destination country. "Δ_{95-05} LWC Market share" denote the 1995-2005 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. $\Delta\#$ *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.

Table 4: Quality and Competition from High and Low-Wage Countries

	(1)	(2)	(3)	(4)
	Dep. var: Δ_{95-05} ln Quality			
Δ_{95-05} Main Comp. high wage cty	-0.080^b	-0.097^b	0.002	0.014
	(0.039)	(0.037)	(0.027)	(0.031)
Δ_{95-05} 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

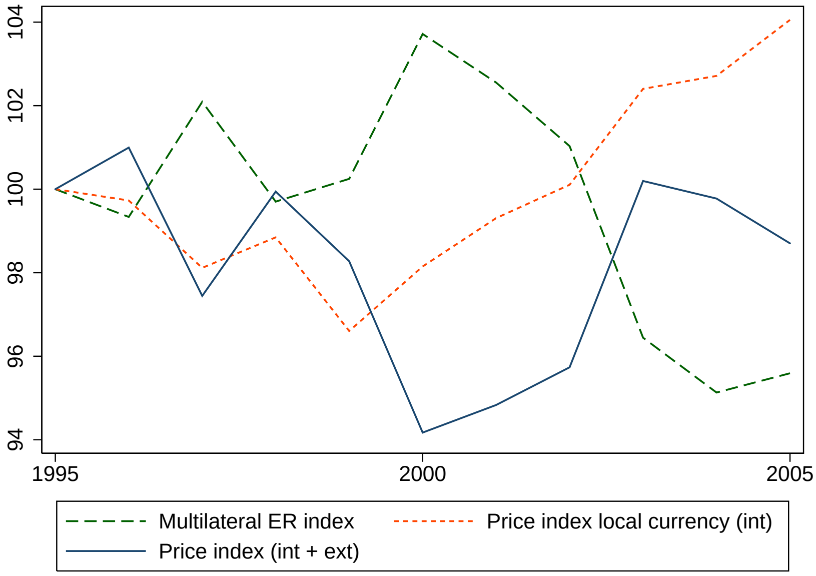
Notes: Robust standard errors in parentheses. ^{a} $p < 0.01$, ^{b} $p < 0.05$, ^{c} $p < 0.1$. The dependent variable is the log difference of the quality index between 1995 and 2005, computed at the ISIC (revision 2) level for each destination country."Δ_{95-05} Main Comp high wage cty " denotes the change in the market share of the main competitor interacted with a dummy equal to one if the main competitor is a high wage country. "Δ_{95-05} Main Comp low-wage cty " is the change in the market share of the main competitor, interacted with a dummy equal to one if the main competitor is a low-wage country. All market shares are computed excluding France.

Figure A.1: Evolution in the Number of French Export Flows



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

Figure A.2: 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*.

Table A.1: 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 A.2: 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 A.3: 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.