



# Quality upgrading and price heterogeneity: Evidence from Brazilian exporters<sup>☆</sup>



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## ABSTRACT

This paper uses producer quality information to investigate whether firms segment markets and adapt product quality and prices according to destination country characteristics. Using detailed price and quality data for Brazilian exporters over time, the results document quality-based market segmentation, by which firms raise quality and prices to high-income destinations. A major exchange rate shock and further robustness analysis reinforce the hypothesis that adjustments in quality and prices happen within the firm and that differences in prices across destinations may be driven by investments in product quality and demand for high quality.

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## 1. Introduction

A growing body of literature has documented a systematic variation in export prices across destination countries, to a large extent even within the same exporting firm. While several papers have suggested quality differences as one plausible explanation,<sup>1</sup> the lack of direct data on producer quality has limited empirical evidence to the use of

proxies.<sup>2</sup> A second strand of the literature that investigates the demand side argues that high-income countries have a higher willingness to pay for quality.<sup>3</sup> However, recent empirical investigation still faces the challenge of separating the quality effect from other sources of price variation across destinations, such as market competition, firm composition, supply factors such as shipping costs, and further destination country characteristics. Therefore, the questions of why prices are a function of destination country characteristics and whether heterogeneous adjustments in quality happen within the firm remain a puzzle.

I use export price data combined with quality upgrading behavior of Brazilian exporters over time, which allows evaluating the sources of within-firm price adjustments across destinations over time. The empirical approach focuses on within-firm adjustments that discern quality and prices for (i) firms that upgraded quality from those that did not, (ii) by destination countries and (iii) over the period 1997–2000. Another important layer of differential effects refers to the product upgraded by the firm. The period under analysis, which can be interpreted as a catch-up phase of trade liberalization in mid-level economies, provides an ideal empirical setting, as firms made important efforts to bridge the

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<sup>1</sup> See Hummels and Klenow (2005) and Hallak (2006) for an analysis using aggregate data. Similar evidence is found using a structural approach (Khandelwal, 2010; Hallak and Schott, 2011) and within firms (Manova and Zhang, 2012; Bastos and Silva, 2010).

<sup>2</sup> Exceptions to this literature are Goldberg and Verboven (2001) and Crozet et al. (2012), using detailed product characteristics, although data are generally only available for narrowly defined sectors. The study by Crozet et al. (2012) on French wines is closely related to my study. However, they focus on price variation across firms rather than across destination markets within firms, using cross-section data (the literature is discussed in detail in Section 2).

<sup>3</sup> One prominent example is Simonovska (2015), who estimates price elasticities with respect to per-capita income using information for identical products sold in different countries.

quality gap.<sup>4</sup> The empirical approach is motivated by the theoretical idea that income differences across countries lead to a different willingness to pay for quality. Hence, firms that innovate have stronger profit incentives to increase product quality and prices to high-income (Northern) countries in comparison to low-income (Southern) countries, and therefore to segment markets. The theoretical motivation is presented in the web appendix for the sake of brevity.

Results document quality-based market segmentation, by which improvements in product quality are associated with higher prices only in the case of sales to high-income destinations. Evidence suggests that investments in product quality and demand for high quality are the driving forces of heterogeneity in export prices across destinations. To my knowledge, this is the first study that provides direct evidence on quality upgrading over time and that directly evaluates quality upgrading as a source of firm-level price adjustment across destinations. Moreover, while previous studies have used general measures of innovation to investigate technology upgrading and innovation, the Brazilian innovation survey allows general innovation shocks (for instance, process innovation) to be separated from product quality changes, and therefore I evaluate different types of innovation and relate results to the recent literature on firm heterogeneity.

To assess the hypothesis of market segmentation through quality, I use novel and uniquely rich Brazilian firm-level data. The data are well-suited for the empirical analysis for several reasons. *First*, a distinctive feature of the data is the possibility of combining export price data with detailed innovation data, which allows me to build a direct and comprehensive measure of firm-level quality upgrading, instead of relying on proxies. While the measure is restricted in the sense that it is a firm indicator variable, it is informative about upgrading over time, which is the interest of the paper. *Second*, a further layer of comparison between firms over time relates to the fact that many firms innovate in *process* but do not upgrade product *quality*, which allows for separation of different types of innovation. *Third*, for many firms, the data allows information on the product that received the quality treatment to be exploited, which is an important aspect in case of multi-product firms. *Fourth*, in the period under analysis, a major and unexpected exchange rate devaluation provides an exogenous source of variation to investigate producer price responsiveness to the shock. *Fifth*, the paper also makes use of linked employer–employee data with workers' characteristics to evaluate skill upgrading in addition to product quality upgrading. Hence, the richness of the combined data makes it possible to study within-firm adjustments over time. Finally, the period under analysis provides an ideal empirical setting, as innovation efforts seem particularly important for incumbent firms. Firms' efforts to increase product quality were 30% higher in comparison to later years and export orientation was the main determinant of product innovation (Kannebley et al., 2005).<sup>5</sup> Moreover, in this period, among firms that traded exclusively with Mercosur (Southern) countries, only six of them reported high efforts to increase product quality to meet foreign consumer requirements (PINTEC, 2000). This low number already suggests that firms upgraded quality to export to high-income destinations.

The most significant weakness of the paper is the fact that I work with a very particular set of firms: Permanent exporters that are present in high and low-income destinations, such that I can identify quality and price changes across markets in a difference-in-differences approach. This implies that the effect is not representative of the population of firms. To partially address this issue, I investigate the extensive margin

of export destinations following quality upgrading. The results suggest an important role of upgrading on export entry in high-income destinations.

## 2. Literature

This paper is related to a broad literature investigating the relationship between quality, prices and trade. Virtually every empirical paper studying trade prices predicts a positive relation between a country's income per capita and average trade prices, suggesting that high-income countries consume and produce goods of higher quality.<sup>6</sup> With the availability of firm-level data, many papers have uncovered several dimensions of firm-product price heterogeneity. Martin (2012), Manova and Zhang (2012), Bastos and Silva (2010), and Goerg et al. (2010) document systematic export price variation across destination countries, in some cases even within firms, and attribute this variation to quality sorting and markups.<sup>7</sup> However, export values and quantities (used in general to proxy for quality) are also influenced by several factors other than quality. Therefore, with the data at hand it has not been possible to establish the determinants of price variation across destinations. One exception in the literature regarding quality data refers to Crozet et al. (2012), who use quality ratings of French wine. Using detailed cross-sectional data for the Champagne industry, they find that firms ranked as high-quality producers charge higher prices and export more to a larger number of markets. While they are interested in the variation across firms in a cross-section, I am interested in the variation *across countries* and *over time*, which allows me to control (among other things) for firm unobserved heterogeneity.

The paper is also related to the literature investigating product quality, wage inequality, and the gains from trade in developing economies. Recent studies for Latin-American economies argue that firms upgraded quality to high-income destinations following trade liberalization, whereas sales to domestic markets and neighboring low-income countries remained of low quality. Using data for Mexican and Argentinean firms, respectively, Verhoogen (2008) and Brambilla et al. (2012) suggest that exporters adjust product quality and/or markups to high-income destinations. I build on a similar argument for the Brazilian economy, although the approach differs in directly considering producer quality information and price data over time.

On supply side effects, the paper is related to a well-documented literature that takes the Alchian and Allen hypothesis (Alchian and Allen, 1964) as a starting point. The quality-sorting patterns I find are consistent with the Alchian and Allen hypothesis, because firms charge higher prices in more distant and richer destinations. However, concerning distance, I show that my results also hold for countries with varying income for a given distance (results reported in robustness checks). Exploiting supply-side effects of quality production in a Ricardian general equilibrium model, Sutton and Trefler (2016) investigate how quality capabilities affect per capita income of a country and the mix of its exports. Moreover, Lileeva and Trefler (2010) and Bustos (2011) investigate how improved access to foreign markets encourages firms to innovate; although these papers do not explicitly account for quality upgrading, the fixed investment costs in innovation and R&D may correspond to higher fixed quality investments. In my paper, part of the results may be explained by the fact that some firms incur a fixed cost to innovate and increase product quality. However, an important part of the results is driven by demand-side considerations. Therefore, I relate to the literature on vertical differentiation and demand-side effects that allow individual preferences to vary across

<sup>4</sup> The first phase of trade liberalization occurred mainly until 1995, when tariffs fell from an average of 29% in 1991 to zero in 1995. The second (*catch-up*) phase happens when wage and capability differentials create profit incentives for firms to increase product quality (see Sutton (2007) for a discussion on the catch-up phase of trade liberalization in mid-level economies).

<sup>5</sup> The most cited reasons for manufacturing exporters to innovate were to improve product quality (80% of the firms) and to maintain market share (82% of the firms) (PINTEC, 2000). For 86% of the firms, foreign consumers were the main source of information for product development (PINTEC, 2000).

<sup>6</sup> See Schott (2004), Hummels and Klenow (2005), and Hallak (2006). These results are supported by Khandelwal (2010) and Hallak and Schott (2011), who relax the direct price-quality relation and infer quality from both price and market share data.

<sup>7</sup> Price variation across destinations is also documented in a comparison between domestic and foreign sales. Iacovone and Javorcik (2012) show that firms obtain a price premium in the domestic market one year prior to entry into export markets, which is consistent with the hypothesis that firms upgrade quality to export markets.

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