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Abstract: This paper studies the relationship between firm-level markups and trade status using balance sheet information linked to detailed trade data from Hungary between 1995-2003. We find that importing is strongly positively correlated with markups both across and within firms. We argue that this correlation can reflect three channels: self-selection, higher physical productivity resulting from access to a larger variety of inputs and quality upgrading based on high-quality imported intermediate inputs. We present evidence for the relevance of the latter channel by showing that the markup premium is higher when inputs arrive from developed countries and that importing is correlated with higher quality exports. We find limited evidence for exporter premium when controlling for importing. We argue that the small exporter premium results from the stronger competition in export markets relative to domestic ones. Our results strengthen arguments for policy focusing on promoting imports as a source of increased firm-level competitiveness.

Keywords: markup premia, detailed trade data, quality, self-selection

JEL Classification: D22, D24, F14, L11, L60

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1 Introduction

A large body of empirical work has shown that trading firms are larger and more productive than non-traders (Bernard and Jensen, 1995). More recent literature has found that firms importing intermediate inputs are also more productive, larger, charge higher prices and pay more for imported goods (Halpern, Koren and Szeidl, 2015; Kugler and Verhoogen, 2009). A growing body of research has started to study the relationship between trade status and markups, a key measure of competitiveness. On the one hand, De Loecker and Warzynski (2012) and Bellone, Musso, Nesta and Warzynski (2014) have provided evidence that exporters also have higher markups than non-exporters. On the other hand, Marin and Voigtländer (2013), in contrast, found no markup premia for exporters.

Our paper aims to contribute to this literature by handling exporting and importing in a symmetric way when estimating markup premia and document some of the channels behind these premia. Handling the two trade activities symmetrically turns out to be important, because they are highly correlated and our results show that exporters' premium disappears when we control for importing. For this exercise, we use Hungarian balance sheet and disaggregated trade data and rely on a simple model which includes the possible channels to guide our empirical exercise. We calculate markups at the firm-year level from the balance sheet data following De Loecker and Warzynski (2012).

We find robust and consistent evidence for a markup premium of importers in the different specifications. We present a simple variable markups model following Melitz and Ottaviano (2008) and Antoniades (2015) to incorporate the possible channels which may drive this relationship. The first channel is the self-selection of more physically productive firms into importing under a fixed cost of importing (such a fixed cost is also assumed in the outsourcing literature, see Antras, 2015). Second, the access to a larger variety of intermediate inputs can increase the firm's physical productivity (Halpern et al., 2015). Finally, importing intermediate inputs may help firms in upgrading their quality level (Kugler and Verhoogen, 2012; Atkin et al., 2015; Kugler and Verhoogen, 2009). If increased quality rotates out the demand curve, importing firms face a less elastic demand and will charge higher markups.

Our database does not allow us to directly quantify the importance of these mechanism and we are only able to provide somewhat indirect evidence about the role of different channels. Our first approach compares premia estimated from cross-sectional and panel regressions. The cross-sectional importer premium may include all three channels while within-firm and event study evidence may isolate the two latter channels. We find a cross-sectional premium of about 4-5 percent compared to 2-2.5 percent within-firm. Thus, self-selection may explain about half of the cross-sectional premium. We also present evidence for the relevance of the quality channel, using a similar strategy as Bas and Strauss-Kahn (2015).

In particular, we show that the importer markup premium is larger when the imported intermediates arrive from developed countries, which are likely to specialize in higher quality intermediate good production. We also use finely disaggregated trade data to demonstrate that starting to import is associated with an increase in the quality of exported products. Similarly to the markup premium, this effect is stronger when the import comes from a developed country. These results - albeit indirectly - demonstrate that, besides the increase in productivity, the quality upgrading channel may play an important role in the markup premium.

In contrast to importing, our results show no robust evidence for a markup premium for exporters. This result qualifies existing findings of exporters' markup premia (De Loecker and Warzynski, 2012) but is in line with some event-study type evidence (Marin and Voigtländer, 2013). We argue that the lack of exporters' premium may result from the lower prices charged on the foreign market either because of stronger competition on those markets or dynamic pricing considerations, as suggested by Marin and Voigtländer (2013).

Our paper contributes to the literature that studies the effects of importing on firm performance. This literature has mainly focused on the relationship between importing and productivity and established that the TFP premium from importing intermediate inputs proves to be at least as important as the productivity premium from exporting (Manova and Zhang, 2012; Amiti and Khandelwal, 2013; Fan, Li and Yeaple, 2015). Kasahara and Rodrigue (2008), for example, showed that starting to import intermediate goods led to a productivity increase in Chile. The productivity premium of importers, and especially two-way traders, is found to be large by Smeets and Warzynski (2013) for Denmark and Vogel and Wagner (2010) for Germany. Amiti and Konings (2007), Topalova and Khandelwal (2011), and Goldberg, Khandelwal, Pavcnik and Topalova (2010) document the productivity-increasing effect of import liberalization episodes. A key contribution to this literature is Halpern, Koren and Szeidl (2015), who have built a model in which importing each intermediate input requires some sunk cost, but using more high-quality imported intermediate inputs leads to increased productivity. These authors confirm the predictions of this model using the same Hungarian firm-level data that we analyze in this paper. Kasahara and Lapham (2013) uses a similar framework of simultaneous choice between exporting and using imported intermediaries, and test the predictions on Chilean firm-level data. As we will discuss, the TFP estimated in these models is revenue TFP, which is strongly related to markups. Indeed, revenue TFP is mainly related to physical productivity via markups. In this sense, our work strongly complements this line of research.

Closely related to our work, a small but growing literature has analysed the relationship between importing and markups. For example, when analysing India's trade liberalization De Loecker, Goldberg, Khandelwal and Pavcnik (2016), show that input tariff liberalization leads to higher markups, because the pass-through of lower production costs to prices is incomplete.

Our paper emphasizes that quality upgrading, rather than only physical productivity differences, can play a role in importers' markup premium, which has also been argued for by other authors. A mechanism for how input quality affects productivity is proposed in Kugler and Verhoogen (2012) in a heterogeneous firm model framework, in which firms can choose both inputs and outputs endogenously. Atkin, Chaudhry, Chaudry, Khandelwal and Verhoogen (2015) show that soccer ball producers in Pakistan who charge higher markups also produce higher quality balls and buy more expensive inputs. The results of Kugler and Verhoogen (2009) suggest that importing is potentially a key source of higher quality inputs. In this paper we provide suggestive evidence for a large set of firms that importing indeed helps in producing higher quality outputs, for which they can charge higher markups. Close to our approach, Bas and Strauss-Kahn (2015) uses Chinese transaction-level data to show that a decrease of import tariffs is associated with an increasing unit value of Chinese exports. Similarly to our results, this increase proves to be larger for firms sourcing inputs from developed economies and exporting output to high-income countries.

Our simple theoretical framework builds on variable markup models and all our results strongly suggest that pass-through is incomplete. A line of literature develops heterogeneous firm models with a variable markup by departing from the CES utility function.[1] The influential paper of Melitz and Ottaviano (2008) develops a general framework with a quadratic utility function and monopolistic competition in which markups in export markets differ systematically because of different competitive conditions. Mayer, Melitz and Ottaviano (2014) have expanded this model to multi-product firms to generate new predictions on the product mix of exporters.

Our paper contributes to these strands of literature in three respects. First, we use a high-quality dataset from an emerging country to provide additional evidence on markup and TFP premia of exporting and importing firms. Importantly, we have information both about exporting and importing, and we can account for these two activities simultaneously. Our result that exporters' premium disappears after controlling for importing shows that these two decisions are better treated in a simultaneous way. Second, we provide a simple theoretical framework incorporating the channels suggested by the different lines of literature to explain importers' and exporters' premia systematically. Notably, this framework distinguishes between channels which work through higher physical productivity and those which affect markups directly, via stronger competition and higher quality. Third, we provide some additional evidence for the possible importance of the latter channel in the case

[1] See e.g. Krugman (1979), Melitz and Ottaviano (2008) with quadratic utility function, and Feenstra and Weinstein (2010) or Novy (2013) with Translog expenditure function.

of importing by demonstrating that the importer premium is heterogeneous with respect to source countries and by showing directly that starting to import is associated with quality upgrading of exported products.

Our paper also faces a number of limitations. First, we can only measure markups at the firm-year level and cannot calculate firm-product or firm-market level markups. Furthermore, we have no information to estimate marginal costs or physical productivity. This limitation precludes us from investigating the different channels in a more direct way. Second, our analysis is not guaranteed to yield causal effects. Even within-firm and event study regressions may suffer from the endogeneity of entry - hence the results can mostly be interpreted as correlations rather than causal effects. Still, the consistency and robustness of our results makes us confident that the patterns we have uncovered reflect important empirical regularities. Third, our paper focuses only on one country, hence external validity may be limited. Indeed, some of the results may reflect the characteristics of very open emerging countries where imported inputs are a key source of quality upgrading and export markets are more competitive than domestic ones. This may not be the case for the most developed countries but can nevertheless provide important policy insights.

The rest of the paper is structured as follows. Section 2 describes our theoretical framework. Section 3 introduces the dataset and presents its most important characteristics as well as the methodology of estimating markups and productivity and provides descriptive evidence on the estimates. In Section 4 we show our main results. Section 5 concludes.

2 Theoretical framework

In this section we describe the possible channels driving the relationship between trading status and markups and present a simple model which incorporates them. First we describe the role of importing followed by that of exporting.

2.1 Importing and markups

Based on the previous literature, we have identified three main channels that can drive the relationship between importing intermediate inputs and markups. First, the outsourcing literature, summarized recently by Antras (2015), has emphasized self-selection into importing based on physical productivity as an important mechanism. The models in this literature follow the logic of the Melitz-model, requiring a fixed cost for trading (outsourcing in this case). Second, via importing, firms may access a larger variety of inputs, which may increase the firms' physical productivity (Amiti and Konings, 2007; Topalova and Khandelwal, 2011; Goldberg et al., 2010; Halpern et al., 2015). In these two channels the relationship between importing and markups runs through higher physical productivity. Importantly, the relationship may work more directly. In particular, importing may enable the firm to produce higher quality products, shifting (and rotating) out the demand curve. This third channel had received somewhat less attention, but there is some recent literature that has documented it convincingly (Kugler and Verhoogen (2012), Atkin, Chaudhry, Chaudry, Khandelwal and Verhoogen (2015), Kugler and Verhoogen (2009) and Bas and Strauss-Kahn (2015)).

Importantly, all the three channels mentioned predict a positive relationship between importing and markups. Here we will present a simple model which incorporates these three mechanisms. In this section, we handle importing and exporting separately but we provide a more symmetric model in Hornok and Muraközy (2015).

2.1.1 Demand

The basic structure of the model follows a partial equilibrium version of the model in Antoniades (2015) and Yu (2013), which, in turn, builds on Melitz and Ottaviano (2008). The main conceptual difference between our approach and that of Antoniades (2015) is that in our case the quality-enhancing will result from importing rather than innovation. In particular, the quality parameter, z_i, will take the value of zero for non-importers and a constant z for importers. Higher quality, in turn, will 'rotate out' the demand curve, making it optimal to charge higher prices and markups.

The utility function of each consumer c is the following:

$$U = q_0^c + \alpha \int_{i\in\Omega} (q_i^c + z_i)\, di - \frac{1}{2}\gamma \int_{i\in\Omega} (q_i^c - z_i)^2\, di - \frac{1}{2}\eta \left(\int_{i\in\Omega} \left(q_i^c - \frac{1}{2} z_i \right) di \right)^2, \qquad (1)$$

where q_0^c and q_i^c are consumed quantities of the numeraire good and variety i ($i \in \Omega$), respectively, and α, γ and η are positive demand parameters. γ, in particular, shows consumers' valuation of quality.

This yields a linear market demand system for each variety i that is consumed in a market with L consumers[2] (this set of products is denoted by $\Omega^* \subset \Omega$):

$$q_i \equiv L q_i^c = \frac{\alpha L}{\eta N + \gamma} - \frac{L}{\gamma} p_i + L z_i + \frac{\eta N}{\eta N + \gamma} \frac{L}{\gamma} \overline{p} - \frac{1}{2} \frac{\eta N L}{\eta N + \gamma} \bar{z}, \qquad (2)$$

where N is the measure of consumed varieties, $\overline{p} = (1/N) \int_{i\in\Omega^*} p_i di$ is their average price and $\bar{z} = (1/N) \int_{i\in\Omega^*} z_i di$ is the share of importing firms.

Consumers only consume products for which

$$p_i \leq \frac{1}{\eta N + \gamma} (\gamma\alpha + \eta N \overline{p} - \gamma\eta N \bar{z}) \equiv p_{max}, \qquad (3)$$

[2] Here we will take market size as given - in reality it may depend on whether the firm exports, as we show in Hornok and Muraközy (2015). The simultaneous modeling of the two decisions, however, does not change the main features of the model besides emphasizing the complementarity between importing and exporting.

where p_{max} is the price where demand is driven to 0 for a product with $z_i = 0$, i.e. for non-importing firms.

2.1.2 Firm behavior

For simplicity, the wage level is set to unity. The model is one of monopolistic competition: differentiated goods producers take the number of firms and prices as given.

Production exhibits constant returns to scale: each firm can produce one unit of output at marginal cost c (i.e. physical productivity is $1/c$). c represents realizations of a random draw from a common distribution $G(c)$ as in Melitz and Ottaviano (2008). To allow for self-selection, as in Antras (2015), we assume that importing requires a fixed cost, denoted by f^I. This is motivated by the very plausible entry costs of building capacity for importing and finding foreign sellers and also by the robust observation that only a minority of firms import directly.

The productivity-enhancing effect of importing will be represented by the parameter ζ, showing the effect of importing on marginal cost. Under these assumptions, the cost function is the following:

$$TC = \begin{cases} cq & \text{if not importing} \\ (c-\zeta)q + f^I & \text{if importing} \end{cases} \tag{4}$$

Let $c^D = p^D_{max}$ be the cost level when such a firm is indifferent between entering the market and exiting.

When the firm does not import (denoted by NI), its profit and markup are:[3]

$$\Pi^{NI}(c) = \frac{L}{4\gamma}(c^D - c)^2 \tag{5}$$

$$\mu^{NI}(c) = \frac{1}{2}(c^D - c) \tag{6}$$

Under importing (I), the firm will have to pay the fixed cost but will be able to produce with a lower marginal cost and will face a higher demand. The profit and markup are:[4]

$$\Pi^I(c) = \frac{L}{4\gamma}(c^D - c)^2 + \frac{L}{4\gamma}[(\zeta + \gamma z)^2 + 2(c^D - c)(\zeta + \gamma z)] - f^I \tag{7}$$

$$\mu^I(c) = \frac{1}{2}(c^D - c + \zeta + \gamma z) \tag{8}$$

Firm i will import if $\Pi^{NI}(c) \leq \Pi^I(c)$. This inequality is linear in c and yields:

$$c \leq c^D + \frac{1}{2}(\zeta + \gamma z) - \frac{2\gamma}{L(\zeta + \gamma z)}f^I \equiv \bar{c} \tag{9}$$

[3] Its price and quantity are $p(c)^{NI} = \frac{1}{2}(c^D + c)$ and $q^{NI}(c) = \frac{L}{2\gamma}(c^D - c)$, respectively.

[4] Its price and quantity are $p(c)^I = \frac{1}{2}(c^D + c - \zeta + \gamma z)$ and $q^I(c) = \frac{L}{2\gamma}(c^D - c + \zeta + \gamma z)$, respectively.

Intuitively, $\frac{1}{2}(\zeta + \gamma z)$ represents the benefit of importing, i.e. lower cost and higher demand, while f^I is its (fixed) cost. More physically productive firms (with lower c) self-select into importing. The threshold cost for importing is increasing (threshold productivity decreasing) in market size (L), the cost advantage (ζ), the quality advantage (z) and the higher customer valuation of quality (γ) while it is decreasing in the fixed cost of importing. Note that the fact that larger market size is associated with a higher cost threshold suggests a complementarity between importing and exporting: the larger market served by exporters implies a higher (cost) threshold for importing.

In this model, combining (6) and (8), the markup function is the following:

$$\mu(c) = \begin{cases} \frac{1}{2}(c^D - c) & \text{if } \overline{c} < c \leq c^D \\ \frac{1}{2}(c^D - c) + \frac{1}{2}(\zeta + \gamma z) & \text{if c} \leq \overline{c} \end{cases} \tag{10}$$

2.1.3 Empirical consequences

In our empirical exercise, first we will show that importers, indeed have a markup (and TFPR) advantage in a pooled cross-sectional setting in the order of 4-5 percent. In order to separate pre-existing productivity differences (differences in c), we will run panel models to show that starting to import is associated with a markup increase of about 2-2.5 percent. This suggests that self-selection may be responsible for about half of the importers' premium while productivity and quality upgrading may be responsible for the other half.

Our data do not allow us to decompose the increase in markups into the contributions of increased productivity and quality. However, to study whether quality may play a role, we run two sets of additional regressions. First, we show that importers' markup premia are significantly larger when importing from developed countries, in line with the hypothesis that such imports help in producing higher quality products. Second, we run an auxiliary analysis on export unit values to show that starting to import, especially from developed countries, is indeed associated with higher quality of the exported goods. We conclude that all three channels may play a significant role in the markup premium of importers.

2.2 Exporting and markups

When considering the relationship between exporting and markups, two channels are to be taken into account. First, more physically productive firms tend to self-select into export markets. This channel predicts a positive relationship between exporting and markups. Second, export markets may be more or less competitive than the domestic market. If, for example, the foreign market is more competitive, domestic exporters may have to lower their markups to remain competitive there or they may choose to rely on dynamic pricing strategies, charging lower prices to build up a customer base. As a result, the average firm markup measured from balance sheet data, conditional on physical productivity, may be lower for exporters than for non-exporters. Empirically, we find that the positive relationship from the first channel is roughly counterbalanced by the second, resulting in no markup advantage for Hungarian exporters.

2.2.1 Theoretical framework

We may model these channels by extending the previous model to a two-country case, but abstracting away from the possibility of importing inputs. We assume that the foreign country (F) is larger than the domestic (D), hence $L^F > L^D$. The larger size of the foreign market implies increased competition, higher quality and more entry in the general equilibrium version of the Antoniades (2015) model. Consequently, we can also assume that $\overline{p}^F < \overline{p}^D$ and that $N^F \geq N^D$. These assumptions are quite reasonable in our empirical investigation, in which we study a small country with a lower average quality level than its main trade partners. According to Equation (3) these assumptions imply that $p^F_{max} < p^D_{max}$.

When exporting, firms pay iceberg-type transportation costs, $\tau > 1$, and so the unit cost of delivering becomes τc. Let $c^F = p^F_{max}/\tau$ denote the cost level of firms that are indifferent to entering the foreign market. Since $p^D_{max} > p^F_{max}$ and $\tau > 1$, $c^D > c^F$. This implies the self-selection of more (physically) productive firms into the foreign market.

Under these assumptions, firms will charge $p^F(c) = \frac{\tau}{2}(c^F + c)$ in the foreign market, while the quantity produced will be $q^F(c) = \frac{L^F}{2\gamma}\tau(c^F - c)$. The firm-level markup of domestic exporters will be the (quantity) weighted average of the markups on the two markets:

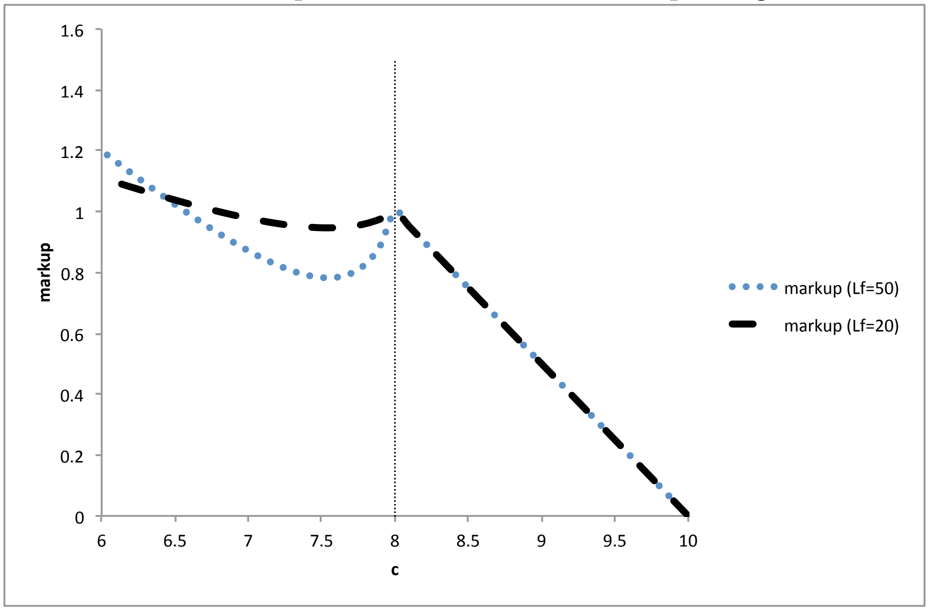
$$\mu^E(c) = \frac{L^D(c^D - c)^2 + L^F\tau^2(c^F - c)^2}{2L^D(c^D - c) + 2L^F\tau(c^F - c)} \tag{11}$$

Given (8) and (11) the markup function can be written as:

$$\mu(c) = \begin{cases} \frac{1}{2}(c^D - c) & \text{if } c^F < c \leq c^D \\ \frac{L^D(c^D-c)^2+L^F\tau^2(c^F-c)^2}{2L^D(c^D-c)+2L^F\tau(c^F-c)} & \text{if } c \leq c^F \end{cases} \tag{12}$$

This relationship is illustrated by Figure 1, with the threshold cost level for export, $c^F = 8$. Let us start from $c = 10$, the threshold to enter the domestic market. Between $c = 8$ and $c = 10$, markups increase linearly as c decreases. The function, however, is U-shaped below the threshold cost level c^F. The intuition is the following. Take a firm with a very low export share. A fall in the marginal cost will rapidly increase the firm's export intensity and, hence, the weight of the more competitive market in its average markup. True, the markups in both markets increase, but this is counterbalanced by the increasing share of the more competitive market. This is not the case for a firm with an already large export share.

Figure 1: Firm level markup as a function of c with exporting threshold $c^F = 8$



Notes: The figure illustrates the markup function in Equation (12) when exporting is possible. The parameters are: $c^D = 10$, $c^F = 8$, $L_D = 10$, $\tau = 0.8$.

For such firms, the increase in markups on both markets will dominate the (relatively small) composition effect.[5]

This model predicts two countervailing channels behind the export-markup relationship: while self-selection implies higher markups for exporters, the composition effect predicts a non-linear relationship. The relative strength of these channels depends on the difference in competition between the markets and their relative sizes. If the foreign market is large and

[5]This is actually always the case if the difference between the size of the two countries is not extreme, i.e. $p^F_{max} > p^D_{max}\tau/2$. The numerator of the derivative of $\mu^E(c)$ is $\left[-2(L^D)^2 + 2L^D L^F \tau\right](c^D - c)^2 + \left[-2(L^F)^2\tau^3 + 2L^D L^F \tau^2\right](c^F - c)^2 - 4L^D L^F \tau(1+\tau)(c^D - c)(c^F - c)$. This can be rewritten as $\mu^{E'}(c) = -2\left(L^D + L^F\tau\right)\left(L^D + L^F\tau^2\right)c^2 + 4\left(L^D c^D + L^F \tau c^F\right)\left(L^D + L^F \tau^2\right)c - 2\left[\left(L^D c^D + L^F \tau c^F\right)\left(L^D c^D + L^F \tau^2 c^F\right) - L^D L^F \tau\left(c^D - c^F\right)\left(c^D - \tau c^F\right)\right]$. We will prove that this quadratic function is increasing from a negative value at $c = 0$ to a positive value at $c = c^F$, and hence, the markup function is U-shaped in this interval. Plugging in $c = 0$ yields negative number under our assumption that $p^F_{max} > p^D_{max}\tau/2$. Plugging in $c = c^F$ yields a positive derivative because under our assumption that $L^F > L^D$, $-2(L^F)^2\tau^3 + 2L^D L^F \tau^2 > 0$ in the first form of the derivative. Finally, one can calculate the roots of the derivative function. This takes the form $c_{1,2} = \frac{L^D c^D + L^F \tau c^F}{L^D + L^F \tau} \pm \sqrt{\frac{(L^D c^D + L^F \tau c^F)^2}{(L^D + L^F\tau)^2} - \frac{(L^D c^D + L^F \tau c^F)(L^D c^D + L^F \tau^2 c^F) - L^D L^F \tau (c^D - c^F)(c^D - \tau c^F)}{(L^D + L^F\tau)(L^D + L^F\tau^2)}}$. The first term is a weighted average of c^D and c^F, so it is larger than c^F. This means that the second root is also larger than c^F, hence only the first root can be within $[0, c^F]$ interval. The fact that the derivative function takes a negative value at the lower end of the interval and a positive on the upper end implies that the first root is within this interval. All in all, the $\mu^E(c)$ function is U-shaped in the interval with a minimum.

competitive relative to the domestic one, the composition effect may dominate.

2.2.2 Empirical consequences

Similarly to the import case, we start with documenting cross-sectional differences. We show that, when controlling for importing, exporters have no significant premium in terms of markups. Panel methods yield mixed results with point estimates close to zero. These patterns imply that the composition effect counterbalances self-selection in the case of Hungarian exporters.

3 Data and methods

3.1 Data

Our database consists of the universe of Hungarian manufacturing firms with more than 5 employees in the years between 1995 and 2003. It combines data from the firms' balance sheets and earnings statements and detailed export and import data from the Hungarian Customs Statistics.

In the balance sheet and earnings statement data we observe, by each firm, total revenue, export revenue, number of employees, the value of tangible assets, various cost measures including expenditures on labor and material inputs, as well as the ownership structure (foreign-owned, domestic state-owned, domestic privately owned). We do not observe product and factor input prices or quantities, although the average wage per employee can be calculated.

The Customs Statistics report data on essentially all export and import flows, both as value and quantity, of each firm by 6-digit HS (Harmonized System) product category, partner country and year.[6] We identify imports of intermediate inputs as the imports of products that belong to the relevant BEC (Broad Economic Categories) codes.[7]

We also clean the export flows of firms in order to eliminate possible carry-along export activities or sales of irregular items, such as capital goods. We measure a firm's export sales as total exports of goods that belong to the firm's core export profile, where we define the core profile as the two-digit industry in which the firm generates the largest export revenue during the sample period.

[6] To avoid classifying small irregular cross-border transactions as genuine foreign trade, we disregard exports and imports of individual firms in a given year and 6-digit product under HUF 100,000 (ca. US$ 500 according to the sample period average exchange rate).

[7] BEC codes 111, 121, 21, 22, 31, 322, 42, 53 cover intermediate inputs, as defined by the United Nations.

We also eliminate from the sample firms with state ownership above 10% at any time during the sample period. This makes us exclude 890 unique firms. Pricing decisions of state-owned firms are more likely to have been affected by some form of price regulation, an effect which we want to rule out here.

Furthermore, we exclude firm-year observations with a large amount of processing trade. Firms engaged in processing trade import and re-export intermediate goods after performing a task on them for a fee, while the product remains the property of the foreign party. Prices in such activities may be determined very differently than in the case of non-processing trade, hence including this may bias our estimates. Processing trade is not reported in balance sheet data, but it is part of the customs statistics. Following Halpern, Koren and Szeidl (2015) we capture processing trade as the difference between customs exports and balance sheet exports of a firm, if positive. We drop firm-years where the share of processing trade to total revenue exceeds 5.7%, which is the median share across firms with processing trade. This makes us exclude roughly 8,200 firm-year observations.

Table 1: Descriptive statistics

	Non-trader	Exporter only	Importer only	Two-way trader	Full sample
Number of employees	24.3	29.5	36.1	141.2	69.7
Domestic market share (%)	1.1	1.4	2.7	7.9	3.8
Revenue per employee (mn HUF)	5.5	6.5	8.9	11.6	8.3
Capital per employee (mn HUF)	1.5	2.0	2.6	3.9	2.6
Wage cost per employee (mn HUF)	0.6	0.7	0.8	1.1	0.8
Export intensity (%)	0.0	15.7	0.0	28.8	12.5
Import intensity (%)	0.0	0.0	21.4	32.0	14.4
Foreign-owned share (%)	5.4	8.9	14.3	42.0	20.5
Number of observations	14,709	4,225	4,385	13,791	37,110
Number of firms	4,498	1,989	1,984	3,895	8,629

Notes: All statistics are sample means, mn HUF stands for millions of Hungarian forints. Trading status is determined for firm-year observations. Export intensity is export sales in total revenue, import intensity is expenditure on imported intermediates in the firm's total expenditure on intermediate inputs. Domestic market share is the revenue share of a firm within the domestic (4-digit) industry. Numbers of firms by status add up to more than the number of unique firms in the full sample due to firms switching status.

Table 1 reports descriptive statistics by trading status for our final estimation sample. A firm-year observation is an exporter (importer) if the firm exports (imports intermediates) in that year. Trading firms are larger, both in terms of employment and revenue market share, they are more productive in terms of revenue per employee, more capital-intensive and pay higher wages than non-traders. Firms that both export and import (two-way traders) are by far the largest, and trade more intensively than others. The share of exports in their sales revenue (export intensity) and the share of imported intermediate inputs in their total expenditure on intermediate inputs (import intensity) are considerably larger than for firms that either export only or import only. Finally, the prevalence of foreign ownership is also associated significantly with the firm's involvement in international trade.

3.2 Estimation and interpretation of markups and TFPR

We estimate the total factor productivity (TFPR) and the markup of the firm jointly following De Loecker and Warzynski (2012). The method of estimating TFPR relies on structural production function estimation in the spirit of Levinsohn and Petrin (2003) and, more closely, Ackerberg, Caves and Frazer (2015). The markup estimate is based on the insight of Hall (1986, 1988) that, for a cost-minimizing producer, markup equals the ratio of the output elasticity of a variable input free of adjustment costs to the input's expenditure share.

As our baseline, we take a value added Cobb-Douglas production function to obtain estimates for TFPR and the output elasticity of the inputs. We take labor as the flexible input and, hence, measure the markup as the ratio of the estimated output elasticity of labor (which in the Cobb-Douglas case equals the labor coefficient in the production function) and the share of expenditure on labor from total revenue. We detail this procedure in Appendix A.

A key characteristic of this procedure is that markups are estimated from balance sheet data. As a result, we have one markup per firm-year. Unfortunately, we have no information on how a firm's markup varies across products and markets - that would require cost and sales data at the firm-product-market level.

Another important characteristic of our approach is that the variation in the estimated markups stems mainly from the variation in the expenditure share of the flexible input (here labor). This is because our output elasticity estimates vary only by industry, while the expenditure share varies by firm and year. Moreover, in our markup analysis below we always control for industry-year fixed effects, which absorbs the variation from the output elasticity. Hence, a firm with a smaller expenditure share on labor is estimated to have a higher markup. The dynamics of markups, in this sense, mirror the dynamics of wages and employment at the firm level. Note that this feature has the advantage that possible biases in the production function estimation do not influence the (within-industry) variation of the markup. As a robustness check we also estimate TFPR and markup based on a value added Translog production function (see more in Appendix A). In the Translog case the estimated output elasticity also depends on the labor and capital use and hence varies by firm and year.

An alternative would be to use a gross output production function and material share to estimate markups, because material share is probably more flexible than labor. This method raises a number of (mostly practical) problems. First, when estimating the VA production function, we use material expenditure as a proxy for productivity shocks to handle endogeneity issues. In the gross output case, material expenditure is also an input, and we would have no other proxy (i.e. price of materials) to reliably identify productivity. Second, material use seems to change suspiciously and non-randomly after different changes in the tax law[8].

Markups and TFPR are estimated very differently and they are also often interpreted as quite distinct objects. They, however, may not measure very different things.

Traditionally, TFPR has often been interpreted as a measure of the firm's physical productivity. TFPR is, however, usually measured in terms of output or value added rather than in terms of physical units. This revenue TFP differs substantially from physical productivity, because it includes prices besides physical efficiency (Foster et al., 2008; Marin and Voigtländer, 2013).

In particular, as shown by Marin and Voigtländer (2013), revenue TFP can be decomposed in the following way. Let us denote the physical productivity of firm i with A_i and its marginal cost by $MC(A_i, \mathbf{w_i})$, where $\mathbf{w_i}$ is the vector of input prices. Under Hicks-Neutrality, TFPR is the product of prices and physical productivity, while prices, in turn, are the product of marginal cost and markup:

$$TFPR_i = p_i A_i = \mu_i MC(A_i, \mathbf{w_i}) A_i \tag{13}$$

Marin and Voigtländer (2013) shows that, under constant returns to scale and given input prices, one can assume that marginal cost can be separated[9] into a function of input prices and physical productivity: $MC(A_i, \mathbf{w_i}) = \frac{\phi(\mathbf{w_i})}{A_i}$, i.e. the marginal cost is inversely proportional to physical productivity. As a result,

$$TFPR_i = \mu_i \phi(\mathbf{w_i}) \tag{14}$$

TFPR is the product of two terms: markups and factor prices.

This decomposition yields three key insights. First, TFPR is only related to physical productivity via higher markups. Estimated markups should reflect differences in physical productivity as much as TFPR.

Second, the difference between the levels of markup and TFPR premia should mostly result from differences in factor prices. If, for example, TFPR premia of exporters is higher than their markup premia, then this may indicate higher input costs, most likely wages, paid by exporters rather than non-exporters.

[8]Changes in regulations on what to consider material cost affected material expenditures greatly in 2000. Also, many firms 'outsourced' labor 'entrepreneurs' (a one-man janitor firm) because of tax reasons. Such practices have different prevalence for more and less productive firms and changed with changes in the regulations.

[9]Proof for this is in the online Appendix A.1 of the most recent version of Marin and Voigtländer (2013), available at `www.anderson.ucla.edu/faculty/nico.v/Research/Exporting_Efficiency_Online_Appendix.pdf`. Part A.2 of this Appendix also shows that deviations from constant returns to scale introduce only a limited bias to this decomposition.

Third, when the identification is within-firm, one may assume (following Marin and Voigtländer, 2013) that changes in input prices are orthogonal to changes in the trade status. If this is the case, then TFPR and markup premia estimated within firm may reflect very similar quantities. In this respect, within-firm TFPR changes can, to some extent, be interpreted as a measure of markup changes. Importantly, markup and TFP measures are identified very differently, hence finding similar premia in these measures is an important sign of the robustness of our findings.

3.3 Estimated markups

We find that the median firm in our sample charges around 23% markup over marginal cost (Table 8 in the Appendix).[10] Our median markup estimate is comparable to the estimates of De Loecker and Warzynski (2012) on Slovenian and De Loecker, Goldberg, Khandelwal and Pavcnik (2016) on Indian data.[11]

The estimated markup is quite stable across the years, showing a slight increase up to year 1998 and then a slow but gradual decline. Clearly, there is considerable variation in markups across industries, which explains ca 10% of the total variation in the firm-year markups. This is not surprising, given that the estimated output elasticity is constant within industries. We find the largest median markup for the production of communication equipment, with the smallest one in wood manufacturing.

Table 2 correlates (within year-industry cells) our preferred markup measure with a number of standard measures of the margins and financial performance of firms, including TFPR, the Price-Cost Margin (PCM), Return on Equity (ROE) and the Profit Margin.[12] The descriptive statistics of these alternative measures are reported in Table 9 in the Appendix.

Our preferred markup estimate is positively and significantly correlated with all these performance measures. Its correlation is very high with the markup estimated from the Translog production function, suggesting that the functional form of the production function does not matter much. It is also positively correlated with TFPR. The correlation coefficient is 0.36, suggesting that TFPR picks up input cost differences besides markup differences (and, probably, the fact that both of these variables are estimated with a fair amount of noise). The other three variables can also be considered as proxies for markups, though they are less able to capture markups on marginal costs and reflect average margins instead. Still,

[10] We clean the markup estimate from outliers below zero or above 10. The occurrence of outliers is very low.

[11] In contrast to our database, which includes privately owned manufacturing firms above 5 employees, the Slovenian data includes all manufacturing firms regardless of size and ownership, while the Indian study uses the Prowess panel of mainly medium-sized firms.

[12] The PCM is calculated by dividing the revenue with variable costs. ROE is after-tax profits over book value of equity. The Profit Margin is the ratio of after-tax operating profit to revenue.

they are frequently used in practice, hence provide an important "reality check" for our markups. Reassuringly, the estimated markups are indeed (relatively) strongly correlated with the PCM and profit margins, which are proxies for markups over average (variable) costs. The correlation is much weaker, but still positive with ROE. This is not surprising - indeed ROE measures return on a fraction of one input, the equity part of capital - hence it is strongly affected by capital intensity and leverage.

Table 2: Correlations of markup and productivity measures

	ln Markup	ln Markup (TL)	ln PCM	ROE	Profit margin	ln TFPR
ln Markup	1.000					
ln Markup (TL)	0.921	1.000				
ln PCM	0.470	0.434	1.000			
ROE	0.150	0.152	0.204	1.000		
Profit margin	0.318	0.273	0.501	0.355	1.000	
ln TFPR	0.362	0.272	-0.076	0.078	0.069	1.000
ln TFPR (TL)	0.263	0.169	-0.145	0.098	0.056	0.798

Notes: Pairwise correlation coefficients within industry-year, N=37,110. All coefficients are significant at 1% significance level. Markup and Markup (TL) are markups, TFPR and TFPR (TL) are revenue productivities estimated from value added Cobb-Douglas and value added Translog production functions, respectively, following De Loecker and Warzynski (2012). PCM is the price-cost margin measured as revenue divided by variable costs. ROE is the return on equity and the profit margin is the ratio of after-tax operating profit to revenue.

4 Results

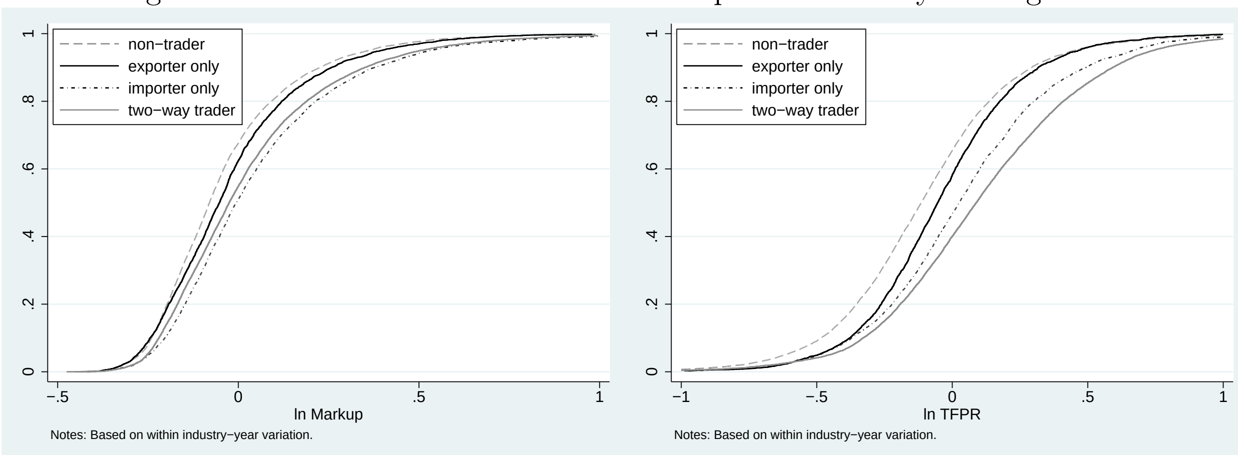
4.1 Cross-sectional analysis

First, let us look at how our markup estimate varies with the trading status of the firm. Figure 2 shows the cumulative distribution of markups and TFPR (as a reference), by trading status after netting out industry trends.

In terms of markups, firms that import intermediate inputs seem to charge higher markups than non-importer firms in the same industry and year. This positive markup premium is larger for firms that only import than it is for two-way traders. In contrast, non-traders and firms that only export have more similar markup distributions. These correlations suggest a strong positive markup premium for importers and a small or nonexistent premium for exporters when importing is taken into account. On a methodological note, this also implies that the measured markup premium of exporters depends on whether we control for import status: the raw exporters' premium may easily be driven by importers' premium.

Figure 2 also shows the distribution of TFPR by trading status. Similarly to markups, importers and two-way traders have significantly higher TFPR than exporters and non-traders. The difference is that exporters only also seem to have a positive TFPR premium relative to non-traders. This may be a result of the higher input, most likely wage, costs of exporters, who are more likely to employ more higly educated employees.

Figure 2: Cumulative distribution of markup and TFPR by trading status



These descriptive patterns are reinforced when we control for key firm characteristics. In particular, we run the following regression equation:

$$y_{it} = \gamma^{\text{im}} D_{it}^{\text{im}} + \gamma^{\text{ex}} D_{it}^{\text{ex}} + \gamma^{x} X_{it} + \delta_{st} + \varepsilon_{it}, \tag{15}$$

where the dependent variable, y_{it}, is either the natural logarithm[13] of markup μ_{it} or of revenue productivity TFPR_{it} of firm i (operating in industry s) in year t. On the right-hand side D_{it}^{ex} and D_{it}^{im} are dummies for the exporting and importing status, respectively. Exporter is a firm-year observation with positive export sales, while importer is a firm-year with positive material imports. Other firm-specific explanatory variables are in X_{it}, δ_{st} denotes the full set of industry-year dummies and ε_{it} is the idiosyncratic error term. As other explanatory variables we include size dummies that are based on the distribution quartiles of the number of employees variable, capital intensity measured by the capital-labor ratio of the firm, and a market share variable that captures the revenue share of a firm in the domestic industry. Firms are classified into the 15 manufacturing industry groups (listed in Table 8) for which the production function was estimated.

Table 3 shows the results for markups. We estimate a positive and significant markup premium for exporters only as long as we do not control for the importer status. One average, exporting firms charge 3.7 percent higher markups, than similar firms selling only domestically in the same industry and year. This estimated premium is largely due to

[13]We have chosen the log specification because of the multiplicative structure of Equation (13). All results are robust to not taking logs.

Table 3: Markup premia of exporters and importers

Dependent variable: ln Markup					
	(1)	(2)	(3)	(4)	(5)
importer dummy	0.073***		0.072***	0.054***	0.042***
	(0.011)		(0.008)	(0.006)	(0.006)
exporter dummy		0.037***	0.001	-0.013	-0.008
		(0.012)	(0.009)	(0.007)	(0.005)
ln market share lagged				0.016***	0.027***
				(0.004)	(0.004)
ln capital-labor ratio					0.068***
					(0.005)
labor quartile dummies					yes
Observations	37,110	37,110	37,110	37,110	37,110
R-squared	0.149	0.134	0.149	0.157	0.314

Notes: Markup is estimated from a value added Cobb-Douglas production function following De Loecker and Warzynski (2012). Market share is the domestic revenue share of the firm within the 4-digit industry. All specifications include industry-year dummies with 2-digit industries. Robust standard errors with 2-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

the fact that most exporters use imported intermediate inputs, and importing firms charge significantly higher markups than non-importers. If we control for the importing status, we get an importer markup premium of 7.2 percent, while the exporter premium disappears (column 3). The importer markup premium is partly explained by the larger market share of the firm in the domestic market, but the premium remains around 5.5 percent even after controlling for domestic market share (column 3). Finally, in column (5) we add size dummies and capital intensity and find a 4.2 percent importer premium.

As a reference, Table 10 in the Appendix shows the results of this exercise when the dependent variable is the logarithm of TFPR. Similarly to markups, we find that importers have higher TFPR both in economic and statistical terms when controlling for both trade activities: importers TFPR premium is about 11-16 percent compared to 3-7 percent for exporters. The exporter premium remains significant (at the 5% level), which may result from their higher input cost.

Table 4 includes a robustness test of our results, using the alternative markup and margin measures in the cross-sectional regression. Reassuringly, using the markup from the Translog production function yields very similar results to the preferred measure estimated from the Cobb-Douglas production function. Similar results are yielded by the PCM and ROE measures: importers tend to have a higher price-cost margin and a better return on equity, while this is not the case for exporters. We do not find a significant relationship between the profit margin and trade status.

One possible concern about these results is whether they are stable over time. It is especially interesting in Hungary, where the economy changed rapidly in the first half of the 1990s. During the 1990s, and especially in the early years of the decade, Hungary could

Table 4: Alternative markup measures and the trading status

Dependent variable:	ln Markup (TL)	ln PCM	ROE	Profit margin
importer dummy	0.037***	0.021***	0.027**	-0.000
	(0.006)	(0.005)	(0.009)	(0.002)
exporter dummy	-0.011**	-0.014***	-0.027*	-0.001
	(0.005)	(0.004)	(0.013)	(0.001)
ln market share lagged	0.021***	0.008*	0.019***	0.001
	(0.004)	(0.004)	(0.004)	(0.001)
ln capital-labor ratio	0.039***	0.031***	-0.020***	0.014***
	(0.012)	(0.003)	(0.003)	(0.001)
Observations	37,110	37,110	37,110	37,110
R-squared	0.494	0.122	0.023	0.054

Notes: Markup (TL) is estimated from a value added Translog production function following De Loecker and Warzynski (2012). PCM is the price-cost margin and ROE is the return on equity. Market share is the domestic revenue share of the firm within the 4-digit industry. All specifications include labor quartile dummies and industry-year dummies with 2-digit industries. Robust standard errors with 2-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

by characterized as a transition economy with episodes of mass privatization and market liberalization while also opening up to trade with "Western" markets. Also, before 1995 the Hungarian currency was repeatedly subject to large devaluations. Our baseline sample period is 1995-2003, hence it excludes the most turbulent years of transition. As a robustness check we replicate our results on the period of 1992-2003, which extends to the early years of transition, and on the shorter period of 1998-2003. This exercise involves a re-estimation of both the production function and equation (15) on the modified samples. We report the estimates for equation (15) in Table 11 in the Appendix. Our main results remain remarkably robust both in qualitative and quantitative terms.

To sum up, the cross-sectional or pooled results suggest that importers indeed have higher markups by about 4 percent than non-importers. This is in line with our expectations, because all three proposed channels point to this direction. We do not find evidence for exporter premium after controlling for importer status - also in line with the countervailing forces of positive selection and stronger competition on export markets. On a methodological note, in this pooled exercise we estimate larger (more positive) TFPR than markup premia both for exporters and importers. Given the theoretical relationship between the two variables, we suspect that the difference results from the wage premium of trading firms.

These results mostly reflect cross-sectional correlation, and as such, cannot distinguish between selection and effect. In the next subsection we will use fixed effects and event study estimators to investigate whether export or import entry has an effect on markups.

4.2 Panel evidence

We use two kinds of within-firm estimators to estimate relationships closer to causal effects. First, we simply estimate equation (15) with firm fixed effects. Second, we use an event study design that looks at the development of markup and TFPR in the years preceding and following the entry of a firm to the import/export market. This approach can handle pre-trends and after-entry dynamics more flexibly than the fixed effects estimator. We consider a window of (-4, 4) years around entries and create event study dummies for both importing or exporting accordingly. The estimating equation for the event study is then

$$y_{it} = \sum_{j=-4}^{4} \gamma_j^{\text{im}} D_{i,t+j}^{\text{im}} + \sum_{j=-4}^{4} \gamma_j^{\text{ex}} D_{i,t+j}^{\text{ex}} + \gamma^x X_{it} + \delta_{st} + \delta_i + \varepsilon_{it}, \tag{16}$$

which differs from equation (15) in that it includes eight-eight dummies for exporting and importing, as well as firm fixed effects, δ_i. We choose the year immediately preceding import/export entry ($j = -1$) as our benchmark and therefore omit this dummy for both exporting and importing from the estimation.[14]

This approach raise two important questions about the sample. First, it is possible that firms that import/export throughout the sample period differ systematically from non-traders and firms that are entering the foreign market. Hence, it may make sense to exclude these "always traders" from the control group. Second, the exporter/importer dummies are identified both from entry and exit. A more conservative way to identify the effect of starting to export/import is to identify only from entry. One way to do this is to exclude firm-years after exit from trading.[15]

The results from fixed effects regressions are reported in Table 5 for the full sample and two restricted samples, one without "always traders" and one without "always traders" and firm-year observations following an exit. We find that starting to import is associated with 2-2.5 percentage increase in markups in all three samples. This estimate is about half of the cross-sectional estimate from column 5 of Table 3 (which includes the same controls). An increase of similar magnitude is suggested by the event study graph on Figure 3, which is based on the second restricted sample. One may carefully conclude that selection into importing may explain about half of the importer markup premium while changes after starting to import represent a similar magnitude.

The fixed effects estimates provide some, though quite weak, evidence for an increase in markups after starting to export. This, however, is not supported by the event study evidence: if anything, starting to export seems to be associated with a decline in markups.

[14] To avoid losing observations, we let observations outside the event window be part of $j = -4$ or $j = 4$.

[15] Controlling for exit with a different dummy yields similar results.

Table 5: Within-firm estimates

	full sample		w/o always traders		w/o always traders & after exit	
Dependent variable:	ln TFPR	ln Markup	ln TFPR	ln Markup	ln TFPR	ln Markup
importer dummy	0.028***	0.021***	0.032***	0.025***	0.030**	0.019**
	(0.003)	(0.006)	(0.004)	(0.006)	(0.013)	(0.007)
exporter dummy	0.011***	0.018**	0.012***	0.015**	0.014	0.006
	(0.003)	(0.006)	(0.004)	(0.006)	(0.009)	(0.007)
ln market share lagged	0.026***	-0.019***	0.030***	-0.021***	0.023**	-0.025***
	(0.006)	(0.006)	(0.008)	(0.005)	(0.008)	(0.004)
ln capital-labor ratio	-0.001	0.034***	-0.006	0.036***	-0.012	0.040***
	(0.016)	(0.004)	(0.020)	(0.005)	(0.028)	(0.006)
Observations	37,110	37,110	20,259	20,259	13,117	13,117
R-squared	0.975	0.880	0.969	0.850	0.972	0.877

Notes: The first restricted sample excludes firms which export or import in all years ("always traders"). The second restricted sample also excludes firm-years after the firm first stopped exporting or importing. TFPR and markup are estimated from a value added Cobb-Douglas production function following De Loecker and Warzynski (2012). Market share is the domestic revenue share of the firm within the 4-digit industry. All specifications include labor quartile dummies, firm dummies and industry-year dummies with 2-digit industries. Robust standard errors with 2-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Overall, similarly to the cross-sectional results, we do not find robust evidence for a markup premium for exporters.

In line with the arguments that TFPR and markup changes measure similar objects in within-firm regressions, TFPR behaves very similarly to markups both in the fixed effects specification and the event study estimation.

We also run fixed effects regressions using the other markup measures, which we report in Table 12 in the Appendix.[16] The results are mixed. First, we find similar results for the Translog markups. Regarding the other measures, the point estimates for importing are always positive but only significant for the Profit Margin. Importantly, the point estimates for exporting are always smaller than for importing, and are never significant.

4.3 Quality upgrading

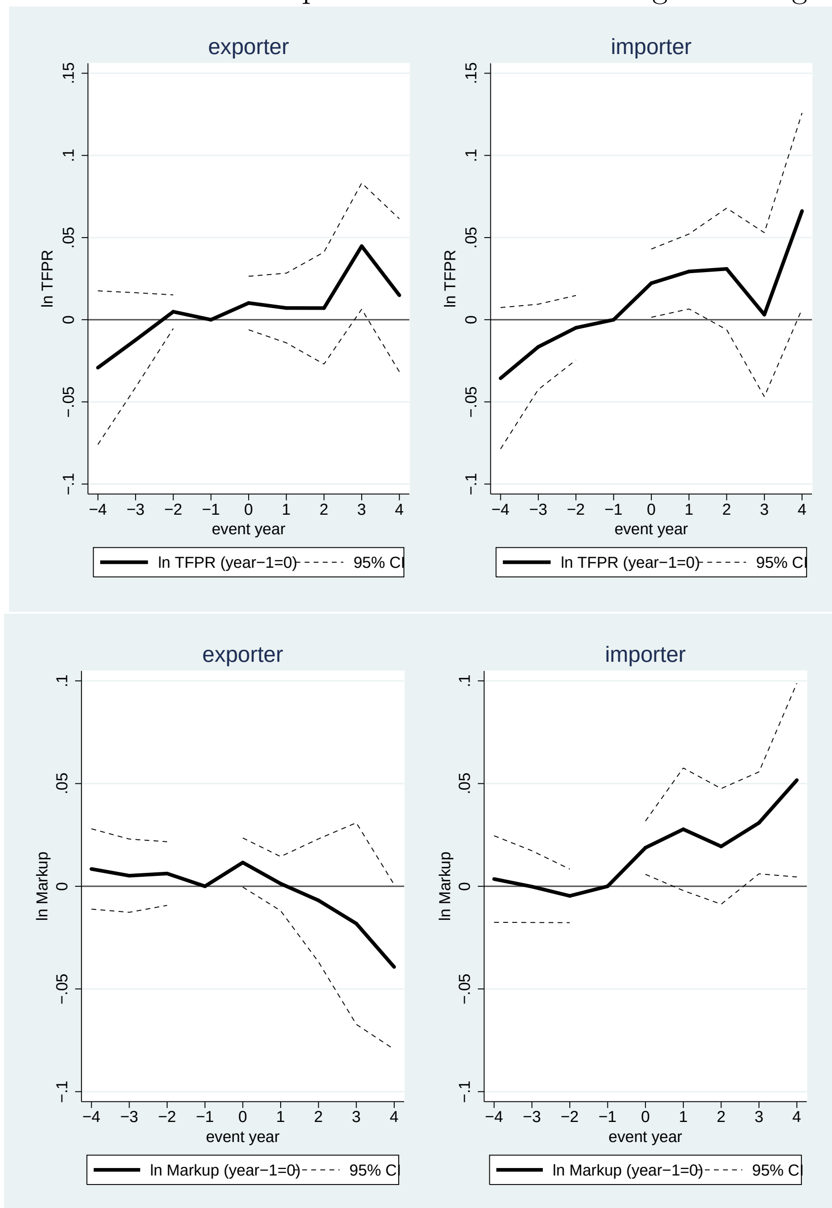
As we have already mentioned, our data do not allow us to fully disentangle the different channels behind the importing-markup nexus. In this subsection, we attempt to provide some indirect evidence for the relevance of the quality upgrading channel. Our main motivation for doing so is that the other two channels are well established in the literature while there is less evidence for the existence of the quality channel.

Our first test is the following. We run the previous markup regressions but distinguish between importing from developed and developing countries.[17] The idea is that developing

[16]Estimation was done on the first restricted sample. If we use the second restricted sample, the point estimates remain similar but lose statistical significance due to larger standard errors.

[17]Developed countries are the 15 countries of the pre-2004 European Union plus Australia, Canada, Iceland,

Figure 3: TFPR and markup before and after entering the foreign market



markets may be a source of cheaper but relatively lower quality inputs (hence they are more likely to affect physical productivity), while more developed markets are likely to specialize in higher quality inputs (and they are more likely to affect markups through quality upgrading). If quality upgrading is an important driver of the importer premium, imports from developed countries may be associated with higher markups than imports from other countries.

In Table 6 we run the pooled and fixed effects regressions but include dummies for the source of imports (developed versus rest of the world). The results suggest that markups are

Israel, Japan, New Zealand, Norway, South Korea, Switzerland, and the United States.

only associated with importing from developed countries, which is in line with the quality upgrading hypothesis.

Table 6: Markup premia and the import market

Dependent variable: ln Markup	(1)	(2)	(3)	(4)
imports from developed dummy	0.038***	0.042***	0.024***	0.023***
	(0.006)	(0.006)	(0.005)	(0.005)
imports from row dummy	0.008	0.009	0.014	0.012
	(0.007)	(0.007)	(0.009)	(0.008)
exporter dummy		-0.010*		0.015**
		(0.005)		(0.006)
firm fixed effects			yes	yes
Observations	37,110	37,110	20,259	20,259
R-squared	0.314	0.314	0.849	0.850

Notes: TFPR and markup are estimated from a value added Cobb-Douglas production function following De Loecker and Warzynski (2012). All specifications include the lagged value of ln market share, ln capital-labor ratio, labor quartile dummies and industry-year dummies with 2-digit industries. Specifications (3) and (4) are run on the restricted sample that excludes firms which export or import in all years (”always traders”). Market share is the domestic revenue share of the firm within the 4-digit industry. Robust standard errors with industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Second, and more directly, we attempt to estimate the relationship between import status and the quality of exported products.

Product quality is not observable directly in trade data and using trade unit values as a proxy has its well-known drawbacks. A key paper in this literature is that of Khandelwal (2010), which proposes estimating quality via estimating a demand function. The underlying idea is the following. Take two products which fall into the same narrow product category. Then the product for which demand is higher, conditional on the price, must be of higher quality. The elasticity of demand is the key variable to estimate, which is usually identified by an instrumental variable strategy. The recent work of Piveteau and Smagghue (2017) estimates firm-product quality by using the import-weighted real exchange rate faced by the exporting firm that also import inputs as an instrumental variable for export prices.

The strategy of Piveteau and Smagghue (2017) has many appealing features and we base our quality estimation on their demand function,

$$\ln r_{igdt} = (1 - \sigma_g) \ln p_{igdt} + \lambda_{igdt} + \delta_{gdt}. \tag{17}$$

The export revenue, $\ln r_{igdt}$, of firm i from good g in country d in year t is a function of the price, p_{igdt}, a term describing relative (within-destination-year) quality, λ_{igdt}, and a term which is constant across firms, δ_{gdt}, capturing product-destination market trends. σ_g is the elasticity of substitution across varieties of good g. The relative quality of firm i's product can be obtained as an estimate for λ_{igdt}.

However, we deviate from Piveteau and Smagghue (2017) in that we do not estimate the price coefficient. We do this because, for our database, their instrumental variable estimation produces very imprecise elasticity estimates. Four characteristics of our data are responsible for this: i) the above instrument is missing or does not vary across non-importers; ii) the number of exporters is relatively small ; iii) the import structure at the firm level is unstable; iv) most Hungarian manufacturing exporters import from EU countries, yielding relatively small variation in the import-weighted firm-level real exchange rate.

Our approach is rather to get consistent estimates for σ_g from the previous literature and simply substitute in these values into the demand function and calculate the λ_{igdt}s. Fortunately, many product-specific estimates are available in the literature. One source is Broda and Weinstein (2006), who estimate the substitution elasticities for imported products in the U.S. Another is Broda, Greenfield and Weinstein (2006), who provide estimates for 73 countries. The latter source enables us to impose elasticities which are also destination-specific.[18] Note that similar strategies have also been used in the literature (Khandelwal et al. (2013), Dingel (2017)).

To see how importing associates with export quality at the firm level, we run the following regression

$$\ln r_{igdt} - (1 - \sigma_G) \ln p_{igdt} = \gamma \mathbf{X}_{it} + \delta_{gdt} + \varepsilon_{igdt}. \tag{18}$$

The expression on the left-hand side is the price-adjusted export revenue and can be calculated from data on the value of export sales, export unit values[19] and the elasticity estimates. The regression runs at the 8-digit HS category. Clearly, elasticity estimates are available for broader product groups (3- and 5-digit SITC in Broda and Weinstein (2006) and 3-digit HS in Broda, Greenfield and Weinstein (2006)), hence the subscript G. In each regression, we control for product-destination market trends (δ_{gdt}) or firm-product-destination fixed effects. $\mathbf{X}_{it}$ includes the importer dummy (also by source country), the capital-labor ratio, a dummy for foreign ownership and the (export-weighted) average GDP per capita of the firm's export destinations. The latter regressors are to control for the possibility that relatively capital-intensive and foreign-owned firms are more likely to sell and tend to export higher quality products than other firms.

We report the estimation results in Table 7 using the elasticity of substitution estimates from Broda and Weinstein (2006) to construct price-adjusted export sales.

Columns (1) and (2) show the pooled results. Importing is very strongly associated with quality: importers sell about 43% more on each market than non-importers when exporting the same product to the same market. This premium results mainly from developed market imports, which are associated with 41% higher price adjusted sales.

[18] When no elasticity estimate is available for a destination country, we use their estimates for the US.

[19] As unit values are typically very noisy, we clean them from outliers as in Piveteau and Smagghue (2017).

Table 7: Export quality and importing

Dependent variable: ln price-adjusted export sales				
	(1)	(2)	(3)	(4)
importer dummy	0.430***		0.141**	
	(0.095)		(0.061)	
imports from developed dummy		0.409***		0.129**
		(0.093)		(0.062)
imports from r.o.w. dummy		0.112		0.105**
		(0.068)		(0.048)
log capital-labor ratio	0.104***	0.097***	-0.014	-0.018
	(0.030)	(0.031)	(0.042)	(0.043)
GDP per capita of export markets	-0.079	-0.053	0.558	0.559
	(0.313)	(0.319)	(0.497)	(0.486)
foreign owned dummy	0.427***	0.407***	0.051	0.041
	(0.067)	(0.068)	(0.081)	(0.087)
firm-product-destination fixed effects			yes	yes
Observations	78,371	78,371	43,927	43,927
R-squared	0.976	0.976	0.996	0.996

Notes: Estimation is done with the reghdfe command in STATA (Correia, 2014). In constructing the dependent variable, we used the σ estimates of Broda and Weinstein (2006) at the 3-digit product level. All specifications include labor quartile and product-destination-year dummies with 8-digit products. Robust standard errors with 4-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Columns (3) and (4) show the estimates from the more demanding specification including firm-product-destination fixed effects. We find that starting to import is associated with a 14% increase in price-adjusted sales. The premium of importing from developed countries (13%) is also somewhat larger than the effect of importing from other countries (10.5%), though the difference is not significant.

These findings suggest that starting to import is, indeed, associated with an increase in quality in export markets. The heterogeneity between developed and other countries is also in line with the results presented in Table 6: developed country imports are the key source of quality and markup improvements.

The results remain robust to using other elasticity of substitution estimates as shown by Table 13 in the Appendix. These include the Broda-Weinstein estimates at the 5-digit SITC product level, the country-specific estimates of Broda et al. (2006) at the 3-digit HS product level and a constant elasticity of substitution set at 5.

To sum up, our investigations have revealed that the importing premia is not only a result of pre-existing differences in productivity. The results in this section provide some evidence that quality upgrading can, indeed, be an important factor behind the markup premium of importers.

5 Conclusions

This paper has investigated the firm-year level markup premia of Hungarian exporters and importers.

We have found strong evidence for both economically and statistically significant premia for importers both in cross-section and within-firm specifications. Comparing the pooled OLS and within-firm estimates revealed that only about half of the cross-sectional premium is explained by pre-importing differences while the other half may result from the productivity improving and quality upgrading effects of importing. We have provided additional evidence in line with the importance of quality upgrading, including demonstrating that the quality (price adjusted sales) of exported products increases after starting to import.

We did not find a consistent markup premium for exporters when controlling for importing. We argue that this may be a result of stronger competition on export markets than in the domestic market.

One consequence of our results is that the raw exporter premium largely arises from the fact that exporters are often also importers. When estimating or modeling the markup of exporters, one should take into account that sourcing decisions are determined by similar factors to exporting.

The premia in terms of markups and TFPR seem to behave very similarly, especially when firm fixed effects are included. In this sense, our work reinforces the argument that levels and especially changes in TFPR are mainly driven by markups (Foster et al., 2008; Marin and Voigtländer, 2013). Changes in physical productivity mainly affect TFPR via markups.

A third message of our work is that not all markup differences are driven by physical productivity. We have argued and provided evidence for two such mechanisms: quality upgrading and differences in competition across markets. These mechanisms seem to be both qualitatively and quantitatively important determinants of markups.

Finally, the markup premium of importers and the lack of it in case of exporters suggest that policy-makers have good reasons to promote access to foreign inputs. The capability of importing firms to raise their markups imply that foreign sourcing may be a source of sustainable competitive advantage in international markets not only because of higher physical productivity but also thanks to quality upgrading.

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Appendix A: Estimation of markups and TFPR

The markup estimation is based on the insight of Hall (1986, 1988) that, for a cost-minimizing producer, the markup equals the ratio of the output elasticity of a variable input to the input's expenditure share. This follows directly from the cost-minimization assumption and requires no further assumptions on the market structure or the demand system. Hence, the markup of firm i in year t can be expressed as

$$\mu_{it} = \theta_{it}^{v} \left(\alpha_{it}^{v}\right)^{-1}, \tag{19}$$

where θ^v is the output elasticity of variable input v and $\alpha^v = \frac{P^v v}{PQ}$ is the expenditure share of the variable input with P^v being the price of the input and PQ the total revenue of the firm. While α^v can be obtained from balance sheet data, the output elasticity must be estimated from a production function.

To estimate the output elasticities and TFPR we assume a Cobb-Douglas production technology with Hicks-neutral productivity, and estimate a production function on the value added,

$$q_{it} = \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it}, \tag{20}$$

where all variables are in natural logarithms, q is value added of production, l and k denote labor and capital, respectively, ω is the term for the (unobservable) productivity and ϵ is the error term containing unanticipated shocks to the producer and measurement error.

We follow the structural estimation procedure proposed by De Loecker and Warzynski (2012), which in turn is based on the method of Ackerberg, Caves and Frazer (2015). The method proxies the productivity term with observed input choices, more specifically by inverting the demand function for materials (assuming that it is strictly monotonic, hence invertible). Productivity is then expressed as

$$\omega_{it} = h_t(m_{it}, k_{it}, l_{it}, \mathbf{z_{it}}),$$

where $h_t(.)$ is the inverted demand function for the material input m_{it} which, for simplicity, is treated as non-parametric. Capital and labor are determined before the firm decides on its material input, and $\mathbf{z_{it}}$ contains other controls affecting material demand.[20]

The estimation proceeds in two steps and closely follows the procedure of De Loecker and Warzynski (2012). In the first stage we estimate (20) with the proxy for productivity, $h_t(.)$, substituting for ω_{it}. Note that in this step none of the β parameters can be estimated, since the inputs and the proxy for productivity are perfectly collinear. However, using the

[20] In this application we include time dummies, the square of capital and a dummy for being foreign owned as other controls. Our main results are robust to the choice of these control variables.

first-stage fitted values, $\hat{\phi}_{it}$, we can express productivity as

$$\omega_{it}(\beta) = \hat{\phi}_{it} - \beta_l l_{it} - \beta_k k_{it}. \tag{21}$$

In the second stage, we estimate the production function parameters with a GMM procedure. We assume a productivity process which takes into account potentially endogeneous productivity improvements due to past exporting and importing activity. Hence, the law of motion for productivity explains current-period productivity as a nonparametric function (approximated by a third-order polynomial) of the productivity level in the previous period, the past trading status of the firm captured by the exporter and importer dummies (D^{im}_{it-1} and D^{ex}_{it-1}), plus an innovation term, ξ_{it}:

$$\omega_{it} = g_t(\omega_{it-1}, D^{ex}_{it-1}, D^{im}_{it-1}) + \xi_{it}. \tag{22}$$

The orthogonality conditions of the GMM estimation exploit the fact that the current-period innovation to productivity (ξ_{it}) must be uncorrelated with the input levels set by the firm in the previous period. Hence, the moment conditions are

$$E\left(\xi_{it}(\beta)\begin{pmatrix} l_{it-1} \\ k_{it} \end{pmatrix}\right) = 0,$$

where $\xi_{it}(\beta)$ is given by (21) and (22) and we take into account that current-period capital is determined in the previous period.

To allow for industry differences in the production technology parameters, we do the estimation procedure separately for 15 broad industry groups.[21] Our estimation hence produces estimates for the industry-specific vector of coefficients, $\beta^s = \{\beta^s_l, \beta^s_k\}$. We measure value added with firm revenue less expenditures on material inputs, labor with the number of employees, and capital with the book value of tangible assets. We deflate all variables in current prices with industry-specific price indices.

Having the estimated production function coefficients and the fitted values from the first-stage regression at hand, we can calculate firm-level productivity from (21) and the firm markup by applying (19). To get the markup we take labor as variable input. The output elasticity is then measured by the estimated industry-specific labor coefficient, i.e. $\theta^l = \hat{\beta}^s_l$, while the expenditure share of labor α^l_{it} is the ratio of labor costs to total revenue from the balance sheet. When calculating the expenditure share of labor we take into account that output may be subject to measurement error and, as in De Loecker and Warzynski (2012), obtain the expenditure share by using a corrected output measure.[22]

[21]These are the two-digit NACE industries from 15 to 37, but we merge some industries (e.g tobacco with food, office machinery with electrical machinery, recycling with manufacturing n.e.c.) to secure enough observations in each group.

[22]For details see De Loecker and Warzynski (2012), page 2449.

For robustness purposes we also estimate a Translog production function on the value added to get alternative TFPR and markup estimates. The Translog production function is

$$q_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_{ll} l_{it}^2 + \beta_{kk} k_{it}^2 + \beta_{lk} l_{it} k_{it} + \omega_{it} + \epsilon_{it}, \tag{23}$$

and the moment conditions naturally extend with the added quadratic and interaction terms,

$$E\left(\xi_{it}(\beta)\begin{pmatrix} l_{it-1} \\ k_{it} \\ l_{it-1}^2 \\ k_{it}^2 \\ l_{it-1}k_{it} \end{pmatrix}\right) = 0.$$

Importantly, under Translog technology, the output elasticity of labor is a function of the firm's input uses and hence vary by firm and year,

$$\theta_{it}^l = \hat{\beta}_l + 2\hat{\beta}_{ll} l_{it} + \hat{\beta}_{lk} k_{it}. \tag{24}$$

This makes a difference compared with the Cobb-Douglas case, where the estimated output elasticity is constant within industry.

Appendix B: Further Tables

Table 8: Markups by year and industry

	median	mean	N
Year			
1996	1.230	1.360	3,095
1997	1.227	1.356	3,546
1998	1.254	1.378	4,313
1999	1.253	1.378	4,959
2000	1.224	1.348	4,843
2001	1.222	1.346	5,573
2002	1.208	1.325	5,299
2003	1.211	1.333	5,482
Industry			
15-16 Food, beverages and tobacco produc	1.203	1.306	5,716
17 Textile products	1.513	1.665	1,049
18-19 Wearing apparel and leather produc	1.093	1.203	1,694
20 Wood and wood products	1.077	1.113	2,094
21-22 Paper products, publishing and pri	1.281	1.437	3,606
23-24 Coke, petroleum, and chemicals	1.337	1.460	1,176
25 Rubber and plastic	1.298	1.420	2,789
26 Non-metalic mineral prods	1.339	1.439	1,677
27-28 Basic and fabricated metal product	1.275	1.390	6,826
29 Machinery and equipment	1.132	1.224	4,223
30-31 Office machinery and electrical ma	1.099	1.204	1,529
32 Communication equipment	1.568	1.740	702
33 Medical, precision and optical equipm	1.224	1.309	1,307
34-35 Motor vehicles, trailers and other	1.425	1.678	792
36-37 Furniture, manuf n.e.c., recycling	1.221	1.324	1,930
Full sample	1.228	1.352	37,110

Notes: Markup is estimated from a value added Cobb-Douglas production function following De Loecker and Warzynski (2012).

Table 9: Alternative markup measures

	median	mean	CV
Markup (VA-CD)	1.228	1.352	0.331
Markup (VA-Translog)	1.144	1.227	0.325
Price-cost margin (PCM)	1.218	1.295	0.223
Return on equity (ROE)	0.168	0.204	2.647
Profit margin	0.042	0.047	1.868

Notes: N=37,110. VA-CD denotes value added Cobb-Douglas, VA-Translog value added Translog production function estimations. CV (coefficient of variation) is standard deviation divided by the mean.

Table 10: TFPR premia of exporters and importers

Dependent variable: ln TFPR	(1)	(2)	(3)	(4)	(5)
importer dummy	0.198***		0.162***	0.112***	0.116***
	(0.034)		(0.024)	(0.013)	(0.008)
exporter dummy		0.150***	0.068**	0.032*	0.053***
		(0.034)	(0.025)	(0.018)	(0.013)
ln market share lagged				0.043***	0.070***
				(0.011)	(0.008)
ln capital-labor ratio					0.054***
					(0.012)
labor quartile dummies					yes
Observations	37,110	37,110	37,110	37,110	37,110
R-squared	0.759	0.751	0.760	0.768	0.797

Notes: TFPR is estimated from a value added Cobb-Douglas production function following De Loecker and Warzynski (2012). Market share is the domestic revenue share of the firm within the 4-digit industry. All specifications include industry-year dummies with 2-digit industries. Robust standard errors with 2-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 11: Robustness - alternative estimation samples

	1992-2003		1998-2003	
Dependent variable:	ln TFPR	ln Markup	ln TFPR	ln Markup
importer dummy	0.126***	0.038***	0.111***	0.039***
	(0.007)	(0.008)	(0.008)	(0.008)
exporter dummy	0.054***	-0.007	0.057***	-0.013**
	(0.011)	(0.007)	(0.014)	(0.006)
ln market share lagged	0.074***	0.027***	0.065***	0.033***
	(0.008)	(0.005)	(0.010)	(0.006)
ln capital-labor ratio	0.025**	0.059***	0.040***	0.076***
	(0.011)	(0.004)	(0.010)	(0.004)
Observations	37,437	37,437	29,415	29,415
R-squared	0.748	0.351	0.714	0.303

Notes: TFPR and markup is estimated from a value added Cobb-Douglas production function following De Loecker and Warzynski (2012). Market share is the domestic revenue share of the firm within the 4-digit industry. All specifications include labor quartile and industry-year dummies with 2-digit industries. Robust standard errors with 2-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 12: Within-firm estimates for alternative markup measures

Dependent variable:	ln Markup (TL)	ln PCM	ROE	Profit margin
importer dummy	0.019**	0.006	0.021	0.006***
	(0.007)	(0.004)	(0.018)	(0.002)
exporter dummy	0.014**	0.001	0.007	0.002
	(0.006)	(0.004)	(0.018)	(0.001)
Observations	20,259	20,259	20,259	20,259
R-squared	0.905	0.696	0.402	0.564

Notes: The sample excludes firms which export or import in all years ("always traders"). Markup (TL) is the markup estimated from a value added Translog production function following De Loecker and Warzynski (2012). PCM is price-cost margin, ROE is return on equity. All specifications include ln market share lagged, ln capital-labor ratio, labor quartile dummies, firm dummies and industry-year dummies with 2-digit industries. Robust standard errors with 2-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 13: Export quality and importing: robustness

Dependent variable: ln price-adjusted export sales						
	BW 5-digit		BGW		σ=5	
imports from developed dummy	0.310***	0.165**	0.480***	0.196**	0.553***	0.143**
	(0.100)	(0.066)	(0.184)	(0.086)	(0.111)	(0.069)
imports from r.o.w. dummy	0.129	0.143**	0.147	0.090	0.011	0.076
	(0.082)	(0.068)	(0.148)	(0.067)	(0.106)	(0.071)
log capital-labor ratio	0.111***	-0.028	0.177	0.008	0.110**	-0.002
	(0.036)	(0.047)	(0.121)	(0.062)	(0.052)	(0.065)
GDP per capita of export markets	0.178	0.308	1.118*	0.316	0.569	0.680
	(0.323)	(0.628)	(0.635)	(0.811)	(0.455)	(0.656)
foreign owned dummy	0.493***	-0.030	0.734***	0.128	0.561***	0.034
	(0.069)	(0.175)	(0.246)	(0.161)	(0.118)	(0.099)
firm-product-destination fixed effects		yes		yes		yes
Observations	63,946	35,945	78,177	43,862	78,371	43,927
R-squared	0.993	0.999	0.992	1.000	0.831	0.971

Notes: Estimation is done with the reghdfe command in STATA (Correia, 2014). In constructing the dependent variable, we used the σ estimates of Broda and Weinstein (2006) at the 5-digit product level or the country-specific estimates of Broda, Greenfield and Weinstein (2006; BGW), or assumed a constant σ= 5. All specifications include labor quartile and product-destination-year dummies with 8-digit products. Robust standard errors with four-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1