Abstract

Using detailed trade data linked to firm balance sheets from Hungary, this paper studies the relationship between the scope of importing and exporting activities and markups. When considering import status besides exporting we show that importing is associated with large markup premia, while that of exporting becomes insignificant when we control for import status. We also find that larger import share in material use is associated with higher markups while this is not the case for exporting. Third, productivity differences explain much from trading premia, but the importer premium remains positive even when controlling for productivity. Fourth, on EU markets, where competition is supposedly tougher, export premia are smaller (more negative).

1 Introduction

Recent empirical work has shown that trading firms are much different from firms serving the domestic market. Exporting firms are larger, more productive, pay higher wages and charge higher prices (Bernard, Jensen and Lawrence, 1995). A recent but growing literature focusing on the import side have concluded that importing firms are also more productive and larger (Halpern, Koren and Szeidl, 2011). Subsequent research has also shown that large exporters are also large importers, and a large part of the export premium can be explained by differences in the import status (Amiti et al., 2012).
The differences in productivity and size imply that the market power of internationalized firms may also be larger. Indeed, De Loecker and Warzynski (2012) provide evidence that exporting firms charge higher markups. In this paper we try to dig deeper into the question how the different dimensions of internationalization are related to market power. We argue that importing has an unambiguously positive association with markups because both self-selection and the productivity improving effect of imported inputs point into a markup premium of importers. Exporting, on the other hand, may have a more ambiguous relationship with markups, because the effect of productivity sorting may be offset by the effect of tougher competition on export markets.

These hypotheses are much in line with the patterns we find in Hungarian firm-level data for 1995-2003 which was merged with detailed trade data. We use the balance sheet data to estimate firm-year level TFP and markups with the methodology proposed by De Loecker and Warzynski (2012), and create measures of the scope of importing and exporting activities from the detailed trade data.

Our main findings are the following. First, we consider import status besides exporting to show that importing is associated with large markup premia, while that of exporting becomes insignificant when we control for import status. Second, we study how the extent of importing and exporting is related to markups and find that larger import share in material use is associated with higher markups while this is not the case for exporting. Third, productivity differences explain much from trading premia, but the importer premium remains positive even when controlling for productivity. Fourth, on EU markets, where competition is supposedly tougher, export premia are smaller (more negative).

We use a variable markups heterogeneous firm model to explain these observations. The model follows the Melitz and Ottaviano (2008) framework in terms of the market structure, and we also introduce the role of imports following Halpern et al. (2011). In the model importing inputs leads to an improvement in productivity and markups. The difference between exporting and non-exporting firms is more ambiguous. While positive productivity sorting leads to a positive association between exporting and markups, the tougher competition on the export market may offset this effect. We show that as a result the relationship between productivity and firm-level average markups becomes non-monotonic: firms with small export shares can have lower average markups than firms with a productivity level just below the threshold for exporting.

Our paper contributes to four strands of literature.

First, motivated by the large productivity premium associated with exporting (see e.g. Wagner,
2012) a growing literature has shown that importing is associated with a productivity premium which is at least as important as that of exporting. Kasahara and Rodrigue (2008), for example, showed that starting to import intermediate goods led to a productivity increase in Chile. Smeets and Warzynski (2013) found that, unlike exporters, importing firms had a large productivity premium in Denmark, but two-way traders had an even larger advantage. Vogel and Wagner (2010) also has shown that two-way traders have the highest productivity in Germany, but in that country exporters had higher premia than importers.

The productivity-increasing effect of importing was also confirmed by studies measuring the effect of trade liberalization of intermediate inputs and firm-level productivity. Amiti and Konings (2007) used census data from Indonesia to show that 10 percentage point fall in input tariffs led to 12 percent productivity gain for importers. Topalova and Khandelwal (2011) showed that the fall in import tariffs contributed much to firm-level productivity increase in India. Goldberg, Khandelwal, Pavcnik and Topalova (2010) found that an important factor behind this effect was that lower import tariffs accounted for 31% of the new products introduced by Indian firms.

An important theoretical framework for the productivity advantage was provided by Halpern et al. (2011) who has 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. Both selection and the higher productivity of imported inputs plays a role in the productivity premium of importers. Halpern et al. (2011) estimates and confirms the predictions of this model using detailed trade data from Hungary. Kasahara and Lapham (2008) uses a similar framework of simultaneous choice whether to export or use imported intermediaries, and test the predictions on Chilean firm-level data.

Second, another strand of literature started to explore how much differences in prices or markups can explain from the variation in measured productivity across firms. Foster, Haltiwanger and Syverson (2008) addressed the question whether selection mechanisms (such as that in exporting) are based on differences in productivity or profitability. They distinguish between physical and revenue productivity and argue that the two can diverge because of differences in input and output prices. De Loecker and Goldberg (2013) decomposed differences in firm performance to physical productivity, input and output prices and showed that different approaches studying firm performance may be biased by omitting input or output price heterogeneity. These contributions suggest that the measured TFP premium of trading firms may partly be explained by differences in markups.
Third, a growing theoretical literature started to study how trade is related to markups. Melitz and Ottaviano (2008) developed a general framework in which markups in different export markets differ systematically because of different competitive conditions. The model assumes a linear demand system and monopolistic competition. Mayer, Melitz and Ottaviano (2014) has expanded this model to multi-product firms to generate new predictions on the product mix of exporters. An alternative variable markups model was developed by Atkeson and Burstein (2008). Amiti, Itskhoki and Konings (2012) builds a model of exchange rate pass-through which includes both variable markups and the imported input productivity premium from Halpern et al. (2011).

Fourth, a number of papers proposed and used different methods to estimate markups from firm-level information. Building on the work of Hall (1986) and Klette (1999) De Loecker and Warzynski (2012) has developed an econometric method which simultaneously estimates productivity and markups. The logic of the method is similar to that of Hall (1986): it estimates markups from the relationship between variable input shares in revenues and output elasticity of the same input, but it also controls for productivity shocks. De Loecker (2011) has shown that using data on production extends the flexibility of markup estimation. Loecker, Goldberg, Khandelwal and Pavcnik (2012) has used production data to estimate markups for multi-product firms.

This method was used in different contexts to provide evidence about the relationship between trade and markups. De Loecker and Warzynski (2012) used data from Slovenia to show that exporters have a premium in terms of markups. Loecker et al. (2012) used trade liberalization to find that falling import prices were associated with an increase in markups, which effect was only partially offset by the pro-competitive effect of the liberalization on output prices.

We extend these strands of literature in several ways. First, we provide a simple theoretical framework with endogenous markups building both on the Melitz and Ottaviano (2008) and the Halpern et al. (2011) mechanism. This model is quite similar to Amiti et al. (2012), but it provides predictions for average firm-level markups rather than firm-product-country-level pass-through. This framework shows that exporting and importing can have quite different effects on markups because of the possibility that competition in export markets is stronger. Second, we use Hungarian balance sheet data merged with detailed trade data to estimate the relationship between markups and both exporting and importing to show that, not unlike productivity, importing may play a more important role in the markup premium than exporting. Third, we differentiate between EU and non-EU markets and show that the strength of competition on the export market is indeed related to the markup premium of exporters.
The structure of the paper is the following. Section 2 introduces the dataset and presents its most important characteristics. Section 3 introduces the methodology of estimating markups and productivity. Section 4 presents our theoretical framework. Section 5 describes the main results, while Section 6 includes the robustness checks. We discuss the results in Section 7.

2 Data and estimation sample

Our sample is a panel of Hungarian manufacturing firms with more than 5 employees in 9 years between 1995 and 2003. The database combines balance sheet data from the firms’ Earnings Statements and detailed export and import data from the Hungarian Customs Statistics.

In the balance sheet data we observe sales, employment, fixed assets, various cost measures including expenditures on labor and materials, as well as ownership structure (foreign, state, private). We do not observe product and factor input prices or quantities.

The Customs Statistics report data on annual exports and imports of each firm by 6-digit HS (Harmonized System) product category and by partner country. We identify imports of intermediate inputs as the imports of products that belong to the relevant BEC (Broad Economic Categories) codes.\(^1\) We also clean the export flows of firms in order to eliminate possible carry-along export activities or sales of irregular items, including 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 the products of which the firm generates the largest export revenue during the sample period.

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 et al. (2011) 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 9%, which is the median share across firms with processing trade. This makes us exclude 10% of the firm-year observations.

Finally, we eliminate from the sample firms with state ownership above 10% ever during the

\(^1\)BEC codes 111, 121, 21, 22, 31, 322, 42, 53 cover intermediate inputs, as defined by the United Nations.
sample period, which makes us exclude around 6% of the firms.

After all data cleaning, our sample includes 47,523 firm-year observations with 10,584 unique firms. When estimating productivity and markup we lose part of the sample, mostly due to lagged explanatory variables. This leaves us with 31,476 firm-year observations, 8,078 unique firms and eight years (1996-2003) for further investigation.

Table 1: Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>Non-trader</th>
<th>Exporter</th>
<th>Importer</th>
<th>Two-way</th>
<th>Full sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment</td>
<td>30</td>
<td>41</td>
<td>44</td>
<td>170</td>
<td>76</td>
</tr>
<tr>
<td>Sales revenue (million HUF)</td>
<td>174.6</td>
<td>258.2</td>
<td>513.2</td>
<td>3401.8</td>
<td>1225.1</td>
</tr>
<tr>
<td>Capital per worker (million HUF)</td>
<td>1.8</td>
<td>2.3</td>
<td>3.1</td>
<td>4.4</td>
<td>2.8</td>
</tr>
<tr>
<td>Material share in output</td>
<td>62.1%</td>
<td>64.7%</td>
<td>69.9%</td>
<td>66.5%</td>
<td>64.6%</td>
</tr>
<tr>
<td>Export intensity</td>
<td>23.8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Import intensity</td>
<td></td>
<td>19.1%</td>
<td>28.9%</td>
<td></td>
<td>10.9%</td>
</tr>
<tr>
<td>Foreign owned</td>
<td>6.5%</td>
<td>14.4%</td>
<td>19.7%</td>
<td>49.3%</td>
<td>22.2%</td>
</tr>
</tbody>
</table>

Number of observations 21,777 6,280 4,647 14,819 47,523
Number of firms 6,335 2,757 2,081 4,013 10,584

Notes: All are means unless otherwise reported. Trading status is determined for firm-year observations. Numbers of firms by status add up to more than the number of firms in the whole sample due to firms switching status. Export intensity is export sales over total sales, import intensity is expenditure on imported intermediate inputs over total expenditure on intermediate inputs.

Table 1 reports descriptive statistics from the sample used for productivity and markup estimation. Trading firms are larger, both in terms of employment and sales revenue, and more capital-intensive than non-traders. Firms that both export their products and import materials (two-way traders) are by far the largest. Two-way traders also 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 only export or only import. Finally, the prevalence of foreign ownership also increases with the involvement in international trade.

3 Estimating productivity and markups

We follow the method of De Loecker and Warzynski (2012), henceforth DLW, to jointly estimate firm-level total factor productivity and markup. The method relies on production function estimation and the insight that, for a cost-minimizing producer, markup equals the ratio of the output
elasticity of a variable input (labor or materials) to the input’s revenue share.

The first-order condition for a cost-minimizing producer $i$ in period $t$ implies that, for a given variable input $X$, the markup is

$$\mu_{it} = \theta_{it}^X \left( \alpha_{it}^X \right)^{-1}, \quad (1)$$

where $\mu$ denotes markup, $\theta^X$ is the output elasticity of the input and $\alpha^X = \frac{p^X X}{PQ}$ is the share of the expenditure on input $X$ in the total revenue of the firm. While the revenue share is directly observable in the data, the output elasticity can only be estimated from a production function.

We estimate, by two-digit NACE industries, either Cobb-Douglas or Translog production functions with Hicks-neutral productivity. We start with a value added production function with labor as the only variable inputs, but also produce estimates with a gross output production function with two variable inputs. In the latter case, the markup can be uncovered from either the labor or the material input as in (1).

Our baseline specification is the value added Translog production function, which is

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_{ll} l_{it}^2 + \beta_{kk} k_{it}^2 + \beta_{lk} l_{it} k_{it} + \omega_{it} + \epsilon_{it}, \quad (2)$$

where the $\beta$s are parameters, all variables are in logs, $y$ is value added of production, $l$ and $k$ denote labor and capital, respectively, $\omega$ is productivity and $\epsilon$ is the error term containing unanticipated shocks to the producer and measurement error.

The estimation accounts for productivity shocks unobserved to the econometrician (but not to the firm), in the spirit of Olley and Pakes (1996), Levinsohn and Petrin (2003) and Ackerberg et al. (2006). The input choice of the firm is potentially endogeneous to such shocks, which can lead to biased estimates of output elasticities, and hence productivity and markups. The method we use proxies productivity by inverting the demand function for materials such that $\omega_{it} = h_t(m_{it}, k_{it}, z_{it})$, where $m$ denotes materials and $z$ contains other controls affecting material demand.

We closely follow the two-stage estimation procedure described by eqs (11)-(14) in DLW. In the first stage we estimate (2) with the proxy for productivity. In the second stage, using the first-stage fitted values, we estimate the production function parameters (the $\beta$s) with a GMM (Generalized Method of Moments) procedure. We assume a law of motion for productivity, where current-period productivity is a nonparametric function (approximated by a third-order polynomial) of the productivity level in the previous period, plus an innovation term. The GMM moment conditions exploit the uncorrelatedness of the innovation in productivity with the lagged levels of input use.

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2Our additional controls include exporter, importer and year dummies.
Having the $\hat{\beta}_s$ and the fitted values from the first-stage regression at hand, we can easily calculate firm-level productivity and markup. Note that for the value added Translog production function the output elasticity of labor is calculated as

$$\hat{\theta}_L^{it} = \hat{\beta}_l + 2\hat{\beta}_{ll}L_{it} + \hat{\beta}_{lk}k_{it},$$

which then is used to calculate markup as in (1). Note the difference from a Cobb-Douglas production function, where the estimated output elasticity of labor is constant and equals the corresponding production function coefficient. In this latter case, the firm-level variation in the markup estimates entirely comes from the differences of the labor’s revenue share across firms.

A measurement issue is that we observe neither physical quantities (of output, sales, capital, or materials) nor firm-level prices. Therefore we deflate all variables with available industry-specific price indices. While the use of deflation is clearly inferior, DLW show that it affects only the level of the markup estimates, and not the correlation between markups and firm-level characteristics (such as the exporting or importing status).

A further measurement issue relates to our labor and material inputs. Outsourcing in-house services or parts of the production process to independent producers, which was common in the period in Hungary, shows up in the form of substituting labor with materials. In estimating a gross output production function, with both inputs variable, this leads to decreasing labor and increasing material revenue shares and, hence, increasing labor-based and decreasing material-based markup estimates. To correct for this we also report a “composite” markup estimate for the gross output specification, which is the geometric mean of the labor-based and material-based markups.

Table 2: Various markup estimates

<table>
<thead>
<tr>
<th>Specification</th>
<th>median</th>
<th>mean</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value added, Cobb-Douglas</td>
<td>1.79</td>
<td>2.16</td>
<td>0.61</td>
</tr>
<tr>
<td>Value added, Translog</td>
<td>1.51</td>
<td>1.79</td>
<td>0.58</td>
</tr>
<tr>
<td>Gross output, Translog (labor)</td>
<td>1.08</td>
<td>1.50</td>
<td>0.87</td>
</tr>
<tr>
<td>Gross output, Translog (materials)</td>
<td>1.21</td>
<td>1.38</td>
<td>0.51</td>
</tr>
<tr>
<td>Gross output, Translog (composite)</td>
<td>1.19</td>
<td>1.29</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Notes: CV (coefficient of variation) is standard deviation over the mean.

Table 2 reports markup estimates from different specifications of the production function.\(^3\) The first two rows correspond to a value added production function, either specified as Cobb-Douglas

\(^3\)We clean the markup estimates from outliers below zero or above 10. Occurrence of outliers is low, not exceeding half a per cent of the observations, for all types of estimates.
or Translog (specifications I and IV in DLW). The last three rows show estimates from the same gross output Translog production function (VI in DLW), with markups being calculated either from labor or materials, or as the geometric mean of the two.

The median markup estimates take reasonable values, but differ considerably across specifications. They are higher (50%–80%) for the value added production functions than for the gross output production function (8%–20%). The lower end of our estimates is comparable to the markup estimates of DLW for Slovenian firms during 1994-2000 and to those of Loecker, Goldberg, Khandelwal and Pavcnik (2012) for India during 1989-2003.

Correlation between Cobb-Douglas markups and Translog markups is high, with correlation coefficients around 0.9. Correlation between markups from value added and markups from gross output (labor-based or composite) is moderate at 0.4–0.5. For any markup estimate, co-movement is the weakest with material-based gross output markups (small negative correlation coefficients), which might be due to the above measurement issue related to outsourcing.

There is considerable variation in markups across industries, although the median markup estimates in most two-digit industries fall in the reasonable range of 1–2. Exception is the value added Cobb-Douglas specification, which produced quite a few median industry markups above 2. We find the largest markups in the tobacco industry, while smaller ones are more common in, for example, leather and wood manufacturing.

Figure 1: Cumulative distribution function of markups by trading status
In what follows we focus our attention on the markup and productivity estimates from the value added Translog production function, our baseline specification. Alternative estimates are used for robustness checks.

Let us look at how our preferred markup estimate vary with the trading status of the firm. Figure 1 shows the cumulative distribution of markups (in logarithm) by trading status for all firm-year observations. Firms who import materials seem to charge higher markups than others. The positive markup premium is larger for firms who only import than for two-way traders. (This difference is however less pronounced for alternative markup estimates on Figures 3 and 4 in the Appendix.) Non-traders and firms who only export have very similar markup distributions, the equality of which cannot be rejected by a Kolmogorov-Smirnov test.

We find strong positive association between firm-level markups and productivity i.e. more productive firms seem to charge significantly higher markups. Table 3 reports results from regressions of the logarithm of markup on the logarithm of productivity. Both within industry-years and within firms higher firm productivity is accompanied by higher firm-level markup, even after controlling for foreign ownership and the size of the firm.

<table>
<thead>
<tr>
<th>Table 3: Markups and productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
</tr>
<tr>
<td>Dependent variable: log markup</td>
</tr>
<tr>
<td>log TFP</td>
</tr>
<tr>
<td>0.023</td>
</tr>
<tr>
<td>Other controls</td>
</tr>
<tr>
<td>Industry-year dummies</td>
</tr>
<tr>
<td>Firm dummies</td>
</tr>
<tr>
<td>Year dummies</td>
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<tr>
<td>Observations</td>
</tr>
<tr>
<td>R-squared</td>
</tr>
</tbody>
</table>

Notes: Markup and TFP are estimated from a value added Translog production function following De Loecker and Warzynski (2012). Other controls include a dummy for foreign ownership and size dummies, the latter defined on the number of employees (between 5 and 20, between 20 and 100, above 100). Industry-year fixed effects are with two-digit industries. Robust standard errors with two-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1
4 Theoretical approach

We interpret our results with a simple framework including both variable markups and productivity gains from importing intermediate inputs of production. Our framework is based on a partial equilibrium version of the Melitz and Ottaviano (2008) model. Also, we study only a two-country version of the model. The two countries are home and the rest of the world, and we assume that the rest of the world is larger, and competition on the export market is stronger (which is a general equilibrium consequence of the larger market size in the full Melitz-Ottaviano framework), hence prices are lower there. This simplification to having two countries is mainly driven by the nature of our dataset, where we can only observe one markup for each firm-year, hence we cannot observe the markup in each country. Deriving such an average from a model with many countries would require many assumptions about the joint distribution of size and strength of competition across countries.

We extend this framework with the productivity-enhancing effect of imported inputs as in Halpern et al. (2011). For tractability, we will simplify the model by assuming the number of imported inputs is exogenous, conditional on productivity. Variation in the share of imported inputs conditional on productivity results from the heterogeneity in the cost of imported inputs in the Halpern et al. (2011) model. Amiti et al. (2012) shows how an endogeneous choice of imported inputs can be built into a variable markup model, but that model would be less tractable to motivate our analysis.

Intuitively, the story is the following. First, the model will predict a positive effect of imports on markups. Imported inputs make the firm more productive, and in a model of variable markups higher productivity is associated with higher markups. Also, if the bundle of imported inputs is determined endogeneously, more productive firms will tend to import more intermediate inputs. This selection effect simply reinforces the positive relationship between imported inputs and markups.

Second, the model predicts a non-monotonic relationship between the scope of exports and firm-level markups. On the one hand, there is a selection effect: more productive firms are more likely to enter the export market. On the other hand, competition is stronger on the export market, which drives down the markups of exporters. We will show that this effect introduces a non-monotonic relationship between productivity and firm-level markups: after productivity increases above the threshold of entering the export market, average firm-level markup will fall on an interval before continuing to increase. The negative slope is explained by a composition effect: as the productivity
of exporting firms increases, they export an increasing share of their production to the (more competitive) export market, and for some productivity values this composition effect is stronger than the within-market positive relationship between productivity and markups. As a result, exporting firms may have lower markups than similar non-exporting firms.

4.1 Demand

The basic structure of the model follows that of Melitz and Ottaviano (2008). We distinguish between two countries, home and foreign (D and F, respectively). We assume that the foreign country (the rest of the world) is larger than the home country, hence \( L^F > L^D \).

The utility function of each consumer \( c \) is the following:

\[
U = q^c_0 + \alpha \int_{i \in \Omega} q^c_i di - \frac{1}{2} \gamma \int_{i \in \Omega} (q^c_i)^2 di - \frac{1}{2} \eta \left( \int_{i \in \Omega} q^c_i di \right)^2,
\]

where \( q^c_0 \) and \( q^c_i \) are consumed quantities of the numeraire good and variety \( i \) \((i \in \Omega)\), respectively, and \( \alpha, \gamma \) and \( \eta \) are positive demand parameters.

This yields a linear market demand system for each variety \( i \) that is consumed in country \( l \) \((l = D, F)\) (this set of products is denoted by \( \Omega^l \subset \Omega \)):

\[
q_l \equiv L^l q^c_l = \frac{\alpha L^l}{\eta N^l \gamma} - \frac{L^l}{\gamma} p^l + \frac{\eta N^l}{\eta N^l + \gamma} \frac{L^l}{\gamma} \bar{p}^l, \quad l = D, F,
\]

where \( N^l \) is the measure of consumed varieties and \( \bar{p}^l = (1/N^l) \int_{i \in \Omega^l} p^l_i di \) is their average price in country \( l \).

Consumers only consume products for which

\[
p^l \leq \frac{1}{\eta N^l + \gamma} (\gamma \alpha + \eta N^l \bar{p}^l) \equiv p^l_{\text{max}}, \quad l = D, F,
\]

where \( p^l_{\text{max}} \) is the price where demand is driven to 0.

We will assume that competition is stronger on the foreign market, \( \bar{p}^F < \bar{p}^D \). This is motivated by one of the central general equilibrium results of the Melitz-Ottaviano model, that, under symmetric trade costs, the larger country has higher average productivity and lower prices. The larger market size also implies more entry, hence \( N^F \geq N^D \).

According to Equation (6) these assumptions imply that \( p^F_{\text{max}} < p^D_{\text{max}} \).

4.2 Firm behavior

We look at firm behavior from the perspective of firms in the domestic economy. For simplicity, the wage level is set to unity. The model is one of monopolistic competition: differentiated goods
producers take the average number of firms and prices as given.

Production exhibits constant returns to scale, each firm can produce one unit of output at marginal cost $c$. We will assume that this marginal cost is composed of two parts. The first component, $c^0$, denotes marginal costs without any imported inputs. Following the Halpern, Koren and Szeidl (2011) model we assume that imported inputs reduce marginal costs by $g(sh_i)$, where $sh_i$ represents the share of imported inputs in the intermediate goods used by firm $i$ and $g(\cdot)$ is an increasing function.

Under these assumptions, the unit cost of each firm is

$$c(c^0, sh) = c^0 - g(sh).$$

$c^0$ represents realizations of a random draw from a common distribution $G(c^0)$ as in Melitz and Ottaviano (2008) and we assume, for simplicity, that the import share is determined exogenously, resulting for example from the heterogeneity in fixed costs of importing across firms.

The profit maximizing price on the domestic market for a firm with $c$ marginal cost satisfies

$$q^D(c) = \frac{L^D}{\gamma} [p^D(c) - c].$$

When exporting, firms pay iceberg-type transportation costs, $\tau > 1$, and so the unit cost of delivering becomes $\tau c$. Profit maximization in the export market then requires

$$q^F(c) = \frac{L^F}{\gamma} [p^F(c) - \tau c].$$

Let $c^D = p^D_{\text{max}}$ and $c^F = p^F_{\text{max}}/\tau$ denote the cost levels of firms who are indifferent to entering the domestic and foreign markets, respectively. Since $p^D_{\text{max}} > p^F_{\text{max}}$ and $\tau > 1$, $c^D > c^F$. The model implies sorting: firms with $c > c^D$ exit, firms with a cost level between $c^F$ and $c^D$ only produce to the domestic market, while firms with $c < c^F$ export.

Optimization yields:

$$p^D(c) = \frac{1}{2} (c^D + c), \quad q^D(c) = \frac{L^D}{2\gamma} (c^D - c),$$

$$p^F(c) = \frac{\tau}{2} (c^F + c), \quad q^F(c) = \frac{L^F}{2\gamma} \tau (c^F - c),$$

from which the absolute markups, $\mu^D(c) = p^D(c) - c$ and $\mu^F(c) = p^F(c) - \tau c$ are

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

$$\mu^F(c) = \frac{\tau}{2} (c^F - c).$$
In the empirical exercise we can only observe the firm level markup, \( \mu(c) \). For non-exporters this is equal to \( \mu^D(c) \). For exporters, this is the quantity-weighted average of the markups on the domestic and foreign markets:

\[
\mu(c) = \begin{cases} 
\frac{1}{2}(c^D - c) & \text{if } c^F < c \leq c^D \\
\frac{L^D(c^D - c)^2 + L^F\tau^2(c^F - c)^2}{2L^D(c^D - c) + 2L^F\tau(c^F - c)} & \text{if } 0 \leq c \leq c^F
\end{cases}
\] (14)

Let us analyse these functions by following how markups change as the cost level of a firm decreases (or, its productivity increases); this is illustrated by Figure 2. First, the firm only enters the domestic market when its cost level becomes smaller than \( c^D \). Between \( c^D \) and \( c^F \), the markup is linearly increasing as costs become smaller. Second, as cost falls below \( c^F \), the firm enters the export market. Under our assumptions, there is always an interval where markup is decreasing when \( c \) decreases. On this interval the composition effect resulting from lower markups on the foreign market dominates the negative within-market relationship between costs and markups.\(^4\) Third, depending on the parameters, there may also be a minimum, below which the share of revenue coming from the export markets is large enough for the within-market effect to dominate the composition effect. These two cases are shown by Figure 2 with parameter values set at \( L^F/L^D = 10 \), \( c^D = 2 \), \( \tau = 1.2 \), and \( c^F \) being either 1 or 0.2, i.e. the foreign country being two or ten times more productive than the domestic one.

### 4.3 Empirical predictions

The model suggests a non-monotonic relationship between productivity and markups: the mainly positive association between the two can be modified by the possibly negative composition effect when the firm reaches the export threshold. When controlling for export share, however, one can unambiguously expect a positive effect of productivity on markup.

The increasing share of imported inputs is associated with higher productivity. Hence, we expect a positive relationship between the share of imported inputs, especially when controlling for export status and share.

Finally, the unconditional relationship between exporting and markups are most likely to be positive. It may be important to control for import status, however, because these two variables are likely to be strongly correlated. When controlling for both import share and productivity, the effect of exporting on markups can become insignificant or negative, reflecting the effect of the

\(^4\)Left-differentiating the function with respect to \( c \) when \( c = c^F \) yields \( \frac{1}{2}(c^D - c_F)^2L_D(\tau L_F - L_D) > 0 \).
stronger competition on export markets.

To sum up, we have the following empirical predictions:

- Markups increase in productivity when controlling for export share;

- When controlling for productivity, exporting can have zero or negative effect on markups because of the composition effect;

- When controlling for export status, import share should be positively associated with markups.

5 Empirical results

In what follows we look at empirically how firm markup and productivity (TFP) vary with the trading status of the firm. Unless otherwise noted we use the markup and productivity estimates from the value added Translog production function. Later we show that the results are qualitatively the same for the alternative markup and TFP estimates.

5.1 Markup, productivity and trading status

We run separate regressions for markup and productivity on our estimation sample. We estimate within industry-year groups, where we classify firms into 22 two-digit manufacturing (NACE)
industries. Hence, estimates uncover cross-sectional relationships and cannot be interpreted as causal.

The regression equation for the markup is

\[
\ln \mu_{ikt} = \gamma^{ex} D_{ikt}^{ex} + \gamma^{im} D_{ikt}^{im} + \gamma^x X_{ikt} + \delta_{kt} + \varepsilon_{ikt},
\]

where \(\ln \mu_{ikt}\) on the left-hand side is the logarithm of markup of firm \(i\) operating in industry \(k\) and year \(t\). On the right-hand side \(D_{ikt}^{ex}\) and \(D_{ikt}^{im}\) are dummies for the exporting and importing status, respectively. Exporter is a firm-year with positive export sales, importer is a firm-year with positive material imports. Other firm-specific explanatory variables are in \(X_{ikt}\), \(\delta_{kt}\) denotes a full set of industry-year dummies and \(\varepsilon_{ikt}\) is the idiosyncratic error term.

We also estimate the productivity premium for exporters and material importers with a regression equation similar to (15) but with the logarithm of TFP on the left-hand side. We report the results for both markup and productivity in Table 4.

### Table 4: Markup and productivity premium estimates

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>(1) log markup</th>
<th>(2) log TFP</th>
<th>(3) exporter</th>
<th>(4) importer</th>
<th>(5) foreign owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>exporter</td>
<td>0.066***</td>
<td>0.020</td>
<td>-0.003</td>
<td>0.162***</td>
<td>0.067**</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.010)</td>
<td>(0.026)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>importer</td>
<td>0.135***</td>
<td>0.056***</td>
<td>0.282***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td></td>
<td></td>
<td>(0.022)</td>
</tr>
<tr>
<td>foreign owned</td>
<td>0.095***</td>
<td>0.063***</td>
<td>0.049***</td>
<td>0.144***</td>
<td>0.078**</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.016)</td>
<td>(0.015)</td>
<td>(0.037)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>log TFP(-1)</td>
<td></td>
<td>0.311***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.020)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Size dummies: yes yes yes yes yes
Industry-year dummies: yes yes yes yes yes
Observations: 31,476 31,476 22,769 31,476 31,476
R-squared: 0.298 0.310 0.383 0.707 0.733

Notes: Markup and TFP are estimated from a value added Translog production function following De Loecker and Warzynski (2012). Size dummies are defined on the number of employees (between 5 and 20, between 20 and 100, above 100). Robust standard errors with two-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

We estimate a positive and significant markup premium for exporters (column 1), as long as we do not control for the importer status and productivity. Exporting firms charge 6.6% higher markups, on average, than firms of similar size and ownership that sell only domestically in a given industry and year. This estimated premium is however largely due to 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 13%, while the exporter premium falls to 2%, and becomes insignificant (column 2).

If we control for the past productivity level of the firm (column 3), we find that the positive exporter markup premium disappears and the importer markup premium more than halves. This suggests that the positive markup premium of trading firms is to a large extent due to the fact that these firms are more productive than non-traders.

In the last two columns of Table 4 we indeed find sizeable and significantly positive productivity premia for both exporters and importers. In fact, the importer premium is estimated to be at least twice as large as the exporter premium. We note here that our TFP variable is a revenue-based productivity estimate, which, apart from physical efficiency, is likely to also reflect firm heterogeneity in demand-side effects, pricing strategies or factor input prices. Hence, we cannot rule out that the large estimated importer productivity premium might partly be caused by input price variation embodied in our revenue TFP estimate.

5.2 Markup and trade by foreign market

An important feature of our model is the asymmetry in the toughness of competition between the domestic and the foreign economy. Domestic firms charge lower markups on the export market than domestically, because the foreign market is bigger and hence more competitive than the domestic one.

The most important trading partner of Hungarian manufacturing firms during our sample period was the then European Union with 15 developed member states (henceforth, EU15). In our sample, firms sell around 75% of their exports to and purchase 65% of their imported inputs from the EU15. The EU15 is a large single market for manufactures with an almost 40 times larger population than Hungary. All other export destinations of Hungarian firms are smaller, more fragmented markets and/or less important trading partners. Hence we assume that firms exporting more to the EU face tougher competition than other firms exporting to, for example, Eastern European or developing countries.

5It is not the change in the sample size that causes the change in the coefficient estimates. Reproducing regressions (1)–(3) on the shorter sample yields qualitatively the same results as on the whole sample.

6See De Loecker and Goldberg (2013) for a recent summary and discussion on the differences between revenue and physical TFP estimates.
To test our theoretical prediction that markups of exporters are smaller on big markets with fierce competition, we look at whether firms who export dominantly to the EU15 charge lower markups than exporters who also sell to other destinations. We do this exercise also for material importing, mainly for robustness, but also to see if there is variation in the cost-reducing effect of material imports by the level of development of the source country.

We identify firm-year observations with the EU15 as the dominant destination/source market by taking firm-years with an EU15 share in exports/imports above 90% (around the median in both cases). We estimate (15), adding interaction terms of $D^{ex}$ and $D^{im}$ with the dummies indicating the dominance of the EU15 market in exporting and importing, respectively.

Table 5: Markup premium and foreign markets

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable:</td>
<td>log markup</td>
<td></td>
</tr>
<tr>
<td>exporter</td>
<td>0.057***</td>
<td>0.015</td>
</tr>
<tr>
<td>exporter x EU15</td>
<td>-0.078***</td>
<td>-0.040**</td>
</tr>
<tr>
<td>importer</td>
<td>0.139***</td>
<td>0.059***</td>
</tr>
<tr>
<td>importer x EU15</td>
<td>-0.013</td>
<td>-0.006</td>
</tr>
<tr>
<td>log TFP(-1)</td>
<td>0.307***</td>
<td></td>
</tr>
</tbody>
</table>

Other controls: yes
Industry-year dummies: yes
Observations: 31,476 22,769
R-squared: 0.314 0.384

Notes: Markup is estimated from a value added Translog production function following De Loecker and Warzynski (2012). Other controls are a dummy for foreign ownership and firm size dummies. Robust standard errors with two-digit industry clusters are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Results in Table 5 give support to the theoretical prediction. The exporter markup premium is significantly smaller for firms exporting dominantly to the EU15 than for other exporting firms. This finding is robust to controlling for past productivity. For material importing we find no significant difference between the markups of the two types of firms. The results are qualitatively similar (not reported here), if we replace the EU15 with a broader set of developed countries that
also includes non-EU OECD countries.

5.3 Markup and the scope of exporting and importing

Next we look at the relationship between markup and the scope of trade. We capture export and import scope in two alternative ways. First as intensities, where export intensity is the share of export sales in total sales and import intensity is the share of imported materials in the total expenditure on material inputs. Second, we measure scope by the number of varieties (in terms of products and partner countries) traded by a firm.

Clearly, our simple two-country model with single-product firms provides limited implications for the scope of trade. The import scope enters the firm’s cost function (7) through import intensity and, by decreasing the cost of production, leads to higher markup.\footnote{As for the scope of export, our model predicts that, for a given level of productivity, firms with a larger export intensity will have a lower average markup, simply because a larger share of their sales is destined to the more competitive foreign market.}

We again estimate equation (15), but now, in addition to the exporter and importer dummies, $D^{ex}$ and $D^{im}$ also include the scope variables. We first capture a firm’s export scope by export and import intensities and report results in Table 6. Then we measure scope as the number of destination/source countries and the number of (6-digit) products the firm exports/imports and report results in Table 7.

We find that, on top of the importer markup premium, larger import intensity is also associated with significantly higher markups. It is in line with our model prediction: the larger share of intermediate inputs is sourced from abroad, the higher markup the firm is able to charge. In contrast, export intensity associates with lower markups, which is supportive for our composition effect. Namely, that average firm markup falls if the firm sells a larger share of its output on the more competitive foreign market.

Similarly, estimation results in Table 7 provide strong evidence for a positive association between markup and import scope. Firms that import a greater number of intermediate input varieties from a greater number of source countries tend to charge higher markups. This finding is in line with Halpern et al. (2011), who show robust positive relationship between productivity and import scope for a similar sample of Hungarian firms.

\footnote{For the connection between import intensity and the number of imported products see Halpern et al. (2011).}
Table 6: Markup premium with export and import intensities

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable: log markup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>exporter</td>
<td>0.081***</td>
<td>0.039***</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.013)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>export intensity</td>
<td>-0.063*</td>
<td>-0.088**</td>
<td>-0.049</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.035)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>importer</td>
<td>0.113***</td>
<td>0.041***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.012)</td>
<td></td>
</tr>
<tr>
<td>import intensity</td>
<td>0.130***</td>
<td>0.099**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.038)</td>
<td></td>
</tr>
<tr>
<td>foreign owned</td>
<td>0.103***</td>
<td>0.059***</td>
<td>0.043***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.017)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>log TFP(-1)</td>
<td></td>
<td></td>
<td>0.307***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.020)</td>
</tr>
<tr>
<td>Size dummies</td>
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<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Industry-year dummies</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Observations</td>
<td>31,476</td>
<td>31,476</td>
<td>22,769</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.299</td>
<td>0.313</td>
<td>0.384</td>
</tr>
</tbody>
</table>

Notes: Markup and TFP are estimated from a value added Translog production function following De Loecker and Warzynski (2012). Other controls are a dummy for foreign ownership and firm size dummies. Robust standard errors with two-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, we find no significant relationship between the export scope and firm markup, when export scope is defined as the number of export varieties.

6 Robustness

To be completed [...]

Cobb-Douglas and gross output markups

Endogeneous productivity

7 Conclusion

To be completed [...]

20
Table 7: Markup premium with export and import scope

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable: log markup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>exporter</td>
<td>0.015</td>
<td>0.030</td>
<td>0.029</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.019)</td>
<td>(0.020)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>e-countries</td>
<td>-0.001</td>
<td>-0.000</td>
<td>0.000</td>
<td></td>
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<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td></td>
</tr>
<tr>
<td>e-products</td>
<td>-0.008</td>
<td>-0.010*</td>
<td>-0.007</td>
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<td></td>
<td>(0.006)</td>
<td>(0.005)</td>
<td>(0.005)</td>
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<tr>
<td>importer</td>
<td>0.096***</td>
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<td>0.102***</td>
<td>0.039***</td>
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<td>(0.010)</td>
<td>(0.008)</td>
<td>(0.007)</td>
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<tr>
<td>i-countries</td>
<td>0.014***</td>
<td>0.009***</td>
<td>0.004*</td>
<td></td>
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<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td></td>
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<tr>
<td>i-products</td>
<td>0.005***</td>
<td>0.003</td>
<td>0.003**</td>
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<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.001)</td>
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</tr>
<tr>
<td>log TFP(-1)</td>
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<td></td>
<td></td>
<td>0.303***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.019)</td>
</tr>
</tbody>
</table>

Other controls: yes yes yes yes
Industry-year dummies: yes yes yes yes
Observations: 31,476 31,476 31,476 22,769
R-squared: 0.321 0.320 0.323 0.392

Notes: Markup and TFP are estimated from a value added Translog production function following De Loecker and Warzynski (2012). Other controls are a dummy for foreign ownership and firm size dummies. Robust standard errors with two-digit industry clusters are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

References


8 Appendix
Figure 3: Cumulative distribution of markups (VA, CD) by trading status

Figure 4: Cumulative distribution of markups (GO, TL, composite) by trading status