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Trade Complexity and Productivity

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Keywords: Trade openness, Firms' Heterogeneity, Productivity

JEL Classification: F12, F14, L25

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Trade Complexity and Productivity

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Abstract

We exploit a panel dataset of Hungarian firms merged with product-level trade data for the period 1992-2003 to investigate the relation between firms' trading activities (importing, exporting or both) and productivity. We find important self-selection effects of the most productive firms induced by the existence of heterogeneous sunk costs of trade, for both importers and exporters. We relate these sunk costs of trade to the relationship-specific nature of the trade activities, entailing a certain degree of technological and organizational complexity. We also show that, to the extent that imports and exports are correlated within firms, failing to control for the importing activity leads to overstated average productivity premia of exporters.

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1 Introduction

In the last twenty years the organization of production worldwide has undergone a fundamental change, whereby production of individual goods is increasingly fragmented among different production sites, often in different countries, as extensively discussed in Arndt and Kierzkowski (2001). Moreover, such a larger array of intermediate inputs often entails significant technology transfer costs, because some of the technologies are relatively complex, and therefore might require extensive problem-solving communication between the supplier and the producer (Keller and Yeaple, 2008).

In such a context it is not surprising to observe, at the aggregate level, a growing importance of traded intermediate inputs (Feenstra, 1998; Hummels, Ishii, Yi, 2001; Yi, 2003), while at the micro level we have evidence of manufacturing firms facing positive and significant sunk costs of trade (SCT), first measured by Das, Roberts and Tybout (2007) in the case of Colombian exporting firms. The existence of significant SCT is also consistent with an acknowledged feature of trading firms, that is only the most productive firms self-select into trading activities, as originally postulated in the seminal papers of Melitz (2003) and Bernard et al. (2003).

While the latter finding has been confirmed by a very large number of studies on exporters starting with Pavcnik (2002), more recent evidence has shown that, as for the case of exporters, also importers have a variety of positive attributes, being bigger, more productive and more capital-intensive than nonimporters, with both imports and exports appearing to be highly concentrated among few firms[1]. Such new evidence on importers can be used in order to provide further insights on the relationship between the productivity of a firm, the sunk costs it faces for the different trade activities, and its self-selection into trade.

On the one hand, exporters are assumed to face sunk costs linked to the marketing of their product and eventually the setup of a foreign distribution chain (Arkolakis, 2008). Importers, on the other hand, do not typically face these costs. Moreover, in nowadays globalized markets domestic firms can access imported intermediates without directly trading them, buying these inputs as standardized products from local distributors. Or they can import standardized goods or commodities traded on organized (e-)markets. In both cases, these firms would face zero or very limited SCT due to the organizational modalities of their sourcing, i.e. irrespectively of the traded product category[2].

However, the more recent data matching product and firm-specific trade transactions show that, as for exporters, a non-negligible number of firms import differentiated products through direct, contractual-specific transactions. These firms face the informational asymmetries linked to the imperfect monitoring of the quality of the purchased good, and the cost of transferring

[1] See Bernard et al. (2005 and 2007) for US; Castellani et al. (2008) for Italy; Muuls and Pisu (2007) for Belgium; Andersson et al. (2007) for Sweden; Kasahara and Lapham (2008) for Chile.

[2] In other words, if imports are undertaken through organized markets or relate to homogeneous products, the nature of the traded good (e.g. consumption, intermediate, capital) would not affect the sunk cost of trade, but possibly only the fixed ones.

the technology embedded into it. Moreover, to the extent that production of a given finished product requires the use of a relatively large number of specialized parts and components, eventually sourced from different countries, importers might also face input-specific fixed costs linked to the organizational aspects of the production process (different legal procedures, language and communication barriers, quality screening, etc.). As an example, Brembo, an italian multinational company active in the automotive industry, screens prospective suppliers worldwide on the basis of a 10-pages long questionnaire, involving detailed information on some 200 different items[3].

As a result, both importers and exporters might end up facing important SCT, a feature first detected by Kasahara and Laplam (2008) providing such evidence in the case of Chilean exporting and importing firms. If the nature of these sunk costs varies between the importing and the exporting activity, to the extent that imports and exports are correlated within firms, failing to control for the importing activity might bias the magnitude/interpretation of the detected productivity premium of exporters. Moreover, different characteristics of the traded bundle could generate different sunk costs, and thus give raise to heterogeneous trading premia across firms.

In this paper we therefore explore in greater details the relationship between the productivity premium of firms, their different trading activities and the sunk costs they might face. In particular the paper capitalizes on a dataset matching, for the case of Hungary, information on international transactions of firms at the product level with firm-level balance sheet data over a long time period, from 1992 to 2003. The case of Hungary constitutes an interesting quasi-natural experiment, since our data cover the decade in which the organization of production has changed worldwide, together with a good control for initial conditions, given the positive shock to trade and foreign investment flows which Hungary experienced after the signing of the free trade agreements with the European Union and the other Central and Eastern European countries in the early 1990s. Our data thus incorporates information on more than 6,500 cases of firms who switched their trade status during the considered period, over a total of some 192,000 firm-level observations.

Overall, in line with the results of Kasahara and Lapham (2008), we find a self-selection effect of the most productive firms for both importing and exporting firms. However, we also find that, when taking into account the importing status of exporting firms, the self-selection of exporters is still present but it is greatly reduced, with the coefficient related to the productivity premium more than halved. In other words, failing to control for the importing activity, as a large part of the literature has done insofar, leads to an overstated productivity premium of

[3]Brembo screens prospective suppliers not only in terms of prices, but also takes into account the quality, innovation and service of the purchased product; the possibility to involve the suppliers in their Environmental Management System, in order to reduce the environmental impact of all their activities; the presence of a quality system certification released by an accredited Certification body; the technical characteristics of the purchased product, etc. The details of Brembo purchasing policy, together with the questionnaire, are available at: http://www.brembo.com/ENG/AboutBrembo/Suppliers/CriteriaBrakes/SuppliersCriteria.htm

exporters. As in Bernard and Jensen (1999) for the export case, we find that also for importers productivity is a strong predictor of the probability of becoming a trader, with the coefficient higher for imports vs. exports, consistently with the previous result. We also show that there seems to exist a clear ordering of firms in terms of productivity driven by the import, not the export status: firms who never import are less productive then firms switching into imports, who are in turn less productive than firms having always imported. Instead, the effect of exports on productivity tends to be heterogeneous within each of these importing groups[4].

In order to provide a rationale for the latter finding, we discuss the possible origins of the sunk costs of trade, and the resulting heterogeneous self-selection of firms into different trading activities detected in our results. To this extent, we build various proxies of the complexity associated to the trading activity (importing or exporting), considering for each firm the heterogeneity in terms of number of traded products and destinations, the distance of each destination combined with its institutional quality, the extent of relationship-specific intensity of the traded bundle (measured through the Rauch index of product differentiation). We find all these indexes to be strongly correlated to the firm's productivity, but to a different extent between importers and exporters.

The paper is structured as follows. Section 2 presents data and preliminary evidence on trading activity. Section 3 discusses some measures of TFP for trading firms, while Section 4 presents the results of a number of models relating importing and exporting decisions to firms' productivity. Section 5 discusses the relationship between trade complexity, trade status and productivity. Section 6 concludes.

2 Data and preliminary evidence

We use a large and comprehensive panel of Hungarian firms obtained by merging tax and customs data for the period 1992-2003. The first dataset contains accounting and financial data of Hungarian firms. The source of data is the Hungarian Tax Authority (APEH). This database represents more than 90% of Hungarian employment, value added and exports and is almost complete outside the scope of non-trading micro enterprises. To avoid a number of potential problems in the calculation of firms' performance, in this paper we have restricted the analysis to manufacturing data only, with the Appendix reporting the number of firms per year and by NACE2 industry[5].

The APEH dataset has then been merged at the firm-level with a trade dataset, containing transaction-level data as registered by the customs office. The unit of observation in this trade dataset is firm-product-destination. The dataset includes information on both the dollar value of shipments and their physical quantity. In this paper we define the amount of trade as the

[4]The heterogeneous effect of the export treatment across different groups of firms goes along the same lines of the results obtained by Lileeva and Trefler (2007).

[5]The dataset and features of various types of trading firms is presented in Békés et al (2008).

Table 1: Trading activity and firms' characteristics

Trade status	*N. of obs.*	*Firms' characteristics*					
		Sales [(a)]	Empl.	VA [(a)]	Wage [(a)]	Capital	L/K
No traders	101,485	42.25	9.59	12.7	0.55	12.70	9.14
Exporters	12,074	83.41	17.29	23.56	0.67	25.19	8.25
Importers	28,627	155.44	17.31	42.33	0.84	44.43	5.55
Two-way traders	50,162	1409.62	117.43	375.5	0.95	433.99	4.27

(a) in Million HUF

dollar value of shipments. We have measures of export and import varieties in terms of number of different HS6 category good the firm trades[6]. We also have information on the countries of origins and destinations firms export to or import from.

Finally, the dataset also contains information on a firm's ownership, and thus allows us to control for the presence of multinational firms[7], a critical dimension of our analysis since foreign-owned firms might be trading within their international network, and thus could differ along several dimension from other firms (Feinberg and Keane, 2001). The third table in the Appendix reports how relevant foreign-owned firms are in our dataset.

In our framework a firm can be in one of the following four trading status FZ in a given year: firms that both import and export (two-way traders); firms that either import or export (only importer and only exporter); firms not engaged in any trade activity (no traders). Moreover, a firm can remain permanently into that trade status, or switch from one trade status to another. To attribute each trade status to each firm, for the time being the export/import status is measured as a year-specific dummy equal to one if the value of export and/or import is positive in a given year. The first columns of Table 1 show the number of firms by their trade status.

More than 37.9% of firms export and more than 29.9% import in our dataset, showing the important role international trade plays in life of firms operating in a small and open economy, like Hungary. Also, more than half of trading firms conducts two-way trade, although we find a large number of firms in each category, showing the heterogeneity of firms' trade statuses. Table 1 also shows the most important characteristics of firms with a different trading status. Trading firms perform better in all dimensions: they are larger, generate higher value-added and pay higher wages. Two-way traders are the highest performers, followed by only importers and only exporters. The differences are large and significant. Traders' operations are also more capital intensive.

Table 1 provides a static comparison of trading firms. However, looking at the data over

[6]"Motor cars and vehicles for transporting persons" is an example for a 4-digit category, while "Other vehicles, spark-ignition engine of a cylinder capacity not exceeding 1,500 cc" is an example 6-digit category. The number of varieties ranges in case of import from 1 to 797 and in case of export from 1 to 355.

[7]Throughout the paper, a firm is considered as foreign-owned if at least 10% of its capital is controlled by a foreign owner. We carried out robustness checks on the threshold. Given that most foreign acquistion leads to majority ownership within a few years, results are not at all sensitive to raising the 10% threshold to, say, 25%.

time, we find that 32% of our firms have altered their trade status within four years. In order to evaluate the persistency of the import and export status and the transition probabilities from one type of trading activity to the other, we have constructed a transition matrix of the various trade status FZ in which firms are engaged. Table 17 in Appendix shows the transition matrix of firms observed from 1993 to 1997, the one for firms observed from 1998 to 2003 being virtually identical[8]. Two features characterize our transition matrixes. First of all, we find evidence of the persistency of the two extremes in the trade status. Looking at the relative magnitude of the figures for non traders or two-way traders along the diagonal of the matrix, it is in fact true that firms who were in one of these two trade statuses at the beginning of the period (1993) are likely to remain in the same trade status at the end of the period (1997).

Second, similarly to the results of Kasahara and Lapham (2008) for Chile, we find that firms who originally only import or export have a probability of remaining in the same trade status comparable to the one of becoming either two-way traders or non traders[9]. Such persisting turbulence in the off-diagonal part of the transition matrix thus signals the fact that some firms have a transitory experience of trading, then reverting back to a non trading status, while some others, once they start trading, tend to move to the full spectrum of the trading activities, becoming two-way traders (the probability being the same whether they come from an import or export status). It thus seems that -in a small and open economy- importing or exporting only tends not to be a steady state equilibrium strategy for the majority of firms.

The preliminary evidence thus shows that trading firms seem to differ in a number of characteristics from non-traders, but also points to a certain heterogeneity both across the different trade statuses and over time. The next section tries to link these findings to firms' productivity premia.

3 TFP measurement in trading firms

The measurement of firm-level total factor productivity (TFP) for trading firms is subject to a number of econometric problems. There are several ways to measure total factor productivity, and each methods offer some advantage in treating endogeneity or being more adept to data availability. In this exercise, we use a modified version of the standard semiparametric TFP measure of Olley and Pakes (1996, henceforth OP). The main reason for this is that OP treats attrition explicitly, and for an economy, like Hungary, undergoing fundamental structural change, exit is rather crucial.

[8] Additional evidence, available on request, also shows that the presence of switching firms is balanced across sectors. The only relatively significant difference in terms of timing is that no-traders are slightly less likely to remain in the same status in the second period of our analysis, with 79% of firms not engaged in any trade activity in 1993 remaining such in 1997, compared to 68% for the period 1998-2003. The latter findings are consistent with the increasing opening up of the Hungarian economy along the transition to the market.

[9] This is especially the case in the period 1993-1997, and, to a certain extent, also in the period 1998-2003 for exporting firms. The importing status seem to persist more in the 1998-2003 period.

Several small changes are made to the original OP methodology. We start from a log-linearized Cobb-Douglas production function of the form

$$y_{it} = \beta_0 + \beta_l \, l_{it} + \beta_k \, k_{it} + e_{it} \tag{1}$$

where the log of output (value-added) of firm i at time t, y_{it}, is a function of the log of labor input l and the log of the capital input k. It is assumed that $e_{it} = \omega_{it} + \epsilon_{it}$, and ω_{it} follows a first order Markov process.

The calculation of TFP as the Solow residual of the estimated Equation 1, with no a priori assumption imposed on the industry-specific returns to scale, is subject under OLS to a well-known simultaneity problem, accruing from the fact that profit-maximizing firms can immediately adjust their inputs each time they observe a productivity shock, which makes input levels correlated with the same shocks.

Moreover, a second endogeneity problem arises from sample selection, induced by the fact that firms leave the market when productivity falls below a certain threshold. Since surviving firms will have a TFP derived from a selected sample, ignoring this selection mechanism may bias estimates of productivity. Finally, given the heterogeneity we have detected in the preliminary analysis, it might be the case that the firm's decision to invest or exit the market is quite different for different types of trading firms, and thus the trade status should not be treated as exogenous when estimating TFP.

In order to tackle all these problems, we follow Amiti and Konings (2007, henceforth AK) and measure firms' TFP through an industry-specific two-stage estimation, in which we control for the simultaneity bias induced by the productivity shock, the selection equation of firms' survival and the impact of the firm's trade status (importer, exporter or both) on input choices. In terms of regressors, as it is common in the literature, we have used value added to proxy output, the number of employees as a proxy for the labour input, and the deflated value of tangible fixed assets as a proxy for capital. In particular, we have deflated our balance sheet data using disaggregated industry price indexes.

However, using national PPIs to deflate balance sheet data does not control for the fact that output and factor prices might be different and/or evolve differently over time for trading firms, which might induce an omitted price variable bias in our estimates. The problem is particularly relevant for importing firms, since, as acknowledged by AK (2007), differentials in TFP across firms might accrue from differences in domestic and (imperfectly measured) import prices, rather than actual changes in the quality of imported inputs. To control for such a price effect in TFP estimation, we have carried on two adjustments to the standard methodology.

First, we have calculated the real value added variable by taking into account two potential sources of inputs, domestic and international ones. Since, contrary to AK(2007) we do not have a deflator for imported inputs, we exploit the information on the source of imports. Thus, we have used the real exchange rate in order to deflate for trading firms the imported inputs differently

from the domestic ones[10]. Hence, our value added (VA) is calculated as $VA = (Domestic\ Sales + Exports) - Domestic\ materials - (Imported\ materials * REER)$.

Second, we have introduced some changes to the semi-parametric estimation algorithm currently used in the literature. AK(2007) have proposed that import and export decisions at time $t-1$ should be treated as additional state variables, together with productivity and capital, in the firm's investment demand function. Formally, they modify the OP algorithm to derive the following measure of productivity ($OP-AK$):

$$y_{it} = \beta_l\ l_{it} + \Phi_{it}(I_{it}, k_{it}, FM_{it}, FX_{it}) + \eta_{it} \tag{2}$$

where they exploit the fact that the investment demand function of the firm I_{it} can be written as a function of four states variables: capital k_{it}, productivity ω_{it}, the import status (FM) and the export status (FX). The latter, once inverted, gives an expression for productivity as a function of investment, capital and the trade status[11]. Since productivity is incorporated in the error term e_{it} of Equation 1, by substituting its expression as a function of the state variables yields Equation 2. The latter, once estimated through semi-parametric procedures and a survival equation, allows to recover consistent estimates of the input coefficients, and thus obtain an unbiased TFP measure.

As shown in Eq. 2, the $OP-AK$ measure incorporates two dummy variables, one for importing firms and one for exporting firms in the investment equation. However, given that productivity may be differently affected by the characteristics of the imported goods, and since the latter are likely to be correlated to the factor intensities / institutional environment of the country from which imports are sourced (Nunn, 2007), we have further refined the estimation algorithm by including two separate dummies for firms importing the largest part of their inputs from low vs. high-wage countries. In this way, we can better discriminate between labor-intensive, low-priced imports vs. high-quality, capital intensive ones, and thus minimize potential price distorsions in the estimation of productivity.

Hence, our modified OP measure of productivity correcting for the trade exposure of firms ($OP-TR$) modifies the investment demand equation incorporating three state variables related to the relevant trade statuses of the firm[12].

$$y_{it} = \beta_l\ l_{it} + \Phi_{it}(I_{it}, k_{it}, FML_{it}, FMH_{it}, FX_{it}) + \eta_{it} \tag{3}$$

[10]Note that changes in the REER would immediately impact the recorded value vs. quantity of imports, while exported values would not change, as exports are denominated in local currency. Clearly, in equilibrium export quantities would be affected by changes in the REER, an issue we address in one of our robustness checks.

[11]The main assumption of the OP technique is based upon the existence of a monotonic relationship between investment and the unobserved heterogeneity at the firm-level.

[12]Three dummy variables measuring if a firm imports from a low-wage vs. high-wage economy, or if it exports. Relative low-wage economies were defined as having no more than 50% higher wages than the destination country, Hungary. Relative high-wage economies were defined as having more than 50% higher wages than Hungary. Relative capital intensive economies are basically from Western Europe, North America and Japan. All Central and Eastern Europe and most of Asia belongs to the other category.

Table 2: Trading activity and productivity premia

Trade status	*N. of obs.*	*TFP* [(a)]				
		LP	OLS	FE	OP-AK	OP-TR
No traders	101,485	0.69	2.44	1.40	0.64	0.68
Exporters only	12,074	0.7	2.85	1.67	0.83	0.87
Importers only	28,627	1.32	2.79	1.76	1.26	1.29
Two-way traders	50,162	1.48	4.15	2.91	1.54	1.61

LP: Levinsohn-Petrin (2003) semi-parametric algorithm, using materials as proxy;

OP-AK: modified version of Olley-Pakes (1996) algorithm as in Amiti and Konings (2007).

OP-TR: modified TFP estimate for various traders, as described in Section 3.

Number of observations refer to OP, it varies slightly by the methods.

where the import status is now split into import from low wage (FML) as well as high wage (FMH) countries.

By treating imported inputs differently from domestic ones, and by considering where imports originate as well as their presence, the risk of picking up a price effect in our estimated TFP for imported firms should be reduced.

Table 2 reports the average TFP for the different groups of trading firms in our sample. In particular, consistently with the analysis of firms' characteristics discussed in the previous section, the data show that shows that two-way traders are almost twice as productive as non-trading firms. Moreover, the difference between non-traders and exporters is relatively small, while the productivity of only importers is closer to that of two-way traders.

For robustness, we present in Table 2 the results with TFP calculated following OLS and fixed effects (FE), the standard semi-parametric estimation suggested by Levinsohn and Petrin (2003), the OP-AK procedure and our TFP measurement algorithm - refined for various types of traders, denoted as OP-TR. Results are robust across all methods, with TFP measures slightly differing in the point estimates, but a significant difference in terms of trade status always confirmed.

For Belgium and Italy, in particular, Muuls and Pisu (2007) and Castellani et al. (2008) have found that two-way traders (i.e. firms that both import and export) appear to be the most productive, followed, in descending order, by importers only, exporters only and non-traders.

Graph 1 confirms the ranking of productivity not only for the mean firm, but also in terms of dominance of the cumulative distribution of (log) TFP, using our modified algorithm. The same picture of stocastic dominance remains constant using the Levinsohn-Petrin (2003) measure as robustness check, within each industry of our dataset and across the individual years[13].

[Graph 1 about here]

[13]The only slight deviations have been detected in industry NACE-19 (leather) with exporters slightly more productive than importers, and NACE-26 (metals), where exporters and non traders showed a very similar TFP. These are however sectors accounting for less than 7% of total firms in our sample, as reported in Annex.

Table 3: Trading activity, productivity premia and firms' ownership [(a)]

Trade status	*All*	*Domestic*	*Foreign-Owned*
No traders	0.68	0.68	0.69
Exporters only	0.87	0.88	0.84
Importers only	1.29	1.22	1.49
Two-way traders	1.61	1.44	1.77
Average	1.07	0.94	1.42

(a) OP-AK1: modified TFP estimate, as described in Section 3.

The ranking of productivity by trade status is also confirmed when partitioning our sample according to ownership, as shown in Table 3. For both domestic and foreign-owned firms, two-way traders are the most productive group, followed by importers, exporters and non traders. Simple TFP averages reveal that foreign-owned firms are more productive than domestic ones, consistently with the theory. When disentangling this information across the trade status, domestic and foreign-owned firms do not differ much in terms of productivity when they are either non trading or exporting only[14], while the productivity premia accruing to foreign-owned firms vs. domestic ones become larger for importers or two-way traders.

All these results consistently show that the importing activity seems to be more strongly associated with higher productivity levels than exporting. The latter might imply that the selection process of firms is different for exporting and importing, an issue to which we now turn.

4 Trading activities and productivity

4.1 Importers vs. Exporters

With respect to the previous evidence, some unobserved firms' characteristics, associated to both TFP and the trade status, might induce a spurious correlation between the trading activity and productivity. For instance, we have seen that foreign ownership affects productivity a great deal and the share of foreign firms is higher among traders than non-traders. As a result, we need to validate these results via a multi-variate regression. To this extent, we have estimated the following Equation (4):

$$\omega_{it} = \beta_0 + \beta_1 FZ_{it} + \beta_2 X_{it} + a_z + a_t + \varepsilon_{it} \tag{4}$$

[14]We find an export premium with respect to non-trading firms, but very similar across domestic and foreign-owned firms. A closer look at the productivity distribution of these firms for those two trade statuses reveals that the least productive firms are domestic non-traders, and the most productive ones are foreign-owned exporters, consistently with the theory. Some slight deviations from the log-normal distribution of TFP then lead to simple means becoming quite similar across the two groups of firms.

Table 4: Productivity level, firm characteristics and trading activity

Sample		Full sample		Exporters	Importers
Dep var: TFP (a)	(1)	(2)	(3)	(4)	(5)
FZ= Exporter	0.362***	0.157***			0.149***
	[58.17]	[22.96]			[15.73]
FZ= Importer		0.463***		0.450***	
		[69.42]		[40.34]	
FZ= Importer only			0.461***		
			[55.94]		
FZ= Exporter only			0.152***		
			[15.20]		
FZ= Two-way trader			0.621***		
			[87.04]		
Firm age	0.0453***	0.0449***	0.0449***	0.0442***	0.0447***
	[36.57]	[36.83]	[36.83]	[24.06]	[25.37]
Firm size	0.163***	0.141***	0.141***	0.131***	0.139***
	[69.77]	[60.07]	[59.58]	[38.99]	[44.11]
Foreign firm	0.209***	0.142***	0.142***	0.239***	0.258***
	[30.89]	[21.30]	[21.20]	[28.38]	[31.54]
dummy: region	yes	yes	yes	yes	yes
dummy: sector	yes	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes	yes
Constant	0.0135	0.11	-0.0642	-1.076***	-0.651***
	[0.0698]	[0.572]	[-0.332]	[-17.19]	[-13.32]
Observations	149797	149797	149797	56695	69822
R-squared	0.25	0.275	0.275	0.295	0.236

Value of t statistics; ** significant at 5%; *** significant at 1%

(a) TFP: OP-AK1, modified TFP estimate, as described in Section 3.

where the level of TFP of each firm ω_{it} is regressed against a dummy indicating the trade status of the firm FZ at time t, a number of firms' characteristics X widely used in the literature to control for productivity determinants, such as firm's size (log annual employment), foreign ownership (dummy = 1 if foreign equity above 10%), and the firm's age (here proxied by the time spent in the sample), plus a full set of industry, regional (to control for border effects) and time dummies.

The results, presented in Table 4, show that, when considering exporters, as it is standard in the literature (Column 1) we retrieve the usual positive correlation with TFP, even when controlling for firms' characteristics typically associated with productivity. However, recalling our results on the importing activity of firms, such a model specification overlooks the fact that some of those exporters might also be involved into importing activities, and thus, to the extent that import and exports activities take place jointly, the productivity premium of exporters might actually derive from their import, rather than export, status. In fact, if we add the import status in our regression (Column 2), we find that also the importing activity is positively

and significantly correlated with productivity and, most importantly, that the inclusion of the import dummy lowers the magnitude of the productivity premium for exporters by more than 50%.

A possible explanation of this finding is that the import and export dummies might be correlated, to the extent that some 70% of our firms are two-way traders. The latter correlation would then be driving both results. To clarify things, in Column 3 we have thus partitioned our sample in mutually exclusive categories (only importers, only exporters, two-way traders), always controlling for firms' characteristics, and thus keeping non traders as the control group. As it can be seen, every trade activity is positively and significantly associated to productivity, with our ranking of productivity premia by trade status confirmed. In particular, two-way traders are on average 62% more productive than non-traders, followed by only-importers (46%), while being only an exporter adds 15% to TFP with respect to non-trading firms.

As a further check, in Columns (4) and (5) we have changed our control group, by running the import and export dummies on the restricted sample of exporting firms and importing firms, respectively (thus excluding non traders): again, we find that the premium in terms of TFP accruing to two-way traders is larger when it comes from exporters adding the importing activity, rather than importers which add export and become two-way traders, always controlling for firms' characteristics.

These preliminary results may depend on the definition of a trading firm, which insofar follows the standard in the literature: a year-specific dummy equal to one if the value of export and/or import is positive in a given year. However, firms might be heterogeneous in terms of the timing of the trade exposure, with some firms trading more regularly over time then others. As a first robustness check, we have therefore checked our result against a more restrictive definition of trading firms, considering as exporters (importers) those firms who have exported (imported) at time t at least 0.5% of their sales for more than 50% of the time between t and exit/end of sample[15]. Second, to the extent that some importing firms might be substituting imported intermediates with labor or capital, it could be that the former induce a correlation across inputs, biasing our measure of TFP. Thus we have estimated our TFP using only domestic materials in our calculations for value added. To control for potential impact of the real exchange rate on exports, we have also calculated VA using $Sales = Domestic\ Sales + Export * REER\ deflator$. Finally, we have also experimented excluding micro firms from our sample (firms with less than 5 employees).

Table 5 reports the coefficients obtained for our trade status dummies in regressions where we have implemented our robustness checks always controlling for the same firms' characteristics and industry, regional and time dummies as in Equation (4)[16]. The first column reports our baseline result (Table 4 - Column 3): as it can be seen, our ranking in terms of productivity

[15]This is the definition employed by Mayer and Ottaviano (2007) in their comparative study of the trade performances of European firms.

Table 5: Robustness checks

Variables	Baseline	Stable traders	TFP with VA1	TFP with VA2	>5 Empl.
Dep var: TFP	(1)	(2)	(3)	(4)	(5)
Importers only	0.461***	0.508***	0.767***	0.496***	0.394***
	(0.0082)	(0.0084)	(0.0086)	(0.0081)	(0.0091)
exporters only	0.153***	0.147***	0.163***	0.141***	0.0528***
	(0.01)	(0.0108)	(0.0101)	(0.0103)	(0.0105)
two-way traders	0.620***	0.631***	1.137***	0.6154***	0.503***
	(0.0071)	(0.0074)	(0.0078)	(0.0072)	(0.0074)
Observations	149797	149797	151568	149268	101173

p<0.01, ** p<0.05, * p<0.1, robust standard errors
Stable traders: trade at least 50% of their lifespan.
VA1: value added not include imported materials
VA2: value added using REER deflator for exports

perfectly holds.

Once endowed with this robust evidence on the relation between imports and firms' performance, we are interested in exploring the possible channels leading to the import vs. export decision. To this extent, we have followed Bernard and Jensen (1999) estimating a probability model of starting a trading activity of the form

$$T_{it} = \alpha + \beta_1 \omega_{it} + \beta_2 X_{it-1} + \gamma T_{it-n} + \Phi + \varepsilon_{it} \tag{5}$$

where T is a dummy variable taking value 1 if a firm is an exporter (importer) and 0 otherwise. TFP is denoted by ω_{it} and plant characteristics, such as such as firm size (log annual employment), firm wage level (log firm level average gross wage) and foreign firm (ownership dummy: foreign if foreign equity above 10%) are included in the vector X, while Φ is a vector of industry, region and time fixed-effects. Regressors are lagged one year to reduce possible simultaneity problems.

The results are reported in Columns (1) and (2) of Table 6 as marginal effects for the average exporter and importer, respectively. The coefficients show that the trade activity is highly persistent (the variable T_{-n} is always positive and significant), and associated to similar firm's characteristics as above (foreign ownership, size). Most importantly for our goals, we find that productivity is a much stronger predictor of the probability of becoming an importer (.094) than an exporter (.055)[17].

All the above evidence is thus consistent with the conclusion that exporters are relatively more similar in terms of productivity to non-traders, while importers and two-way traders are much more productive. In other words, there is evidence consistent with a possible self-selection

[16]Technically, based on the results of Table 3, showing a non-constant effect of foreign ownership on the trade status, we could have interacted the trade dummies with foreign ownership. However, that would have further boosted our premia for importers and two-way traders vs. exporters and non-trading firms. As a result, in the remaining of the paper we will only include a foreign-dummy as control, without interaction terms, knowing that our results would be magnified for foreign-owned firms.

[17]As a robustness check we have run again our specification on the more restrictive definition of trading firms, finding virtually identical results.

Table 6: Probability of being a trader - marginal effects

VARIABLES	exporter	VARIABLES	importer
Dep. var: Trade status			
TFP	0.0551***	TFP	0.0941***
	[30.13]		[39.20]
exported in (t-1)	0.752***	imported in (t-1)	0.755***
	[224.1]		[232.5]
exported in (t-2)	0.325***	imported in (t-2)	0.339***
	[45.50]		[49.11]
Firm size	0.0807***	Firm size	0.0813***
	[62.00]		[52.91]
Foreign firm	0.147***	Foreign firm	0.197***
	[39.26]		[44.95]
Firm age	-0.0109***	Firm age	-0.00945***
	[-13.61]		[-10.11]
Former SOE	-0.0275***	Former SOE	-0.0530***
	[-6.877]		[-11.21]
dummy: region	yes	dummy: region	
dummy: sector	yes	dummy: sector	
dummy: year	yes	dummy: year	
Observations	149791	Observations	149791
Pseudo R-squared	0.601	Pseudo R-squared	0.581

Marginal effects calculated at average values.

* p<0.01, ** p<0.05, * p<0.1 , Robust z-statistics in parentheses.

effect of importers and the associated productivity premium, an effect larger than the one entailed by exports. Failing to control for the importing activity within the exporting firms might thus lead to an overstated productivity premia of exporters, a finding insofar largely neglected by the literature.

4.2 Switching firms

Data reported in Section 2 showed that about one-third of firms have altered their trade status within four years, with many firms switch from being a non-trader to importing or exporting activity. A small but not negligible group of firms switches from no trade to two-way trade in the same year. Focusing on switching firms allows to inspect how adding a trade activity alters the performance of the firm with respect to its pre-switch productivity, thus deriving insights on the potential self-selection of firms into the same trade activity.

In order to prevent the already discussed phenomenon of 'occasional' traders to bias upwards our count of firms changing trade status, we define as 'switcher' a firm which in a given year starts to either import or export (or both) at least 0.5% of its output, and then does not revert back to the previous status in the remaining of the time in which it is present in the data. Thus, consistently with a self-selection hypothesis induced by fixed costs, we only consider 'permanent' switchers.

Table 7 summarizes the characteristics of switching firms in terms of TFP, the latter being always calculated following the AK1 modified semi-parametric algorithm. In particular, Table 7 reports, for every type of switch and for non-switching firms, the average level of TFP in the year t in which the switch has taken place and the TFP at time $t-1$.

Table 7: Switching into different trading activities and productivity (a)

		Num. Firms	TFP (t)	TFP (t-1)
New import (t)	Total	3964	1.14	0.84
	o/w. no trade in (t-1)	3505	1.12	0.82
	o/w. exported in (t-1)	459	1.27	0.95
New export (t)	Total	3662	1.19	0.92
	o/w. no trade in (t-1)	2448	1.01	0.70
	o/w. imported in (t-1)	1214	1.56	1.30
New two-way (t)	no trade in (t-1)	1135	1.14	0.67
Never switchers	Total	26320	1.01	
	o/w. Nontraders	18236	0.71	
	o/w. Importer only	2764	1.40	
	o/w. Exporter only	1022	0.87	
	o/w. Two-way trader	4298	1.63	

(a) TFP: OP-AK1, modified TFP estimate, as described in Section 3.

As it can be seen, the average ex-ante productivity of non-trading firms who switch into import is significantly higher than the ex-ante TFP of non-trading firms switching into export (.82 vs. .70). However, if we just consider a generic 'export-premium' in terms of productivity, as much of the literature has been doing, we would (incorrectly) claim that switchers into exports are ex-ante much more productive than non trading firms (.92 vs. .71), but this is essentially driven by the fact that, among the switchers into exports, there are very productive importing firms (ex-ante TFP of 1.30). Failing to account for the presence of importers thus largely overstates the relevance of export switching in terms of productivity performance, consistently with previous results.

We have also checked whether the stronger self-selection effect detected for importers might be driven by some unobserved time-varying characteristic according to which firms switching into importing are located on ex-ante TFP growth trajectories higher than other firms, as suggested by Arnold-Javorcik (2005) when analysing the productivity gains of foreign-acquired firms. In particular, we control for the growth rates between t-2 and t+2 of the time t at which the switch in status takes place. Controlling also for the TFP gains at t+2 allows us to verify whether significant differences exist between importers and exporters not only in the pre- but also in the post-switch performance.

We have therefore calculated a TFP growth rate as $D = [\ln(TFP)_{t+2} + \ln(TFP)_{t+1}] - [\ln(TFP)_{t-2} + \ln(TFP)_{t-1}]$, i.e. the average change in productivity obtained in the two years after the switch with respect to the performance of the two years before the switch. To control for possible common industry and time-specific shocks which, in a given industry/year might affect productivity for all firms (thus including the switchers), we have also constructed a variable D^* where the firm-specific TFP of the switcher has been normalized for the industry mean in the corresponding year used in the calculation. We have found a positive correlation between the switch into a new trade activity and productivity growth at the firm level for both importers and exporters: both our variables D and D^* are always positive and very similar, thus excluding a potential special behaviour in TFP growth of our importing firms[18].

To investigate self-selection, we look at how switch in time t affects TFP $(t-1)$. A positive coefficient would suggest that switching firms are ex-ante more productive. We run:

$$\omega_{it-1} = \beta_0 + \beta_1 \Delta FZ_{it} + \beta_2 X_{it} + a_j + a_t + \varepsilon_{it} \tag{6}$$

where we have regressed the level of TFP of each firm ω_i at time $t-1$ against the switch in the trade status of the firm, measured through a dummy variable ΔFZ taking value 1 if a firm permanently switched to a new status (export or import) at time t and 0 otherwise. In the regression we control for a number of firms' characteristics X (such as firm size (log annual

[18]We also find that the ex-ante productivity of firms switching into two-way trading (.68) is some 15% below the one of switchers into import or export status alone. However, around 50% of firms switching to two-way trade are part of multinational groups (i.e. they are likely to face lower barriers to internationalisation), while MNE affiliates represent only some 20% of switchers in the import or export-only case.

Table 8: TFP and switching

Trade activity	Exporters	Exporters	Importers	Importers
SAMPLE	NT-EXP	NT-EXP IMP-2way NT-2way	NT-IMP	NT-IMP EXP-2way NT-2way
Switch dummy	-0.0269	-0.0336	0.126***	0.0591**
	[-0.809]	[-1.276]	[4.361]	[2.480]
Firm size	0.191***	0.198***	0.191***	0.180***
	[46.18]	[55.50]	[46.29]	[47.21]
Foreign firm	-0.0300**	0.143***	-0.0281**	-0.0410***
	[-2.345]	[13.32]	[-2.200]	[-3.484]
Firm age	0.0557***	0.0561***	0.0554***	0.0551***
	[24.61]	[27.85]	[24.60]	[26.45]
Former SOE	-0.0177*	-0.0501***	-0.0171*	-0.0206**
	[-1.767]	[-5.537]	[-1.711]	[-2.197]
dummy: region	yes	yes	yes	yes
dummy: sector	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes
Constant	-0.591***	7.385	-0.580***	-0.732***
	[-10.13]	[]	[-9.999]	[-14.13]
Observations	63741	82360	64068	71804
R-squared	0.173	0.185	0.172	0.167

employment), foreign firm (ownership dummy: foreign if foreign equity above 10%), and Firm age, proxied by time spent in the sample), industry and time dummies.

In Columns (1) and (2) of Table 8 we have checked whether firms permanently switching at time t from a no-trade status to the exporting-only vs. the importing-only activity, respectively, are characterized by a productivity level at time $t-1$ significantly higher than non-trading firms. To broaden the scope of our analysis, in Columns (3) and (4) we have included firms switching, respectively, into exporting vs. importing activity from any other trade status, comparing their productivity levels at time $t-1$ to other non-switching firms.

The results show that firms switching into exports-only do not differ ex-ante from non-trading firms, while firms switching into imports-only are ex-ante 12.5% more productive than the average non-trading firm. The results hold controlling for or a number of firms' characteristics, as well as industry, time and regional dummy. The same is true when we consider a more general case of switching into export (import) from any other trade status: in this case, firms switching into imports are ex-ante 6% more productive than the control group.

Thus, we confirm our finding that self-selection of firms into trade seem to be a feature of the importing, rather than the exporting, activity.

Having seen the ex-ante relationship, we turn to testing if the probability of adding a new trade activity is affected by TFP, running on the sample of switching firms the following speci-

Table 9: Probability of adding a new trade function-marginal effects

	NT to Export	0 to Import	Imp to 2-WT	Exp to 2-WT
	Starting to trade		**Second Trade Activity**	
TFP	0.00140***	0.00616***	0.00588***	0.0267***
	[3.976]	[11.84]	[4.197]	[8.253]
Firm size	0.00221***	0.00182***	0.0157***	0.0190***
	[7.161]	[4.453]	[14.13]	[9.365]
Foreign firm	0.00322***	0.00791***	0.0296***	0.0134**
	[3.079]	[5.815]	[8.804]	[2.090]
Firm age	-0.00163***	-0.00392***	-0.00832***	-0.0109***
	[-11.17]	[-19.76]	[-12.82]	[-9.281]
Former SOE	-0.00250**	-0.00732***	-0.0204***	-0.0431***
	[-2.479]	[-5.434]	[-5.224]	[-6.872]
dummy: region	yes	yes	yes	yes
dummy: sector	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes
Constant	-1.597***	-1.882***	-1.009***	-1.581***
	[-8.586]	[-11.04]	[-4.952]	[-3.767]
Observations	76430	76955	21018	8519
Pseudo R-squared	0.0779	0.0908	0.0969	0.108

Marginal effects calculated at average values.

* p<0.01, ** p<0.05, * p<0.1 , Robust z-statistics in parentheses.

NT: no traders; 2-WT: two-way traders

fication:

$$T_{it} = \alpha + \beta_1 \omega_{it-1} + \beta_2 X_{it-1} + \Phi + \varepsilon_{it} \tag{7}$$

where T is a dummy variable taking value 1 if a firm does take up a new trading mode and 0 otherwise. TFP at $t-1$ is denoted by ω_{it-1} and plant characteristics, such as firm size (log annual employment), firm wage level (log firm level average gross wage) and foreign firm (ownership dummy) are included in the vector X_{it-1}, while Φ is a vector of industry, region and time fixed-effects. Regressors are lagged one year to reduce possible simultaneity problems. Results are presented in Table 9. We consider two comparisons: non-trading firms starting to export (Column 1) vs. non trading firms starting to import (Column 2); firms that did import starting to export (Column 3) vs. firms that did export starting to import (Column 4).

Consistently with the previous results pointing at positive but heterogeneous fixed costs of trade, possibly higher for importers, we find that, for both comparison, productivity is a much stronger predictor of the probability of becoming an importer than an exporter (.006 vs. .001 and 0.027 vs. .006, respectively).

The relevance of the importing status in self-selecting firms is also evident by looking at Graph 2, where we show the average TFP premium of firms categorized by trade status with respect to the average TFP of the entire sample. As it can be seen, a change in the import

status clearly partitions the sample of firms in three sub-groups, ranked in terms of TFP from no importer (whose productivity is 21% below the average firm in the sample) to new importer (14% more productive) to permanent importer (42%). No such clear-cut selection can be obtained looking at the export status only: as it can be seen, firms who start exporting can be either above or below the average TFP, depending on their import status[19].

[Graph 2 about here]

All the evidence collected insofar is thus consistent with the idea that the actual self-selection of Hungarian firms in international markets takes place via the importing, rather than the exporting, activity; we have also showed that such a self-selection effect seems to derive from features linked to the importing rather than exporting activity. In the next section we argue that the latter is due to the inherently higher complexity of the importing vs. the exporting activity.

5 Complexity of trade

We have seen that the trade status partitions firms in terms of ex ante productivity, an effect likely driven by the existence of important sunk costs of trade for both the importing and exporting activities. The latter finding is consistent with the results of Kasahara and Lapham (2008), who have provided such evidence in the case of Chile for both exporting and importing firms. We have also found that these sunk costs, to the extent that they drive self-selection, seem to be more important in the case of importing and two-way trading firms. We can thus postulate that SCT are actually heterogeneous not only across firms (as already detected by Das, Roberts and Tybout, 2007 in the case of exporting activities), but most importantly across trade statuses, and explore the possible sources of this heterogeneity.

Our working hypothesis is that, in a world characterized by complex production processes of differentiated goods organized across borders, both importers and exporters face important sunk costs of trade related to the organizational complexity of the trading activity. Moreover, to the extent that each imported product would need to be tailored to the specific needs of the firm in a context of informational asymmetry, and because in general a larger variety of inputs (among which those imported) would need to be used to produce one (possibly exportable) output, it could be possible that the strategic choice of importing might require a more complex (or contractual-intensive) organization of production than the choice of exporting only, thus

[19] We find changes in the export status to be correlated with the productivity of the considered firm in line with previous empirical evidence (effects grow larger from no exporter, to new exporter to permanent exporter); however, the effects in terms of productivity are of a second-order magnitude with respect to the partitioning generated by the import status. These results are confirmed. These results are confirmed by a multivariate regression, available on request, controlling for a number of firms' characteristics, as well as industry, time and regional dummy and the average growth rate of TFP in the given industry/year.

inducing the seemingly stronger self-selection effect of importers detected in our results[20].

Under the latter hypothesis, our previous findings would therefore imply that ex-ante more productive firms are active into more complex trade activities, and that this effect is stronger for importing firms. To test this, we employ a number of proxies for complexity, measurable for both importers and exporters. The number of HS2 categories ($HS2$) of goods traded by each firm is used as proxy for technological complexity, the idea being that dealing with products pertaining to different HS2 industry entails the use of different technologies and thus potentially lower economies of scale/scope in the transfer of technology[21]. The Rauch index of product differentiation ($Rauch$), constructed as a weighted average of each bundle of products traded by the firm, is used as a proxy for organizational complexity, the idea being that the more differentiated the traded goods are, the more relationship-specific (thus involving higher sunk costs) the trade transactions are likely to be (Nunn, 2007).

Finally, we construct a composite index of complexity (C_I) encompassing the number of countries the firm trades with (a proxy for the transaction costs), weighted by their geographical distance (a proxy for transport costs) and the quality of their institutions (a proxy of organizational costs), as a broader measure of trade complexity. In particular, the index is constructed for each year t as follows:

$$C\_I = \sum_i reldist_i * relRoL_i$$

where $reldist$ is the relative distance (in logs) between country i and the closer country to Hungary[22], while $relRoL$ is the yearly value of the World Bank indicator of institutional quality (Rule of Law) for country i, rescaled on an index ranging from 1 (best institutional system) to 2 (worse)[23]. As a result, if a firm trades only with the closest country to Hungary, which has also the highest level of institutional quality, the C_index of that firm would be 1, which constitutes the lower bound of this continuum index of complexity.

Table 10 reports some descriptive statistics on the average value of these measures of complexity for our different types of trading firms. As it can be seen, importers tend to have a larger complexity of their trade activities with respect to exporters as measured by our proxies, in line with our claim; the picture gets instead less straightforward when two-way traders are

[20]Such an hypothesis is in line with the findings of Jorgensen and Schroder (2008) who, capitalizing on recent results of the international organization literature, show in a theoretical model how marginal cost heterogeneity à la Melitz (2003) would tend to reflect sectors dominated by traditional integrated firms, while heterogeneous fixed cost models, possibly driving the self-selection of importers detected in this paper, would relate to situations prevailing in industries featuring the existence of production networks.

[21]We have also experimented with the number of HS6 products, obtaining very similar results. However, a broader range of products traded by the firm within the same industry might not proxy necessarily complexity, but rather a love for variety effect.

[22]The distance is constructed for each firm as the sum of the volumes of the traded goods weighted by the relative distance (in logs) between country i and the closer country to Hungary.

[23]The original Rule of Law indicator ranges from -2.5 to 2.5. Note that, since the closest country to Hungary is at 114Km, while the furthest at some 18.000Km, taking the ratios of log distances implies that the distance variable ranges from 1 to 2.06. Thus, rescaling the Rule of Law indicator implies that trading with the furthest country is roughly as complex as trading with the country with the worse institutional quality.

taken into account. Table 10 also shows that, on average, importers tend to trade their bundle of products from a higher distance then exporters: we can thus rule out that the higher productivity attributed to importers derives from a systematic closeness (and thus lower transport costs) of their trading activities.

Table 10: Complexity indicators and firms' trading activities

	oneway		twoway	
	export	import	export	import
Distance	2.85	3.03	2.91	3.01
HS2	1.6	3.25	4.07	3.36
C_I	2.6	4.02	7.67	10.2
Rauch	0.81	0.79	0.79	0.71

In order to gather some initial insights on the correlation between the complexity of the trading bundle and firms' TFP, we first regress (lagged) TFP on our complexity proxies for both importers and exporters, controlling for the usual firms' characteristics. We add a dummy to pick up higher TFP of two-way traders. As a further robustness check, we also control for a very simple proxy of complexity, that is the average distance of the traded bundle of goods[24]. We also control for another aspect of complexity, which is related to heterogeneous intensive margins: firms trading 90% of their turnover are different from those whose trade exposure is, say, 5%; if trade intensity, rather than trade status, is related to productivity, and importers are different in terms of distribution of the former variable, rather than the latter, this may explain the relevance of importing[25]. We have therefore run our specification including as additional firm-specific control the share of export to sales and the share of import to sales.

Table 11 present these results (coefficient of firms' characteristics not reported). We find that lagged TFP is positively affected by all our proxies of complexity. In Column 1 we can see how the average distance of the traded bundle seems to self-select more importers than exporters. In terms of other proxies, the number of HS2 traded products seem to have similar effects across the two classes of firms, while the C_Index and, to a greater extent, the Rauch index are clearly higher for importers. These results are robust to the inclusion of all the proxies of complexity together, and to the control for the intensive margin of trade and for two-way traders[26].

We thus have a confirmation that, on average, complexity is significantly linked to the ex-ante productivity of trading firms, and that the effect seems to be stronger for importers than exporters. Among the sources of complexity driving this effect for importers, the Rauch and the C_Index seem to be particularly relevant. The latter finding is consistent with our idea

[24]The average distance of the traded bundle is constructed as the sum of the volumes of the traded goods weighted by the relative distance (in logs) between country i and the closer country to Hungary.

[25]In our data the relationship between trade intensity and TFP appears to be non linear: for both importers and exporters, maximum TFP is achieved at around 20-30% of the trade to sales ratio.

[26]Note how the dummy for two-way traders is higher in the case of exporters than importers, thus confirming once again our ranking in terms of productivity also when controlling for complexity.

that importers face a more complex (or contractual-intensive) organization of the production process, since the ex-ante TFP of importers is higher the more numerous, distant and legally uncertain are the number of transactions, and the higher the level of product differentation of the imported bundle[27]. This is to a lesser extent the case for exporting firms, since trade contracts are asymmetric: exporters face some uncertainties, but they have a perfect monitoring of the quality of the goods sold, which implies the C_I and Rauch indexes are in general also positive and significant, but with a smaller effect on lagged TFP.

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To shed more light on these issues, we focus once again our attention on switching firms. Table 12 reports the result of a multivariate regression in which (lagged) TFP of a given category of switching firms $\omega_{it-1|\Delta FZ}$ is regressed against our three measures of complexity plus our firm-specific controls and industry and time dummies:

$$\omega_{it-1|\Delta FZ} = \beta_0 + \beta_1 Complexity_{it} + \beta_2 X_{it} + a_j + a_t + \varepsilon_{it}$$

Results show that the ex-ante productivity of firms switching into imports is positively and significantly associated to higher values of the complexity measure, while the latter is not necessarily true for exporting firms. We thus have again some evidence consistent with the idea that different trade statuses entail a different complexity of the traded goods. In particular, we find that firms switching into importing end up being not only ex-ante more productive but also ex-post active into more complex trade activities, while the latter is not necessarily the case for firms who start exporting.

Finally, to provide another validation of the relationship between trade complexity and the importing activity, we have used our sample of two-way traders as a sort of natural experiment. If any measure of complexity drives self-selection, we should observe the more productive firms operating the most complex activities. Moreover, if complexity matters more on the importing vs. the exporting side, we should observe, within two-way traders, the ratio of exported / imported complexity measures decrease with productivity: the more productive you are, the more complex products you import rather than export. According to our priors, one would thus expect a negative correlation between a two-way trader TFP and the ratio of exported / imported complexity indexes. Since identification takes place within the same firm (two-way trader), we can exclude that our results are driven by some unobserved firm heterogeneity affecting exporters differently than importers in terms of complexity.

To this extent, denote CX the complexity measure of exports and CM the complexity of imports as measured by our proxies. For two-way traders, we can then define a relative complexity measure, $\Psi_{it|z=XM} = CX/CM$ as the ratio of exports to imports' complexity. We

[27]We have also tried to interact the C_I index and the Rauch measure: in the case of importers both effects remain positive and significant, with a negative sign of the interaction. The latter is consistent with the idea that profit maximising firms ceteris paribus try to reduce the degree of product differentiation for a given average distance of the supplier, and vice versa, in order to reduce the overall informational uncertainty of the imported bundle.

Table 11: Complexity and trade status

Exporters vs non-exporters, Dep. Var: Lagged TFP						
	(1)	(2)	(3)	(4)	(5)	(6)
Distance	0.0388***					
	0.0025					
Complexity: HS2		0.0340***			0.0236***	0.0259***
		0.0011			0.0012	0.0012
Complexity: Rauch			0.0440***		-0.0001	0.0067
			0.0038		0.0040	0.0041
Complexity: C_I				0.0113***	0.0087***	0.0089***
				0.0004	0.0004	0.0004
two-way dummy	0.413***	0.442***	0.427***	0.417***	0.417***	0.417***
	0.0071	0.0064	0.0071	0.0066	0.0070	0.0071
trade intensity						-0.0820***
						0.0128
Observations	122920	122920	122920	122920	122920	122391
R-squared	0.287	0.293	0.287	0.292	0.295	0.295
Importers vs non-importers, Dep. Var: Lagged TFP						
	(1)	(2)	(3)	(4)	(5)	(6)
Distance	0.140***					
	0.0023					
Complexity: HS2		0.0376***			0.0133***	0.0180***
		0.0006			0.0008	0.0009
Complexity: Rauch			0.209***		0.146***	0.155***
			0.0038		0.0040	0.0040
Complexity: C_I				0.0247***	0.0160***	0.0157***
				0.0004	0.0005	0.0005
two-way dummy	0.103***	0.195***	0.133***	0.144***	0.0687***	0.0731***
	0.0072	0.0067	0.0071	0.0068	0.0072	0.0072
trade intensity						-0.177***
						0.0163
Observations	122920	122920	122920	122920	122920	122391
R-squared	0.289	0.292	0.285	0.289	0.304	0.305

Dependent variable: TFP, $t-1$

$***p < 0.01$, $**p < 0.05$, $*p < 0.1$

Standard errors in parentheses

Time, sector and region dummies, as well as the usual set of firm-specific variables, included.

Table 12: Complexity and switching firms

SWITCHERS	**Non trader to Importer**			**Non trader to Exporters**		
Dep. var.: TFP	(1)	(2)	(3)	(4)	(5)	(6)
Complexity: HS2	0.0329**			0.0328		
	(0.0130)			(0.0269)		
Complexity: Rauch		0.176**			-0.177	
		(0.0851)			(0.108)	
Complexity: C_I			0.0288***			0.0123
			(0.0108)			(0.0243)
Firm size $t-1$	0.131***	0.130***	0.133***	0.116***	0.0986***	0.0983***
	(0.0259)	(0.0259)	(0.0259)	(0.0325)	(0.0319)	(0.0319)
Foreign firm, $t-1$	0.205**	0.209**	0.218**	-0.101	-0.112	-0.114
	(0.0906)	(0.0905)	(0.0906)	(0.109)	(0.104)	(0.104)
Firm age, $t-1$	0.0512***	0.0525***	0.0503***	0.0911***	0.0936***	0.0948***
	(0.0135)	(0.0135)	(0.0135)	(0.0156)	(0.0156)	(0.0156)
Former SOE, $t-1$	0.112	0.118	0.112	-0.00594	-0.00820	-0.0124
	(0.117)	(0.117)	(0.118)	(0.128)	(0.123)	(0.123)
Constant	-0.430	-0.362	-0.437	-1.178*	-2.156***	-1.976***
	(0.455)	(0.453)	(0.458)	(0.667)	(0.553)	(0.560)
Observations	1424	1424	1424	814	859	859
R-squared	0.134	0.135	0.133	0.246	0.228	0.230
Log likelihood	-2155	-2155	-2156	-1129	-1204	-1203

Dependent variable: TFP, $t-1$

$***p < 0.01$, $**p < 0.05$, $*p < 0.1$

Standard errors in parentheses

Models include time, sector and county dummies

then run the following regression:

$$\omega_{it-1} = \beta_0 + \beta_1 \Psi_{it|z=XM} + \beta_2 X_{it} + a_t + \varepsilon_{it} \tag{8}$$

where we have regressed the level of lagged TFP of each firm ω_i against the relative complexity measure Ψ_{it}, and usual controls.

Table 13 shows the results of this multivariate regression for two-way traders, always controlling for firms' characteristics, industry and time fixed effects. As it can be seen, we always find that the complexity of the imported products increases with productivity proportionally more than the one for exporting products, since the ratio between the measures is always negative and significant. Once again, the ratio is particularly significant for the Rauch index, in line with our previous results pointing to the prevalence of organizational complexity as a driver of sunk costs for importers[28].

Table 13: Complexity and Productivity for Two-way traders

Dep. V.: lag TFP	OLS	OLS	OLS	OLS	OLS	Panel: FE	Panel: BE
CX/CM: HS2	-0.090***			-0.081***	-0.085***	-0.0049	-0.105***
	0.0099			0.0098	0.0101	0.0071	0.0141
CX/CM: Rauch		-0.101***		-0.105***	-0.111***	-0.014	-0.080**
		0.0265		0.027	0.027	0.0214	0.038
CX/CM: C_I			-0.036***	-0.023**	-0.023***	-0.0014	-0.039***
			0.0094	0.0088	0.0089	0.0058	0.0101
import share					-0.042***		
					0.012		
export share					-0.063**		
					0.0286		
Firm size	0.137***	0.138***	0.138***	0.138***	0.140***	0.033**	0.141***
	0.0081	0.00791	0.0079	0.00811	0.0082	0.0167	0.0071
Foreign firm.	0.260***	0.267***	0.264***	0.258***	0.281***	0.104***	0.221***
	0.0182	0.0179	0.0179	0.0181	0.019	0.0194	0.022
Firm size	0.050***	0.050***	0.050***	0.049***	0.048***	0.048***	0.107***
	0.0043	0.0044	0.0044	0.0043	0.0043	0.0028	0.0058
Former SOE	-0.012	-0.01	-0.010	-0.011	-0.017		-0.047
	0.0255	0.0252	0.0252	0.0255	0.0254		0.0303
Constant	-0.35***	-0.26*	-0.33**	-0.24**	0.12	0.37***	-0.99***
	0.115	0.145	0.141	0.116	0.143	0.0784	0.16
Observations	37767	40086	40086	37767	37762	37767	37767
R-squared	0.293	0.283	0.284	0.294	0.299	0.062	0.353
Number of id						7064	7064

Pooled OLS with firm clusters. Robust standard errors in brackets
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

[28]We have also run our estimates using the simple average distance of the traded bundle, with similar results. Moreover, we have incorporated square terms of the CX/CM variables, finding that, not surprisingly, the relationship tends to be non-linear, with marginally decreasing effects in terms of added import complexity as productivity increases.

6 Conclusions

This paper derives a picture in which importing firms seem to implement more complex strategies than exporting firms. It then follows that the importing strategy per se might generate a selection process of firms of an inherently different nature than the simple sunk costs approach traditionally associated to the exporting activity. In other words, we do find evidence of sunk costs of exports leading to self-selection of firms; however, we find evidence that the strategic choice of importing seems to require a more complex organization of production than the choice of exporting, especially from an organizational point of view related to the informational asymmetry faced by importers, thus inducing a (stronger) self-selection effect in terms of productivity.

Since the available empirical evidence points to the fact that, across countries, the importing and exporting activity tend to be highly correlated within firms, one general implication of our results is that failing to control for the importing activity, as a large part of the literature has done insofar, might lead to an overstated average productivity premium of exporters.

Our paper thus offers a possible channel through which open the export-productivity 'black box'. Clearly, this is one of a number of possible directions of research. As theoretically shown by Costantini and Melitz (2008), in fact, the exporting activity may be correlated with other important firm-level decisions (e.g. innovation), and these combined interactions might be the reasons behind differences in the performance of exporters, as well as behind the timing of their decision. Roberts et al. (2009), for example, show in the case of Taiwan electronic industry that exporting firms are among the most productive only when jointly undertaking R&D activities, while exporting only, per se, would not entail a large productivity premium.

We believe that more work is due along these interesting lines of research.

Moreover, our findings are valid for Hungary, a small open economy, in which it is relatively more likely that importers are part of international production networks (although we always control for foreign ownership), and therefore more likely to face a complex organisation of production of their imported bundle, generating the detected self-selection effect. It would be interesting to compare these results in a large, relatively more closed economy, in which the nature of the organization of production of importing firms might be altogether different.

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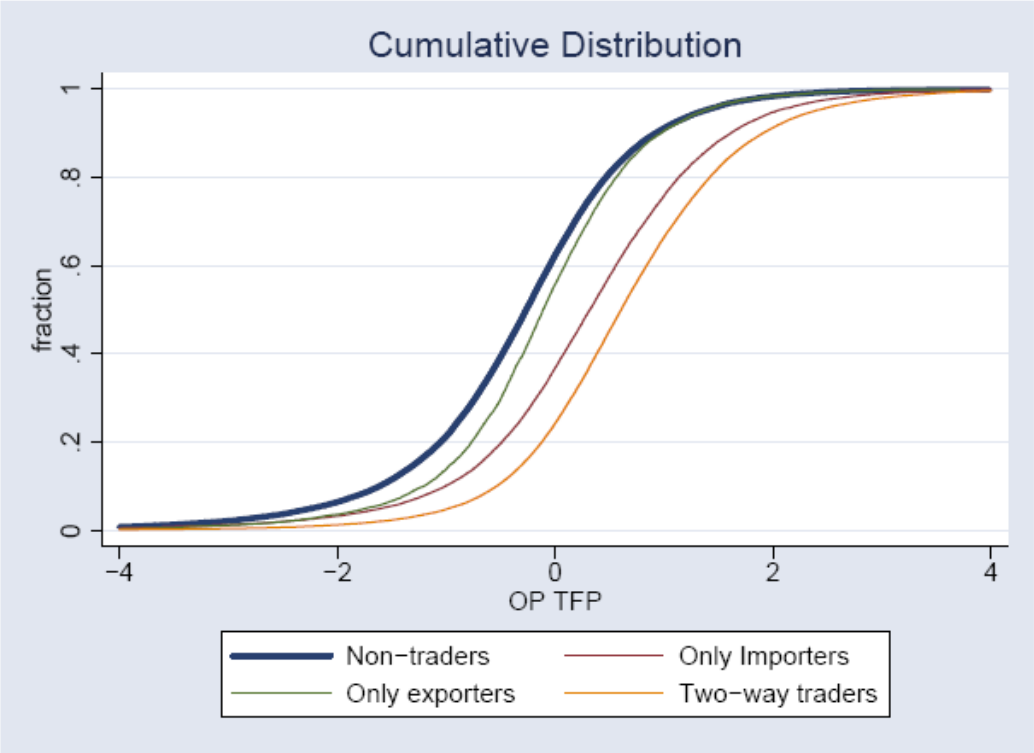
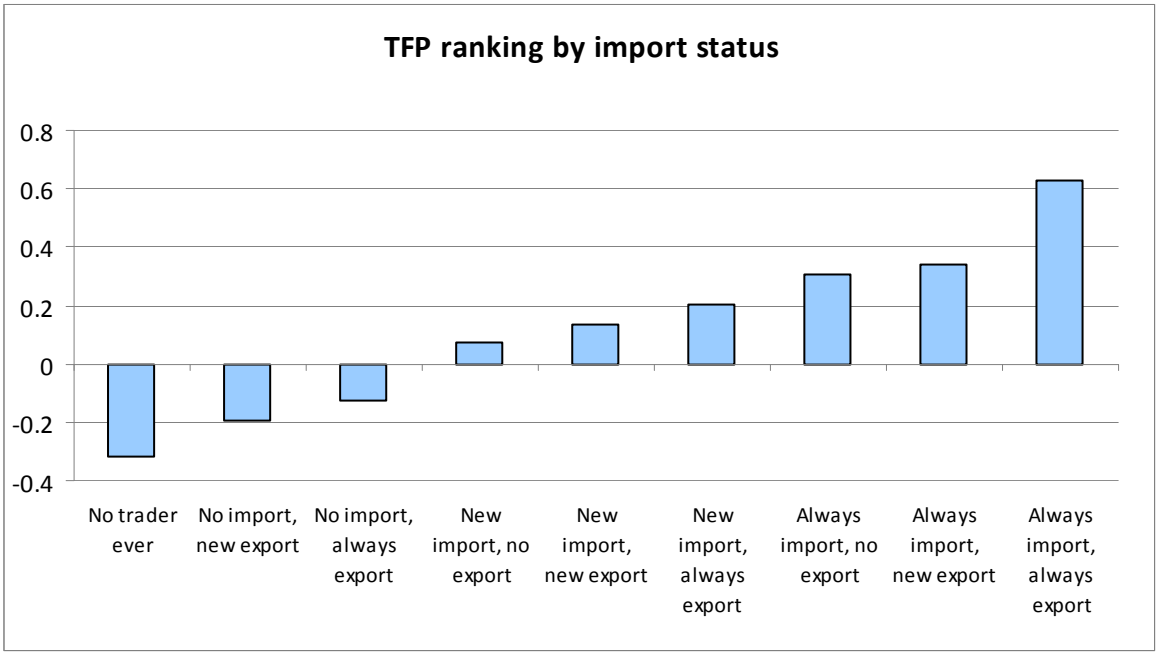
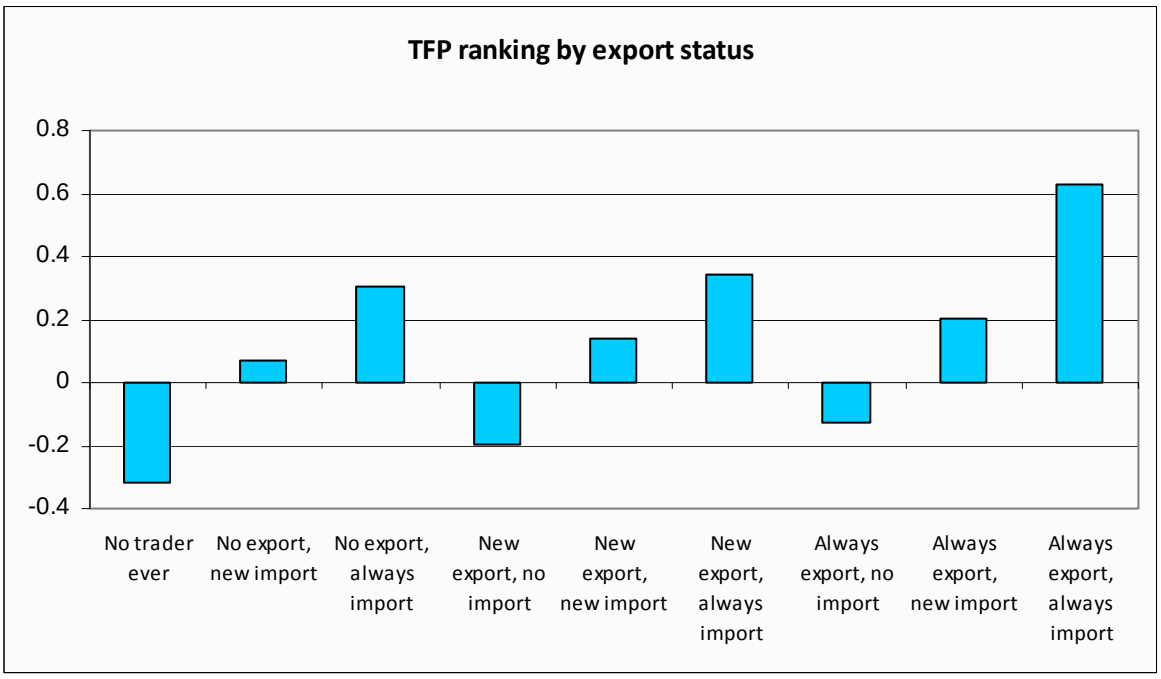
Graph 1:Cumulative TFP distributions [(a)]



[(a)] OP-TR measure of TFP.

Graph 2: Average group TFP by trading activity (ex ante, at time *t-1*)





[a] OP-TR measure of TFP.

Appendix

Table 14: Number of firms in sample per year

Year	N. of firms
1992	11,036
1993	12,832
1994	14,207
1995	15,686
1996	17,741
1997	19,896
1998	20,974
1999	21,063
2000	14,815
2001	14,723
2002	14,889
2003	14,486
Total	192,348

Table 15: Number of firms in sample by NACE2 industry / year

NACE2		1992		1997		2002	
		N.	%	N.	%	N.	%
17	Textiles	465	4.21%	944	4.74%	683	4.59%
18	Clothes	761	6.90%	1155	5.81%	979	6.58%
19	Leather	271	2.46%	411	2.07%	345	2.32%
20	Wood	651	5.90%	1387	6.97%	1096	7.36%
21	Paper	124	1.12%	262	1.32%	258	1.73%
22	Publishing	1545	14.00%	2954	14.85%	1474	9.90%
23	Coke, Petroleum	8	0.07%	18	0.09%	9	0.06%
24	Chemicals	395	3.58%	649	3.26%	523	3.51%
25	Rubber, Plastic	610	5.53%	1141	5.73%	1046	7.03%
26	Non-metallic minerals	455	4.12%	835	4.20%	665	4.47%
27	Basic metals	148	1.34%	235	1.18%	195	1.31%
28	Fabricated metals	1554	14.08%	2895	14.55%	2356	15.82%
29	Machinery	1765	15.99%	2704	13.59%	1848	12.41%
30	Office equipment	117	1.06%	226	1.14%	134	0.90%
31	Electric	452	4.10%	865	4.35%	619	4.16%
32	Audio, Video	374	3.39%	639	3.21%	473	3.18%
33	Medical, precision	488	4.42%	926	4.65%	687	4.61%
34	Motor Vehicles	148	1.34%	246	1.24%	241	1.62%
35	Other transport	75	0.68%	152	0.76%	130	0.87%
36	Furniture	590	5.35%	1139	5.72%	1029	6.91%
37	Recycling	39	0.35%	113	0.57%	99	0.66%
Total		11035	100%	19896	100%	14889	100%

Table 16: Share of foreign-owned firms by NACE2 industry and year

NACE 2		1994	1997	2002
17	Textiles	40%	32%	27%
18	Clothes	39%	29%	25%
19	Leather	42%	41%	37%
20	Wood	28%	27%	20%
21	Paper	42%	35%	29%
22	Publishing	27%	29%	20%
23	Coke, Petroleum	.	.	.
24	Chemicals	42%	43%	32%
25	Rubber, Plastic	37%	33%	28%
26	Non-metallic minerals	42%	38%	25%
27	Basic metals	40%	33%	29%
28	Fabricated metals	29%	26%	22%
29	Machinery	30%	28%	22%
30	Office equipment	34%	28%	22%
31	Electric	31%	30%	30%
32	Audio, Video	32%	31%	30%
33	Medical, precision	32%	32%	23%
34	Motor Vehicles	46%	41%	41%
35	Other transport	39%	34%	20%
36	Furniture	32%	26%	22%
37	Recycling	28%	34%	22%
	mean	33%	30%	24%

Table 17: Transition matrixes of trading activities - 1993-1997

(Transition matrix 1993-1997)

N. of firms	1997					
1993	—No traders	Only Ex-porter	Only Im-porter	Two-way traders	N. Firms	
No traders	4272	236	462	425	5395	
Only Exporter	202	130	30	146	508	
Only Importer	552	56	489	400	1497	
Two-way traders	274	114	231	1709	2328	
N. Firms	5300	536	1212	2680	9728	Percentages

Percentages	1997					
1993	No traders	Only Ex-porter	Only Im-porter	Two-way traders	Total	N. Firms
No traders	79%	4%	9%	8%	55%	5395
Only Exporter	40%	26%	6%	29%	5%	508
Only Importer	37%	4%	33%	27%	15%	1497
Two-way traders	12%	5%	10%	73%	24%	2328
Total	54%	6%	12%	28%	100%	9728
N. Firms	5300	536	1212	2680	9728	

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