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Import, Export and Trade Intermediaries: What Matters the Most?

Marco Di Cintio[1], Emanuele Grassi[1] & Claudio Petti[2]

[1] Dipartimento di Scienze dell'Economia, Universit à del Salento, Lecce, Italia

[2] Dipartimento di Ingegneria dell'Innovazione, Universit à del Salento, Lecce, Italia

Correspondence: Marco Di Cintio, Dipartimento di Scienze dell'Economia, Universit à del Salento, Lecce, Italy.

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Abstract

This paper undertakes a multi-country study to investigate heterogeneity in productivity levels across firms choosing to trade either directly or indirectly through intermediaries, both in the export and import markets. To this end, we implement a stochastic dominance criterion to compare the entire distribution of Total Factor Productivity (TFP) of traders, and we use a generalized ordered logit model to investigate the extent to which a shift in TFP produces a reallocation of firms among different categories of traders. Compared to previous research, our novel findings suggest a productivity sorting of firms which mostly depends on the mode of trade rather than the side. From a policy perspective, our work implies the need to create the conditions for endowing local firms with the necessary knowledge and capabilities to overcome the productivity threshold levels to enter and benefit from direct international trade.

Keywords: direct trade, indirect trade, import – export, productivity sorting, stochastic dominance, TFP

1. Introduction

In this paper, we investigate heterogeneity across firms that both export outputs and import inputs and, simultaneously, may choose to trade either directly or indirectly through intermediaries. Thus, we establish a productivity ranking among firms differently involved in international markets, both concerning the modes and in terms of the two sides of international trade.

The role of firm-level heterogeneity in determining the trading behavior of firms, particularly the role of productivity, has been extensively documented in the new-trade literature (Blum, Claro, & Horstmann 2018). However, there are separate strands of literature where productivity differentials are linked either to the decision to trade or not, to the selection of the trade side (import, export, or both), or the choice of the trade mode (directly or indirectly through intermediaries).

On the one hand, the existing literature has found support of the productivity differentials between exporters and non-exporters. Indeed, theoretical models show as only the more productive firms export, because of the existence of fixed costs of exporting that need to be covered (Melitz, 2003). Even though there is also ample empirical evidence that exporters are significantly more productive than non-exporters (note 1) this focus, however, may have led to the underestimation of other means and other contexts in which also less productive firms may trade abroad.

On the other hand, a related line of research has focused on import activities to better understand the nature of heterogeneity in productivity across firms (Bernard, Jensen, & Schott, 2009; Amiti & Konings, 2007), and evidence suggests that importers tend to be more productive than non-importers (Kasahara and Rodrigue, 2008). This is because similar to what has been observed for exporters, only firms that can bear the burden of sunk and/or fixed costs become active importers (Halpern, Koren, & Szeidl, 2015). Indeed, import activities require establishing a network with foreign suppliers, learning foreign customs regulations (Kasahara & Lapham, 2013) and foreign procedures (Castellani et al., 2010), implementing new production processes (Kiriyama, 2012), and increasing the firms' absorptive capacity (Augier, Cadot, & Dovis, 2013). In particular, Andersson, L ööf and Johansson (2008) pointed out that importing is associated with fixed costs that are sunk costs because imports require a preliminary search process for potential foreign suppliers, inspection of goods, and contract formulation. Moreover, the authors found out that firms that are both importers and exporters (i.e., two-way traders) tend to be more productive than firms that are active in either import or export activities (i.e., one-way traders). This finding is explained by the notion that two-way traders are fully involved in the international

division of labor and use inputs based on frontier knowledge and technology in their production process. Due to sunk cost complementarities, Kasahara and Lapham (2013) also confirmed that two-way traders are more productive than one-way traders. Furthermore, Vogel and Wagner (2010) reported that, compared to firms that do not trade at all, two-way traders have the highest performance, followed by firms that only export, whereas firms that only import have the smallest premia vis-à-vis non-traders. Differently, Castellani et al. (2010) confirmed the first result but pointed out that firms that only import outperform those that only export. However, productivity differences between one-way traders vanish once they control for fixed effects.

Finally, there is a further strand of literature with increasing attention toward different modes of trade (i.e., direct trade versus indirect trade through intermediaries). Import intermediaries differ from export intermediaries in several important features. For instance, export intermediaries trade mainly in homogenous goods and tend to be concentrated in commodity sectors, whereas import intermediaries largely trade in differentiated goods along with a variety of sectors (Blum et al., 2018). Nevertheless, both import and export intermediaries have been proved to be particularly significant for small traders and more distant, smaller, difficult, or protected markets, which explain their widespread diffusion also in developing and emerging contexts (Bernard, Jensen, Redding, & Schott 2010; Blum, Claro, & Horstmann, 2010). Hence, several studies have focused on the relevance of intermediaries in facilitating trade (Ahn, Khandelwal, & Wei 2011) and how indirect traders differ from direct traders (Abel-Koch, 2013). In particular, small firms choosing to trade through intermediaries can access foreign markets, even though they are unable to cover the fixed costs of direct export. Thus, intermediaries may alleviate the difficulty of reaching less accessible markets and they help less efficient firms to supply foreign markets (Crozet, Lalanne, Poncet, 2013). Since uncertainty about product quality is endemic in international trade, intermediaries may also eliminate the costs to acquire information about product quality; in this case, the producers who benefit the most are those with the highest quality (Dasgupta & Mondria, 2018). In addition, intermediaries may also be useful in reducing the cost of matching international sellers and buyers (Petropoulou, 2010). Notwithstanding import intermediaries have been found to account up to three times more than export intermediaries in terms of the respective whole trade volumes (Blum et al., 2018), according to several authors (Muûls & Pisu, 2009; Castellani, Serti, & Tomasi, 2010; Ahn et al., 2011; Wagner, 2012; Grazzi & Tomasi, 2016; Blum et al., 2018), scant attention has been paid to the modes of import compared to that of export.

Thus, from the export perspective, theoretical models usually assume lower (or null) fixed costs of dealing with the intermediaries relative to those of direct export. However, at the same time, firms that export indirectly must share a portion of their exporting revenue with intermediaries (note 2). Therefore, while only the most productive firms export directly, those firms whose productivity is under a given threshold export through intermediaries. Nevertheless, while most empirical analyses showed that the most productive firms choose to export directly (Muûls & Pisu, 2009; Lu, Lu, Sun, & Tao, 2017; Wagner, 2017), the productivity premia of indirect exporters over domestic firms are not always confirmed in the available empirical evidence. For instance, while Békés and Muraközy (2018) found out that firms that export only through intermediaries show no productivity premium compared to non-traders, McCann (2013) concluded that indirect exporters tend to be more productive than domestic firms.

All of the above arguments highlight separate but related lines of research where, in each branch of the literature, only one of the firms' choices is taken into account. Accordingly, it has been shown in recent literature that internationalization strategies are more complex than simply considering two alternatives (Békés & Muraközy, 2016). Particularly concerning the literature on productivity sorting of international traders, since most analyses focused only on a specific international choice, the first drawback of these approaches is that distinct strategies are often tackled as one singular category. In addition, and more importantly, the second limitation of the above studies is that some strategies could be mistreated. Indeed, firms involved in some international activities could also be treated as non-traders. In this regard, while Bernard, Jensen and Redding (2007) and Wagner (2007) focused on productivity differences between exporters and non-exporters, Halpern et al. (2015) and Kasahara and Rodrigue (2008) investigated the efficiency hierarchy between importers and non-importers. Conversely, Kasahara and Lapham (2013), Castellani et al. (2010), and Vogel and Wagner (2010) compared firms active in both the import and the export market with firms engaged just in either import or export. Lastly, Felbermayr and Jung (2011) and Lu et al. (2017) studied the role of trade intermediaries in explaining the productivity differences among direct exporters, indirect exporters, and non-traders. Differently and notwithstanding the importance of trade intermediaries also for import (Bernard et al., 2010), theoretical or empirical analysis of productivity sorting of direct and indirect importers remains quite absent. Hence, all of the above paradigms cannot completely pick the relationship between firms' heterogeneity in productivity and the interdependent choices they make when involved in the international markets along multiple channels (Blum, Claro &

Horstmann, 2018).

Consequently, it has not yet been investigated in prior research how trade sides and trade modes, when simultaneously considered, affect the efficiency order of firms. Thus, what matters for the productivity ranking of international traders? Trade sides, trade modes, or both? To answer this question, we complement the empirical evidence on the sorting literature by investigating firms' heterogeneity in a more complex structure, where different modes of import may be combined with different modes of export.

The remainder of this paper is structured as follows. Section 2 describes the methodology and illustrates our empirical research. The estimation results are presented in Section 3. Specifically, Section 3.1 reports the results of tests of first-order stochastic dominance. Estimations based on the ordered logit model are presented in Section 3.2. Discussion is given in Section 4. Finally, Section 5 concludes the paper and suggests avenues for further research.

2. Methodology

2.1 Data Description

Our empirical study draws on a cross-country (cross-sectional) dataset of firms created by pooling data from the World Bank Enterprise Survey (WBES) implemented in six Latin American countries in 2006, 2010, and 2017. Since 2006, and for each country under investigation, surveys were collected under a common global sampling methodology. The sample was stratified by sector, size, and geographical region. Country data are currently available for 148 economies and more than 168000 firms. We performed our analyses on six Latin American countries (Argentina, Bolivia, Ecuador, Paraguay, Peru, and Uruguay) by merging the 2006, 2010, and 2017 waves of the WBES. The dataset originally contained 11833 observations. Once we focused on firms interviewed at least in two consecutive surveys, we were left with 4892 observations. Specifically, 1000 firms were observed in 2006 and 2010, 585 firms were observed in 2010 and 2017, and 574 firms were observed in all waves. Thus, our starting sample was made up of 2159 firms and 4892 observations (note 3).

The World Bank's survey questionnaire was organized around several topics, including firm characteristics, access to finance, annual sales, costs of inputs, workforce composition, infrastructure, trade, competition, capacity utilization, innovation and technology, and performance measures. Of particular interest for our research question, firms were asked to report the percentages of establishment's sales sold domestically, through indirect export, and through direct export. This allowed us to distinguish among non-exporters, indirect exporters, and direct exporters. Similarly, firms were also asked to report whether they imported material inputs from foreign countries and, if so, whether they were imported directly. Coherently, we classified firms as non-importers, indirect importers, and direct importers. In particular, firms were considered non-exporters (non-importers) if they had sales (purchases) only in the domestic market. Differently, while firms were classified as indirect exporters (indirect importers) if they had a positive share of sales (purchases) in the form of indirect exports (indirect imports), firms were considered direct exporters (direct importers) if they had a positive share of sales (purchases) in the form of direct exports (direct imports). Concerning firms that reported positive shares of sales in the forms of both direct and indirect exports, we coded these firms as direct exporters (note 4). Similarly, we coded as direct importers those firms that import both directly and indirectly (note 5). Summing up, we can distinguish among eight different categories of traders (note 6):

(a) *Indirect only-exporters*: firms trading indirectly only on the export side.

(b) *Indirect only-importers*: firms trading indirectly only on the import side.

(c) *Indirect two-way traders*: firms trading indirectly on the import and export sides.

(d) *Mixed two-way traders with direct exports*: firms trading indirectly on the import side and directly on the export side.

(e) *Mixed two-way traders with direct imports*: firms trading indirectly on the export side and directly on the import side.

(f) *Direct only-exporters*: firms trading directly only on the export side.

(g) *Direct only-importers*: firms trading directly only on the import side.

(h) *Direct two-way traders*: firms trading directly on the import and export sides.

Table 1 shows the number and share of firms belonging to each category.

Table 1. Number of firms by categories of traders

Categories of traders	Number of firms	Share of firms (%)
Domestic firms	486	15.06
Indirect only-exporters	28	0.87
Indirect only-importers	752	23.30
Indirect two-way traders	85	2.63
Mixed two-way traders with direct exports	98	3.04
Mixed two-way traders with direct imports	180	5.58
Direct only-exporters	721	22.34
Direct only-importers	128	3.97
Direct two-way traders	750	23.23
Full sample	3228	100

Source: Own calculations based on World Bank's Data.

Thus, to answer our research question, we attempted to establish a productivity ranking among these different internationalization conditions chosen by firms. As a measure of productivity, we refer to firms' TFP (note 7). In particular, we estimated the TFP under the Levinsohn and Petrin (2003) methodology to account for endogeneity and existence of unobservable productivity shocks (note 8). Table 2 shows the average TFPs (and other statistics) by categories of traders.

Table 2. Average TFP by categories of traders

Categories of traders	TFP			
	Mean	Std. Dev.	Min	Max
Indirect only-exporters	5.815	0.751	3.993	6.948
Indirect only-importers	6.001	0.589	4.509	8.510
Indirect two-way traders	6.120	0.566	4.591	8.267
Mixed two-way traders with direct exports	6.299	0.747	4.325	8.205
Mixed two-way traders with direct imports	6.357	0.591	4.205	8.921
Direct only-exporters	6.435	0.647	4.328	9.403
Direct only-importers	6.470	0.573	5.449	8.280
Direct two-way traders	6.637	0.796	0.261	13.257
Full sample	6.334	0.736	0.261	13.257

Source: Own calculations based on World Bank's Data.

2.2 Estimation Strategy

Following Delgado, Farinas and Ruano (2002), we implement the nonparametric two-tailed and one-tailed K-S tests of first-order stochastic dominance between the distributions of TFP, by looking simultaneously at the side and the mode of trade chosen by firms. Tests can be constructed in the following way. Let F and G be the Cumulative Density Functions (CDFs) of the TFP of, respectively, two categories of firms differing in the side and/or the mode with which they trade. Under the null hypothesis, the two-tailed K-S test checks whether the two distributions are equal, against the alternative hypothesis of different distributions.

Formally,

$$H_0: F(z) - G(z) = 0 \ \ \forall \, \mathrm{z} \in \mathbb{R} \qquad \text{versus} \qquad H_1: F(z) - G(z) \neq 0 \text{ for some } \mathrm{z} \in \mathbb{R},$$

where z is the productivity level. Thus, the two-tailed test can be used to identify, among the above categories, clusters of firms homogenous in terms of the distribution of TFP.

Differently, the one-tailed test can be formulated as follows:

$$H_0: F(z) - G(z) \leq 0 \ \ \forall \, \mathrm{z} \in \mathbb{R} \qquad \text{versus} \qquad H_1: F(z) - G(z) > 0 \text{ for some } \mathrm{z} \in \mathbb{R}.$$

By testing the hypothesis that the distribution G contains smaller values than the distribution F, a positive and significant value of the statistic implies that the distribution F lies to the left of G. Therefore, by detecting first-order stochastic dominance, the one-tailed test is able to establish a productivity ranking among categories

of traders who differ in the side and/or the mode with which they trade.

Once the ranking of productivity among traders is established, we investigate the extent to which a shift in productivity produces a reallocation of firms among categories of traders. To this end, we implemented an ordered logit model where the dependent variable reflects those categories of traders for whom the distributions of TFPs strictly differ. (note 9) This, indeed, allowed us to treat the $(N \leq 8)$ internationalization conditions chosen by firms in terms of an ordinal variable, which takes values $j = 0, \dots, N$. (note 10)

Let y_i be this ordered response variable. Furthermore, let $i = 1, \dots, n$ be an index for the n firms observed in the sample and x_i be a vector of covariates. An ordered logit model assumes that the observed value of each y_i is related to an unobserved continuous variable y^* such that

$$y_i = j \qquad \text{iff} \qquad \phi_j \leq y_i^* < \phi_{j+1},$$

where $\phi's$ are cutoff values with $\phi_0 = -\infty$ and $\phi_{N+1} = +\infty$. Finally, the model assumes that $y_i^* = x_i'\beta + e_i$, where β is a vector of parameters, x' is a set of firm characteristics, and e is the error term. The model can be written as

$$\Pr(y_i > j|x_i) = \frac{\exp(x_i'\beta - \phi_j)}{1 + \exp(x_i'\beta - \phi_j)}, \qquad j = 0, \dots, N.$$

Table 3. Summary statistics

Variables	Mean	Std. Dev.
Firms age	3.291	0.691
Firms size (base: small)		
Medium	0.269	0.443
Large	0.129	0.335
Product quality	0.267	0.442
Mono product firms	0.257	0.437
Contract enforceability (base: not confident)		
Less confident	0.299	0.458
Confident	0.150	0.357
Strong confident	0.044	0.204
Foreign technology	0.156	0.363
Skill intensity	0.742	0.246

Thus, we were able to verify whether or not productivity differentials persist even when other factors are controlled for (note 11). In particular, in addition to the TFP, our empirical model includes the *firm age* (number of years since the firm was established), *firm size* (a categorical variable that takes three possible values, i.e., small [employees < =50], medium [50 < employees ≤ 250], and large [employees < 250] firms), *product quality* (dummy equals 1 if a firm received an internationally recognized quality certification), *mono product firm* (dummy equals 1 if the firm produces only a single product), *contract enforceability* (a categorical variable that reflects whether a firm is more or less confident that the judicial system will enforce its contractual and property rights in business disputes), *foreign technology* (dummy equals 1 if the firm uses technology licensed by a foreign-owned company), and *skill intensity* (fraction of skilled employees divided by the total number of employees) (Note 12). Moreover, to account for the heterogeneity across countries, industries, and years, we controlled for the country, industry, and year fixed effects. In addition, we computed robust standard errors clustered at the industry level to account for potential heteroscedasticity (note 13). Table 3 shows summary statistics for these additional variables.

As a robustness check, we estimated a generalized ordered logit model. In the standard ordered logit model, the effects of the covariates are constant across response categories. Such assumption is commonly referred to as the proportional odds hypothesis. One way to relax this assumption is to allow covariates to have category-specific slopes. This causes an increase in the parameters to be estimated, while it might not necessarily be true that all slopes are category-specific. In order to identify the subset of covariates whose slopes vary across categories, we used the Brant (1990) test. The model can then be rewritten by splitting the set of covariates in the following way:

$$\Pr(y_i > j|x_i) = \frac{exp(x_{1i}'\beta_1 + x_{2i}'\beta_{2j} - \phi_j)}{1 + exp(x_{1i}'\beta_1 + x_{2i}'\beta_{2j} - \phi_j)}, \qquad j = 1, \dots, N,$$

where β_1 is a vector of parameters associated with a subset x_{1i} of covariates, which were not found to violate the proportional odds assumption, and β_j is the vector of parameters that vary with categories and are associated with the subset x_{2i} of explanatory variables.

3. Results

3.1 Trade Sides, Trade Modes, and Productivity Sorting

In line with what was described in the previous section, we tested the stochastic dominance of TFP distributions among different categories of traders. We started by implementing all possible comparisons among the four categories of firms involved in either import or export [i.e., categories (a), (b), (f), and (g)], and then we compared the four categories of firms involved in both sides of the international market [i.e., categories (c), (d), (e), and (h)].

In particular, first, we performed separate K-S tests between only-importers (only-exporters) by distinguishing indirect versus direct mode of trade. In other words, we tested for stochastic dominance between indirect only-importers (exporters) and direct only-importers (exporters). Second, we performed separate K-S tests between indirect (direct) traders by distinguishing importers from exporters. Specifically, on the one hand, we compared the distributions of indirect only-importers versus indirect only-exporters. On the other hand, we checked the differences between direct only-importers and direct only-exporters. Third, we used the K-S test to evaluate the differences in TFP distributions between indirect only-importers and direct only-exporters. Similarly, we performed the test between indirect only-exporters and direct only-importers. Then, we checked for differences among TFP distributions of two-way traders. In particular, we performed six separate K-S tests by considering all possible comparisons among the four categories of two-way traders (i.e., indirect two-way traders, mixed two-way traders with direct import, mixed two-way traders with direct export, and direct two-way traders).

In Table 4, we report the results of the K-S tests. In the first row of each comparison, we report the statistics and p-values of the two-tailed test of equality of distributions. Once we assessed whether the two distributions are equal or not, we performed the one-tailed test to determine which of the two distributions dominates the other. The results are reported in the second and third rows of each panel.

Panel (a) shows that the TFP distribution of indirect only-importers (exporters) is statistically different from that of direct only-importers (exporters). Indeed, in both cases, we were able to reject the null hypothesis of equal distributions. Moreover, the one-tailed tests failed to reject the null hypothesis that the TFP distribution of indirect traders is stochastically dominated by the distribution of direct traders (for both importers and exporters). When we performed similar tests to check for the inverted relationship, we did not fail to reject the null hypothesis of stochastically dominated TFP distributions. Thus, direct traders outperform indirect traders involved on the same side of the international market.

Table 4. One-tailed and two-tailed Kolmogorov–Smirnov test of stochastic dominance

	comparison	statistic	p-value	comparison	statistic	p-value
Panel a)						
Equality of distributions	indirect only-importers VS. direct only-importers	0.352	0.000	indirect only-exporters VS. direct only-exporters	0.446	0.003
Difference	indirect only-importers	0.352	0.000	indirect only-exporters	0.446	0.002
favorable to	direct only-importers	-0.006	0.997	direct only-exporters	0.000	1.000
Panel b)						
Equality of distributions	indirect only-importers VS. indirect only-exporters	0.180	0.638	direct only-importers VS. direct only-exporters	0.100	0.659
Difference	indirect only-importers	0.054	0.914	direct only-importers	0.048	0.796
favorable to	indirect only-exporters	-0.180	0.371	direct only-exporters	-0.100	0.369
Panel c)						
Equality of distributions	indirect only-importers VS. direct only-exporters	0.281	0.000	indirect only-exporters VS. direct only-importers	0.506	0.002
Difference	indirect only-importers	0.281	0.000	indirect only-exporters	0.506	0.002
favorable to	direct only-exporters	-0.003	0.997	direct only-importers	0.000	1.000
Panel d)						
Equality of distributions	indirect two-way traders VS. mixed two-way traders with direct imports	0.295	0.010	indirect two-way traders VS. mixed two-way traders with direct exports	0.258	0.076
Difference favorable to	indirect two-way traders	0.295	0.005	indirect two-way traders	0.258	0.047
	mixed two-way traders with direct imports	-0.015	0.986	mixed two-way traders with direct exports	-0.039	0.932

Equality of distributions	indirect two-way traders VS. direct two-way traders	0.458	0.000	mixed two-way traders with direct imports VS. mixed two-way traders with direct exports	0.131	0.533
Difference favorable to	indirect two-way traders	0.458	0.000	mixed two-way traders with direct imports	0.063	0.756
	direct two-way traders	-0.008	0.995	mixed two-way traders with direct exports	-0.131	0.301
Equality of distributions	mixed two-way traders with direct imports VS. direct two-way traders	0.223	0.000	mixed two-way traders with direct exports VS. direct two-way traders	0.332	0.000
Difference favorable to	mixed two-way traders with direct imports	0.223	0.000	mixed two-way traders with direct exports	0.332	0.000
	direct two-way traders	-0.006	0.993	direct two-way traders	-0.019	0.968

Notes: Positive and significant statistics means that the sub-group distribution lies to the left of that of the alternative sub-group. *Source:* Own calculations based on World Bank's Data.

Moving on to panel (b), we did not find a significant difference between the distributions of TFP in both comparisons. In particular, the results show a similar distribution for indirect only-importers versus indirect only-exporters. The same conclusion also holds for direct only-importers versus direct only-exporters. Thus, we concluded that indirect traders (those who trade just on one side of the international market) are homogenous in terms of the distribution of TFP independently of the side of the market on which they trade. By gathering these categories of traders homogenous in terms of TFP, we labeled as *indirect one-way traders* those firms trading indirectly, either on the export or on the import side. Similarly, we labeled as *direct one-way traders* those firms trading directly, either on the export or on the import side.

At the same time, panel (c) shows that direct only-exporters tend to be more productive than indirect only-importers, as well as direct only-importers versus indirect only-exporters. Therefore, we confirmed the conclusions of Muûls and Pisu (2009), Lu et al. (2017), Wagner (2017), and Békés and Muraközy (2018), who proved that the most productive firms choose to trade directly. Nevertheless, our results extend this finding by concluding that, rather than the side, it is the mode of trade that matters for productivity sorting among firms involved just in one side of the international market. These results partially support the conclusions by Castellani et al. (2010). Indeed, firms that just import do not show a different distribution of TFP from those that just export. However, we pointed out that this is true provided that the mode of trade is the same.

In panel (d), we compare the TFP distribution of two-way traders. Direct two-way traders outperform all other categories of two-way traders. Moreover, the TFP distributions of mixed two-way traders (those with direct import and those with direct export) stochastically dominate the TFP distributions of indirect two-way traders. Interestingly, we did not find a significant difference between the distributions of TFP associated with the two categories of mixed two-way traders. Thus, we merged these categories and labeled them uniquely as *mixed two-way traders*. Therefore, also among two-way traders, rather than the side, it is the mode of trade that matters for productivity ranking. Once again, only the most productive firms choose to trade directly, even when they trade on both sides of the international market.

Now, we performed further checks useful to construct the ordered dependent variable of the logit model, to verify whether productivity differentials among traders persist even if other factors are controlled for. Therefore, considering the Kasahara and Lapham (2013) hypothesis, we also checked for differences between the TFP distribution of one-way traders (distinguishing between indirect and direct traders) and the TFP distribution of two-way traders (distinguishing among indirect, mixed, and direct traders). Thus, by considering all possible comparisons among these five categories of traders (which distributions of TFP strictly differ), we performed 10 evaluation tests of first-order stochastic dominance.

In panel (a) of Table 5, we compare indirect one-way traders with all the other categories. The results clearly show that the TFP distribution of indirect one-way traders lies to the left of the TFP distribution of all the other traders. As expected, from the two-tailed tests, we rejected, at the conventional value, the null hypothesis that distributions are identical. In addition, from the one-tailed tests, we concluded that indirect one-way traders are at the bottom of the performance hierarchy. Similarly, in panel (b), we see that indirect two-way traders are outperformed by mixed two-way traders, direct one-way traders, and direct two-way traders. Then, concerning panel (c), we found that mixed-two-way traders tend to be less productive than direct one-way traders and direct two-way traders, even if, in the former case, the two-tailed test fails to reject the null hypothesis of equal

distributions (p-value = 0.133). Finally, panel (d) focuses on the comparison of direct one-way traders against direct two-way traders. As expected, the TFP distribution of the latter stochastically dominates that of the former. Consequently, on the one hand, we confirmed the results of Vogel and Wagner (2010), Kasahara and Lapham (2013), and Andersson et al. (2008), who found that firms that are both importers and exporters tend to be more productive than firms active just on one side of the international market. On the other hand, we shed light on the extent to which the choice to trade directly just on one side of the international market is correlated to higher productivity than that associated with mixed two-way traders. Probably, this result depends on the fact that the latter have not yet reached such a productivity threshold that allows them to overcome the high fixed costs to trade directly on both sides of the international market.

In the end, we conclude that direct two-way traders have the highest TFP, followed by direct one-way traders and then mixed two-way traders, indirect two-way traders, and, finally, indirect one-way traders. Intuitively, because direct traders incur higher fixed costs, they have to be more productive than firms that choose to trade through intermediaries. In addition, our results are consistent with the empirical literature (Andersson et al., 2008; Muûls & Pisu, 2009; Castellani et al., 2010; Vogel & Wagner, 2010; Kasahara & Lapham, 2013; Grazzi & Tomasi, 2016), suggesting that two-way traders are more productive than one-way traders, due to sunk costs complementarity, or because the former base their production process on frontier technologies and knowledge.

Thus, by considering the above figures, we created a categorical (dependent) variable accounting for six mutually exclusive *trade* conditions strictly ordered in terms of TFP (note 14):

(1) *Indirect one-way traders*: firms trading indirectly, either on the export or on the import side.

(2) *Indirect two-way traders*: firms both exporting and importing indirectly.

(3) *Mixed two-way traders*: firms trading directly on one of the two trade sides.

(4) *Direct one-way traders*: firms trading directly, either on the export or on the import side.

(5) *Direct two-way traders*: firms both exporting and importing directly.

Table 5. Kolmogorov-Smirnov test: one-way traders vs. two-way traders

	comparison	statistic	p-value	comparison	statistic	p-value
Panel a)						
Equality of distributions	indirect one-way traders VS. indirect two-way traders	0.208	0.083	indirect one-way traders VS. mixed two-way traders	0.274	0.000
Difference	indirect one-way traders	0.208	0.049	indirect one-way traders	0.274	0.000
favorable to	indirect two-way traders	-0.065	0.748	mixed two-way traders	-0.017	0.943
Equality of distributions	indirect one-way traders VS. direct one-way traders	0.300	0.000	indirect one-way traders VS. direct two-way traders	0.461	0.000
Difference	indirect one-way traders	0.300	0.000	indirect one-way traders	0.461	0.000
favorable to	direct one-way traders	0.000	1.000	direct two-way traders	-0.006	0.987
Panel b)						
Equality of distributions	indirect two-way traders VS. mixed two-way traders	0.278	0.013	indirect two-way traders VS. direct one-way traders	0.331	0.001
Difference	indirect two-way traders	0.278	0.008	indirect two-way traders	0.331	0.000
favorable to	mixed two-way traders	-0.021	0.972	direct one-way traders	-0.005	0.998
Equality of distributions	indirect two-way traders VS. direct two-way traders	0.480	0.000			
Difference	indirect two-way traders	0.480	0.000			
favorable to	direct two-way traders	-0.009	0.994			
Panel c)						
Equality of distributions	mixed two-way traders VS. direct one-way traders	0.113	0.133	mixed two-way traders VS. direct two-way traders	0.244	0.000
Difference	mixed two-way traders	0.113	0.073	mixed two-way traders	0.244	0.000
favorable to	direct one-way traders	-0.006	0.992	direct two-way traders	-0.007	0.990
Panel d)						
Equality of distributions	direct one-way traders VS. direct two-way traders	0.213	0.000			
Difference	direct one-way traders	0.213	0.000			
favorable to	direct two-way traders	-0.013	0.940			

Notes: Positive and significant statistics means that the sub-group distribution lies to the left of that of the alternative sub-group. *Source:* Own calculations based on World Bank's Data.

In the next section, we will check this productivity sorting by controlling also for other factors related to firms' productivity. Then, we will investigate the extent to which a shift in productivity produces a reallocation of firms among the above six categories of traders.

3.2 Testing the Ordered Logit Model

Table 6 shows the results of the ordered logit model. The estimated coefficient of firms' productivity is positive and statistically significant. In addition, the estimated cutoff points are positive and significant. The large difference between the first and the last cutoff point is a clue to the different cost structures (and, therefore, of different productivity thresholds) faced by firms under different internationalization conditions (Békés & Muraközy, 2018). Thus, jointly considered, these findings further confirm the results of the previous section about productivity sorting among traders who differ in terms of the side and mode of trade in the international market.

Table 6. Ordered Logit Regression Model

Variables	Coefficients (S. E.)
TFP	0.637***
	(0.155)
Firms age	0.181**
	(0.073)
Product quality	0.985***
	(0.116)
Firms size (base: small)	
Medium	1.348***
	(0.180)
Large	1.909***
	(0.339)
Mono product firms	-0.203*
	(0.113)
Contract enforceability (base: not confident)	
Less confident	-0.084
	(0.085)
Confident	0.080
	(0.173)
Strong confident	0.063
	(0.296)
Foreign technology	0.448***
	(0.131)
Skill intensity	3.731***
	(1.362)
Skill intensity (square)	-2.693***
	(0.930)
Cut-off 1	4.786***
	(0.747)
Cut-off 2	6.453***
	(0.721)
Cut-off 3	6.618***
	(0.709)
Cut-off 4	7.211***
	(0.746)
Cut-off 5	8.573***
	(0.691)

Notes: Robust standard errors, clustered at the industry-level, are reported in the brackets. The model includes country, industry and year fixed effects.

Before turning our attention to the TFP variable, we will summarize the results of the other covariates included in the empirical model. First, at this stage, a positive and significant sign of a coefficient can only be interpreted as firms being more likely to fall into the highest category (i.e., direct two-way traders) and less likely to fall in the lowest category (i.e., domestic firms) in response to an increase of the explanatory variable. Specifically, we found that the larger effect on the probability of moving up the ladder of trade exposure stems from the firm size and the share of skilled workers. A positive but smaller effect has been found for firms' age, product quality, and the adoption of foreign technology. We also found that contract enforceability does not affect productivity

sorting, whereas being a mono-product firm reduces the probability of being involved in international trade.

Turning our attention to our main research question, the results show that, along with an increase in the TFP, firms are less likely to be domestic and more likely to be direct two-way traders. The estimated coefficients amount to 0.637. Thus, by looking at the sign of the coefficients, we can infer the direction of the partial effect of the TFP on the predicted probabilities of the extreme categories.

Table 7. Average Marginal Effects

Categories of traders	**1**	**2**	**3**	**4**	**5**	**6**
Predicted probabilities	0.118	0.223	0.028	0.105	0.226	0.301
Variables				**AME**		
TFP	-0.058	-0.050	-0.002	-0.003	0.019	0.094
	(0.016)	(0.011)	(0.001)	(0.002)	(0.004)	(0.025)
Firms age	-0.016	-0.014	-0.001	-0.001	0.006	0.027
	(0.007)	(0.006)	(0.000)	(0).000	(0.002)	(0.011)
Product quality	-0.089	-0.077	-0.004	-0.005	0.030	0.145
	(0.013)	(0.007)	(0.001)	(0.002)	(0.003)	(0.018)
Firms size (base: small)						
Medium	-0.122	-0.105	-0.005	-0.007	0.041	0.198
	(0.014)	(0.016)	(0.002)	(0.002)	(0.008)	(0.022)
Large	-0.173	-0.149	-0.007	-0.009	0.058	0.280
	(0.026)	(0.029)	(0.002)	(0.002)	(0.014)	(0.041)
Mono product firms	0.018	0.016	0.001	0.001	-0.006	-0.030
	(0.01)	(0.008)	(0.000)	(0.001)	(0.003)	(0.017)
Contract enforceability (base: not confident)						
Less confident	0.008	0.007	0.000	0.000	-0.003	-0.012
	(0.008)	(0.007)	(0.000)	(0.001)	(0.003)	(0.013)
Confident	-0.007	-0.006	0.000	0.000	0.002	0.012
	(0.015)	(0.014)	(0.001)	(0.001)	(0.005)	(0.025)
Strong confident	-0.006	-0.005	0.000	0.000	0.002	0.009
	(0.027)	(0.023)	(0.001)	(0.001)	(0.009)	(0.043)
Foreign technology	-0.041	-0.035	-0.002	-0.002	0.014	0.066
	(0.011)	(0.011)	(0.001)	(0.001)	(0.005)	(0.019)
Skill intensity	-0.338	-0.292	-0.014	-0.018	0.114	0.548
	(0.118)	(0.111)	(0.007)	(0.007)	(0.047)	(0.192)
Skill intensity (square)	0.244	0.211	0.010	0.013	-0.082	-0.396
	(0.081)	(0.075)	(0.004)	(0.005)	(0.032)	(0.131)

Notes: Robust standard errors are reported in the brackets. Categories of traders, from 1 to 6, are described in the text.

Therefore, the TFP has a significant and negative effect on the probability of being a domestic firm, whereas it has a positive effect on the probability of belonging to the category of direct two-way traders (note 15). Such effects, as well as those of the other explanatory variables, remain ambiguous on the probabilities of intermediate outcomes (note 16). Nevertheless, we can rely on average predicted probabilities and determine average marginal effects (AMEs) to qualitatively and quantitatively describe the impact of our explanatory variables on all trade categories (note 17). Therefore, we report the average predicted probabilities and AMEs in Table 7, where AMEs measure the impact of a marginal change in each explanatory variable on the probability of belonging to one of the six categories while holding constant all other independent variables.

As Table 7 shows, the average probability of being a domestic firm is 11.8%, whereas the probabilities of being in the other five categories are, respectively, 22.3%, 2.8%, 10.5%, 22.6%, and 30.1%. A marginal increase in the TFP decreases the estimated probability of the first category by 5.8 percentage points, as well as the probabilities of the second, third, and fourth categories (by 5, 0.2, and 0.3 percentage points, respectively). Differently, the AMEs of the last two categories denote an increase in the probabilities, respectively, by 1.9 and 9.4 percentage points. These results first confirm the conventional wisdom that more productive firms are more likely to be international traders, as an increase in the TFP reduces the likelihood of being a domestic firm by 5.8 percentage points.

Nevertheless, and somehow unexpectedly, this likelihood reduction does not spread out uniformly over the remaining categories of traders; rather, we found a reduction for the categories of indirect one-way, indirect two-way, and mixed two-way traders. Second, an overall shift in the TFP produces a reallocation of firms from the first four categories to the remaining categories, with the more pronounced effect being driven by domestic firms and indirect one-way traders (−10.8 overall percentage points) moving into the direct one-way and

two-way traders categories (+11.3). This suggests that an increase in the TFP reduces the probability of relying on trade intermediaries as stated by Grazzi and Tommasi (2016). Third, by distinguishing between direct and indirect traders, our results extend the findings of Kasahara and Lapham (2013). According to the authors, firms that are both importers and exporters are more productive than firms active just on one side of the international market. On the one hand, we confirmed that, among direct traders, the larger the TFP, the higher the probability of being a two-way (+9.4 percentage points) rather than a one-way (+1.9) trader. Differently, a shift in the TFP would decrease the share of indirect one-way traders (who climb the ladder of internationalization modes toward the two upper categories) relatively more than what we found for indirect and mixed two-way traders.

Table 8. Brant Test

Variables	**chi2**	**p>chi2**
Entire model	167.250	0.000
TFP	10.040	0.040
Firms age	11.430	0.022
Product quality	20.560	0.000
Firms size (base: small)		
Medium	27.750	0.000
Large	37.890	0.000
Mono product firms	6.560	0.161
Contract enforceability (base: not confident)		
Less confident	2.640	0.620
Confident	0.980	0.913
Strong confident	2.250	0.689
Foreign technology	7.190	0.126
Skill intensity	6.780	0.148
Skill intensity (square)	8.010	0.091

As pointed out in Section 3.2, the previous ordered logit results rest on the proportional odds assumption. In Table 8, we report the statistics from the Brant (1990) test both for the entire model and for each covariate. The test detects that, overall, we can increase the precision of the model by relaxing the assumption, and it suggests that the covariates for which we can estimate varying slopes are the TFP, firm age, firm size, and product quality.

Thus, for robustness purposes, we re-estimated the models through generalized ordered logit and we present the AMEs in Table 9 (note 18). From the inspection of the table, we saw that the main conclusions drawn from the previous analysis broadly apply to the generalized model results, with a caveat. We noticed that the marginal effects of the last two categories together imply that a shift in the TFP yields a reallocation of firms into the direct one-way and direct two-way traders categories (+12.80%) larger than what was found in the baseline ordered model (+11.30%). Nevertheless, this result is paralleled to AMEs for direct one-way traders, being of a larger magnitude (+5.38%) than in the ordered logit model (+1.95%).

Table 9. Generalized Ordered Logit Regression - AME

Categories of traders	**1**	**2**	**3**	**4**	**5**	**6**
Variables	**AME**					
TFP	-0.061	-0.060	0.010	-0.017	0.054	0.074
	(0.017)	(0.02)	(0.005)	(0.011)	(0.013)	(0.023)
Firms age	0.003	-0.037	-0.019	0.015	0.023	0.016
	(0.015)	(0.011)	(0.006)	(0.007)	(0.014)	(0.02)
Product quality	-0.129	-0.020	0.005	0.053	-0.065	0.157
	(0.036)	(0.041)	(0.006)	(0.017)	(0.027)	(0.021)
Firms size (base: small)						
Medium	-0.086	-0.142	-0.026	0.009	0.063	0.182
	(0.02)	(0.038)	(0.007)	(0.011)	(0.016)	(0.044)
Large	0.338	2.640	-5.817	2.410	0.146	0.283
	(0.097)	(0.126)	(0.274)	(0.153)	(0.04)	(0.073)

Notes: Robust standard errors are reported in the brackets. Categories of traders, from 1 to 6, are described in the text.

4. Discussion

Our analysis is among the first multi-country studies carried out in the branch of literature concerned with

productivity sorting of firms operating internationally, with reference to emerging markets. Therefore, not only does it have significant implications for policy development, but also, hopefully, it will pave the way for more research in this regard.

In this latter respect, we believe that the role of knowledge deserves further attention. The literature suggests that international trade requires threshold levels of productivity, as well as distinctive capabilities, which need to be present or created prior to any engagement with international markets. Knowledge acquisition has been found as a relevant variable in the choice of international trade modes. Indeed, the ability to value, assimilate, and apply new knowledge has been argued to be among the main determinants to enter import markets (Castellani et al., 2010). From the learning perspective, Yasar, Garcia, Nelson, & Rejesus (2007) found evidence of learning-by-exporting effects. The work of Augier et al. (2013) provided further support to the role of absorptive capacity in the decision to import, as it has been found to leverage the import effects through the capability to access better inputs. Moreover, Abel-Kock (2013) found that, besides knowledge, product innovation also has an impact on the choice of the export modes.

The results of our empirical analysis are of particular interest also for the design of theoretical models and their policy implications. Research in such direction should take into account that firm choices of trade modes could play a major role for productivity sorting compared to trade sides. In terms of policy implications, since less productive firms can access foreign markets even if they are unable to cover the fixed costs of direct trading, our results may explain why some countries have implemented policies to encourage trade intermediation.

To the extent that imported goods incorporate advanced knowledge and technologies, they may entail sunk costs that importers must incur to accumulate the absorptive capacity needed to use those goods in production. Indeed, one implication is that some firms can partially benefit from importing high-quality products from abroad, even if they do not directly import intermediate goods. At the same time, since intermediated exports are associated with lower fixed costs of gaining access to foreign markets, they are an attractive option for less efficient firms which want to export their goods. Thus, trade intermediaries could also serve as initial vehicles for less productive firms to learn their potential in exporting markets, either by learning about their efficiency or about foreign demand. However, the knowledge gained by indirect exporters/importers is lower than that acquired by direct traders because trade intermediaries might not necessarily share important pieces of information (such as destination countries' local demand, product preferences, and foreign market conditions) and, thus, may act as a hidden barrier to international knowledge transfer. In this regard, firms in lower-income countries or coming from emerging/developing economies may be more likely to use intermediaries to reach foreign markets. So, policies that subsidize trade intermediation have the merit of dampening large effective barriers to trade.

Nevertheless, the effects of regulatory reforms in the intermediary sector should be evaluated also in terms of aggregate welfare in the long run, by considering the trade-off between wider access to foreign markets and a higher level of learning capacity. For instance, Chinese firms increased their knowledge acquisition and productivity levels after restrictions on direct trading were removed (Bai, Krishna, & Ma, 2017). Despite the growing share of trade intermediaries, Di Cintio, Ghosh and Grassi (2020) showed that direct exporters are more likely to introduce innovations in transition economies. Hence, trade intermediaries may act as a barrier reducing the knowledge transfer from foreign markets to local firms, and potentially shrinking productivity improvements (Di Cintio, 2020).

5. Conclusions

In this study, we established a productivity ranking among firms that are differently involved in international markets, both concerning the modes and in terms of the two sides of international trade. In particular, in this paper, we tried to link related, but separate, strands of literature, where productivity differentials were linked alternatively either to the decision to trade or not, to the selection of the trade side (import, export, or both), or the choice of the trade mode (directly or indirectly through intermediaries). Since prior research has not yet investigated how trade sides and trade modes, when simultaneously considered, affect the efficiency order of firms, we complemented the empirical evidence on the sorting literature by investigating firms' heterogeneity in a more complex structure, where different modes of import may be combined with different modes of export. Thus, we extended previous works by introducing direct and indirect imports as well as export trade modes in the already existing productivity sorting evidence, which often refers just to the export side. Our main result shows that, rather than the side, it is the mode of trade that matters for productivity sorting among firms involved in the international market. Indeed, firms that just import do not show a different distribution of TFP from those that just export. However, we pointed out that this is true provided that the mode of trade is the same. Only the most productive firms choose to trade directly, even when they trade on both sides of the international market. In

addition, we shed light on the extent to which the choice to trade directly just on one side of the international market is correlated to higher productivity than that associated with mixed two-way traders. In the end, we concluded that direct two-way traders have the highest TFP, followed by direct one-way traders and then mixed two-way traders and finally indirect traders (two- and one-way).

Since the literature still lacks comprehensive evidence regarding a productivity sorting model that accounts for both international trade sides and modes, we contribute to the empirical literature that studies the relationship between productivity and different internationalization choices (note 19). Second, we complement another multi-country perspective on the available evidence on emerging markets. The methodological approach is the third contribution of our paper. In particular, we use the stochastic dominance criterion to compare the entire distribution of productivity of traders, who may be involved in either the output supply side (i.e., exports) or the input demand side (i.e., imports) under different trade modes (i.e., either directly or indirectly through intermediaries). Our main result shows that, rather than the side, it is the mode of trade that matters for productivity sorting among firms involved in the international market.

Finally, let us point out the main limitations of our study. Since our data are cross-sectional, it was not possible to precisely estimate causal effects. In other words, we were not able to discern what part of the productivity differentials could depend on the characteristics of firms before entering into the international markets (i.e., self-selection hypothesis) and what part could be a result of this behavior (i.e., learning by trading). This, to some extent, reflects a trade-off between estimating causal effects and establishing productivity sorting (note 20). However, the purpose of our study, rather than determining whether higher productivity is due to selection or learning by trading, is to complement the sorting literature on the relative performance of eight categories of firms, in which heterogeneity is simultaneously characterized by the choice of both the side and the mode of the international trade.

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Endnotes

Note 1. See Wagner (2012) for a comprehensive survey of the empirical literature.

Note 2. For instance, Blum et al. (2009) assumed that intermediaries enjoy economy of scale, which allows for fixed cost reduction. Rauch and Watson (2004) interpreted the share of exporting revenue for the intermediaries because of the negotiation between firms and intermediaries.

Note 3. We take domestic firms (i.e., firms that do not trade internationally) as a separate category with respect to firms actually involved in import and/or export activities.

Note 4. The marginal effects at the means could also be calculated. However, we prefer AMEs, first because mean values are only one of many possible sets of values that could be used and, second, because the use of means may produce a set of values that no real firm could in fact have.

Note 5. We report the AMEs for the coefficients with varying slopes. The complete table and the estimated coefficients are available upon request.

Note 6. Similarly to Békés and Muraközy (2018), we are confident that an ordered logit regression may be appropriate to estimate sorting along multiple potential international choices. Nonetheless, the question is whether or not productivity differentials exist even if other factors, related to both productivity and international trade strategies, are controlled for.

Note 7. A partial exception is due to Grazzi and Tomasi (2016). However, rather than establishing productivity sorting, the authors found evidence of different productivity premia associated with firms engaged in both importing and exporting activities, either directly or indirectly.

Note 8. Greenaway and Kneller (2007) and Wagner (2007) offered a review of these pieces of literature. However, while the evidence of the first mechanism is quite conclusive for exports (e.g., Bernard & Jensen, 1999) and for imports (e.g. Muûls & Pisu, 2009), evidence of the effects of international trade on productivity is more mixed (Wagner, 2012).

Note 9. We remark that the WBES has limited time-series properties. However, even though the longitudinal component of the data is insufficient to pick up time variations, as described in the next section, we make use of the longitudinal dimension to estimate firms' TFP, which is crucial for our analysis.

Note 10. Inspired by the models of Melitz, McCann (2013) used the same approach, noticing that when firms trade through both modes, they have already overcome the higher fixed costs of trading directly

Note 11. The number of observations shrinks to 3228 records with valid information about the chosen side and

mode of trade.

Note 12. The variables (in logs) used to estimate the gross output measure of the TFP include firms' annual sales as a proxy of output (Y); the number of skilled and unskilled workers as a proxy of labor inputs (L); and the net value of machinery, vehicles, and equipment as a proxy of capital inputs (K). As is standard in the literature, we use the cost of raw and intermediate materials (M) in a control function to account for unobserved productivity shocks. All the above monetary variables are expressed in local currency units, which refer specifically to each national survey and the data span on different fiscal years. Thus, for our cross-country estimations, all data were converted into US dollars using the official exchange rate. Moreover, the data were also deflated to 2009 using the GDP deflator for USA. Notice that we are able to estimate the TFP for 1615 firms interviewed at least in two consecutive surveys and for which we have valid information about the side and the mode of trade.

Note 13. Since the method of Olley and Pakes (1996) treats the endogeneity problem by making use of firms' investment as a proxy for unobservable productivity shocks, the absence of information regarding firms' investments precludes the application of this alternative methodology.

Note 14. For the reference category, we set $j = 0$ by indicating domestic firms.

Note 15. For a similar approach, see Lu et al. (2017) and Békés and Muraközy (2018).

Note 16. Abel-Koch (2013) selected the same covariates as firms' characteristics able to explain their trading behavior.

Note 17. After deleting observations without valid information about trade sides, trade modes, TFP measures, and the above further firms' characteristics, we were able to run an estimation for a final sample of 1474 observations.

Note 18. In unreported tests, we also checked and confirmed the stochastic dominance of TFP distributions of importers, exporters, and two-way traders against the TFP distribution of domestic firms irrespective of trading directly or indirectly. Thus, we used domestic firms as the reference category.

Note 19. The odds ratios associated with a one-unit increase in the regressor are immediately computed by taking the exponential of the coefficients. Thus, the change in the odds associated with a δ-unit change is equal to $\exp(\delta\beta)$. For instance, a one-standard-deviation increase in the TFP (i.e., 0.736 for the full sample) implies that the odds ratio of moving away from the domestic firm category increases by a factor of 1.598.

Note 20. Notice that since the sum of the probabilities of belonging to one of the trade categories amounts to one, the sum of the partial effects of an explanatory variable on these probabilities needs to be zero.