Export modes and firms' adjustments to exchange rate movements

Published Version:
Export modes and firms' adjustments to exchange rate movements / Bolatto, Stefano; Grazzi, Marco; Tomasi, Chiara. - In: EUROPEAN ECONOMIC REVIEW. - ISSN 0014-2921. - ELETTRONICO. - 141:(2022), pp. 1-22. [10.1016/j.euroecorev.2021.103955]

Availability:
This version is available at: https://hdl.handle.net/11585/864046 since: 2022-02-22

Published:
DOI: http://doi.org/10.1016/j.euroecorev.2021.103955

Export Modes and Firms' Adjustments to Exchange Rate Movements

Stefano Bolatto[a,*], Marco Grazzi[b], Chiara Tomasi[c]

[a] *Department of Economics, University of Bologna, Italy*
[b] *Department of Economic Policy, Università Cattolica del Sacro Cuore, Milano, Italy*
[c] *Department of Economics and Management, University of Trento and LEM, Italy*

Abstract

The paper provides novel evidence on the heterogeneous response of exporting firms to exchange rate movements. Italian firm-level trade data by product-destination reveal that export price elasticity to exchange rate variation is larger for export intermediaries than for direct (manufacturing) exporters. To bring together such evidence and other stylized facts in the literature, the paper proposes a simple model of heterogeneous pricing-to-market where intermediated trade features double marginalization. Further validation is provided testing additional predictions on the adjustment in the relative number of products traded over the two export channels. Overall, our results suggest that in addition to facilitating trade, export intermediation contributes to stabilize trade patterns across countries.

Keywords: Export intermediation, Heterogeneous markups, Pricing-to-market, Exchange rate pass-through, Export mode selection, Double marginalization, Productivity sorting.

JEL codes: F12, F14, D22, L22

Acknowledgments. This paper has been possible thanks to a research agreement between the Italian Statistical Office (ISTAT) and the Scuola Superiore Sant'Anna in Pisa and builds upon the preliminary evidence of a previous project on intermediaries in international trade (NBER Working Paper No.17711). We gratefully acknowledge Andrew Bernard, who was also involved in that project, for very insightful suggestions. We have also greatly benefited from valuable comments and discussions from Vincenzo Denicolò, Lionel Fontagnè, Enrico Marvasi, John Morrow, Gianmarco Ottaviano, Armando Rungi, Nicolas Schmitt and conference participants at ITSG (Bergamo, 2017), Ljubljana Empirical Trade Conference (Izola, 2017), ETSG (Florence, 2017), International Conference "Economics of Global Interactions" (Bari, 2019) and ISGEP Workshop (Trento, 2019). All errors remain our own.

*Corresponding author. *Address*: Via San Giacomo 3, 40126 Bologna, Italy, *Tel:* +39 051 2092651, *Email:* stefano.bolatto@unibo.it.

Email addresses: marco.grazzi@unicatt.it (Marco Grazzi), chiara.tomasi@unitn.it (Chiara Tomasi)

1. Introduction

A large bulk of literature in international trade, extensively surveyed in Burstein and Gopinath (2014), has documented that exporting firms typically adopt pricing-to-market strategies (PTM hereafter) and adjust their markups so as to limit, purposefully, the transmission of exchange rate movements into retail (and border) prices, leading to incomplete exchange rate pass-through (ERPT). The seminal work of Berman et al. (2012) has linked pricing-to-market to firm-level characteristics, documenting that more productive firms tend to adjust their markups to a greater extent than less efficient ones. Firm heterogeneity in pricing behavior has then shown to be essential to generate realistic aggregate price dynamics and to explain the observed limited response of aggregate variables to exchange rate movements.[1]

Moving from such heterogeneity in firms' price adjustments to exchange rate movements, this article brings into the literature on PTM the difference in pricing behavior between direct exporters and export intermediaries.[2] A well-established fact in trade literature is that manufacturers sort according to productivity in determining their entry mode in the export market, with more productive firms exporting by their own; and less productive ones exporting indirectly, i.e., through an intermediary firm. Theoretical models in this field provide different frameworks for understanding the role of intermediation technology in international trade (see Ahn et al., 2011; Felbermayr and Jung, 2011; Raff and Schmitt, 2009; Akerman, 2018, among others). Empirically, the sorting pattern predicted by these models has then been clearly documented in several studies from a variety of source-country's national data (e.g. Bernard et al., 2010; Ahn et al., 2011; Crozet et al., 2013; McCann, 2013; Davies and Jeppesen, 2015; Grazzi and Tomasi, 2016; Lu et al., 2017).

Collecting together the facts arising from these two streams of literature, PTM and

[1]Following Berman et al. (2012), several other contributions, including Chatterjee et al. (2013); Amiti et al. (2014); Bernini and Tomasi (2015); Caselli et al. (2017); Garetto (2016); Auer and Schoenle (2016); Auer et al. (2018) have thoroughly investigated the issue of firm heterogeneity in pricing-to-market strategies.

[2]Export intermediaries are firms that do not engage in production activities, yet report foreign sales as they do operate as pure intermediaries, enabling manufacturers to export their products indirectly. Many producers indeed seem to opt for this entry mode in the export market: Bernard et al. (2010) report that 35% of US exporters are wholesalers, accounting for 10% of the total export value of the country. Figures are similar for Italy (Bernard et al., 2015), while the share of intermediaries' export is even larger (respectively, up to 15% and 20%) in Sweden (Akerman, 2018) and France (Crozet et al., 2013). In China, approximately one quarter of the country's total export is generated through wholesalers (Ahn et al., 2011). The contribution of retailers is more limited, as they play a more significant role as importers. Given our focus on exporting firms' behavior, we will then use the terms *intermediaries* and *wholesalers* as interchangeable throughout all this paper.

the role of intermediaries, one would expect export prices to react more to exchange rate variation whenever goods are exported directly by their producers, rather than by intermediary firms. This is because (*i*) higher-performance firms absorb exchange rate variation in their markups to a greater extent than firms with lower-performance; and (*ii*) intermediaries tend to trade goods manufactured by lower-performance producers, i.e., characterized by lower levels of productivity.

Using a very rich Italian firm-level dataset with destination-and-product specific information on export values and volumes for the period 2000-2007, the paper provides new evidence on the impact of exchange rate movements on the pricing strategy of the two types of exporters. Empirically, the unit value is used as a proxy for the free-on-board (FOB) export price. When restricting the sample to exports of manufacturing firms only, our empirical analysis confirms that firms with better performance tend to absorb more of the exchange rate variation in their markups, compared to firms with weaker performance, i.e., the behavior of Italian direct exporters conforms to that of their French counterparts, analyzed by Berman et al. (2012). Nonetheless, when considering also wholesalers'exports, estimates from our reduced-form equation show that both direct exporters and intermediaries decrease (increase) their export prices in response to exchange rate appreciations (depreciations), yet the export price elasticity is larger for the latter than for the former. Differences in the price response across the two types of exporters are statistically and economically significant: following a 10% real appreciation, direct exporters undercut their export price by 0.3% on average, whereas for intermediaries the extent of the reduction is doubled (-0.6%).[3] This result is robust to the inclusion of several dimensions of fixed effects that control for unobserved determinants of export price variation; and to the addition of firm, country, and product characteristics whose lack of control could bias our findings.

Intermediaries' export prices are therefore more sensitive to exchange rate movements, a result that appears at odds with the idea that these firms tend to export products manufactured by lower-performance firms, which consequently display a lower margin of markup adjustment. One caveat of our analysis is that we do not observe the characteristics of the indirect manufacturing exporters, whose goods are traded by wholesale firms. This prevents us from directly controlling for productivity sorting.

[3]Albeit it might appear small at the first sight, this value for the average export price elasticity for direct exporters is comparable to estimates from other countries, e.g. around 0.08 for French manufacturers (Berman et al., 2012) and 0.05 for Belgian enterprises (Amiti et al., 2014). Moreover, all these average values hide a considerable amount of heterogeneity across firms, differing along several dimensions such as productivity, market shares, import intensity, output quality and the like.

However, since direct manufacturing exporters are typically more productive than indirect ones (as documented by a series of previous empirical studies); and given that less efficient producers adjust less their prices following an exchange rate movement (as confirmed also in our data), we conclude that the absence of an *ad-hoc* control for productivity sorting might eventually lead us to underestimate the extent to which price adjustment differs between direct exporters and intermediaries. In other words, our estimates provide a lower bound for the difference in the average export price elasticity observed between the two export channels.

The novel evidence that we document here appears as a puzzle at least through the lens of standard trade models, in particular those C.E.S./monopolistic competition models that have been (and in part, are still) the workhorse framework of modern trade theory. Rationalizing this new fact in a way consistent with other consolidated findings in the literature thus requires us to go beyond the most traditional framework and consider a variety of alternative settings, such as models with linear demand *à la* Melitz and Ottaviano (2008), the ones with buyer heterogeneity in the wake of Bernard et al. (2018); or even those with trade intermediaries having some monopolistic power, as in Raff and Schmitt (2009). In the lack of more detailed information on producer and wholesale prices, the exact theoretical mechanism driving our empirical results is hard to pin down. Nonetheless, we propose here what we believe to be the most parsimonious of these mechanisms, that is, double marginalization in presence of heterogeneous markups and generalized pricing-to-market strategy.

By taking this route, we develop a simple variant of the class of models surveyed by Berman et al. (2012) in their appendix, all featuring endogenous markups, and all consistent with the evidence of larger markup adjustment by more productive firms documented in their empirical exercise as well as in our own. We also manage to easily accommodate other consolidated facts in the literature –e.g. productivity sorting in the export mode selection– without departing too far form the groove traced by this seminal paper. More in detail, we consider a variant in which firms' pricing along the intermediated export channel recalls one key-insight from the empirical literature of industrial organization, according to which vertical relationships can be an important factor drawing cost pass-through down, whenever implying sequential price setting and double marginalization (see Hastings and Gilber, 2005; Hellerstein and Villas-Boas, 2010; Neiman, 2010; Bonnet et al., 2013; Hong and Li, 2017).[4] Although this evidence

[4] In particular, Bonnet et al. (2013) show that, in the German coffee market, firms' ability to adjust their markups to the new market conditions is restricted by the adoption of non-linear pricing contracts. The use of resale price maintenance provides a rationale for cost pass-through being larger

mainly relates to the retail sector, the effects produced by the vertical structure of the market might be likely the same at work in the sector of export intermediation.

While double marginalization has been already introduced by Akerman (2018) in the vertical relation between the manufacturer (the indirect exporter) and the intermediary, it is worth stressing that, in our narrative, it operates on top of an endogenous and heterogeneous strategy of pricing-to-market. Hence, both the indirect exporter and the intermediary adjust their own markup following a exchange rate shock. Among manufacturing firms, the extent of this adjustment is still larger for higher-performance ones, implying that direct exporters will adjust more than indirect exporters in light of their superior productivity. Nevertheless, along the intermediated export channel, the intermediary's markup adjustment comes in conjunction with the one of the indirect manufacturing exporter, thus the overall price adjustment is systematically larger than the one observed along the direct export channel.[5]

As for the rest, the model proposed here features a standard trade-off as regard the firm's choice on the entry mode in the export market, in form of fixed cost advantages versus lower variable profits in case of indirect entry, as in Raff and Schmitt (2009); Ahn et al. (2011); Felbermayr and Jung (2011), among others. It also delivers clear predictions on the adjustment in the relative number of products traded along the two channels. Manufacturing firms indeed react to variation in real exchange rates not only by modifying their markups, but also revising, for any variety, their previous choice about the entry-exit decision in the foreign market and the entry mode to adopt. The adjustment process therefore involves (*i*) some varieties previously exported directly that switch into being exported indirectly or vice versa, depending on whether an appreciation or a depreciation occurs; and (*ii*) some varieties exported indirectly that exit or newly enter the foreign market, correspondingly. The estimates from this reduced-form equation, reported in the Appendix, go again in the direction suggested by our theory.

Note that all these predictions are not specific to a given mechanism generating pricing-to-market and variable markups, but to the more general class of models surveyed by Berman et al. (2012) in their appendix; and to the even more general class of models with endogenous price elasticity. While here we present our theory by building

in this market, compared to the case in which standard linear pricing applies. In turn, Hong and Li (2017) use scanner data from a large U.S. retailer and detect a lower degree of cost pass-through for national brands with respect to private labels, again in a way consistent with arm's length sequential price setting for the first category of products.

[5]This holds unless for largely implausible productivity gaps between direct and indirect exporters.

on a linear demand system in the spirit of Melitz and Ottaviano (2008), we show in our Appendix that observationally equivalent predictions can be obtained by introducing double marginalization on different setups, e.g. one featuring C.E.S. preferences and local distribution costs *à la* Corsetti and Dedola (2005).[6]

Overall, the paper conveys a clear message. The new facts that we document (and rationalize) here suggest that the role of intermediaries goes behind that of serving as simple vehicles for export participation of less productive manufacturers. Although we do not provide a quantitative assessments of the welfare effects of the existence of export intermediation, the observed difference on how direct and intermediated exports react to exchange rate movements suggest that, by being more flexible along different margins, wholesalers may contribute to generating more stable trade patterns across countries. This result provides a clear micro-foundation for the evidence on aggregate export patterns documented in Bernard et al. (2015), according to which trade flows to destinations with higher incidence of intermediated exports are overall less responsive to exchange rate fluctuations than flows to markets served more primary by direct exporters. Our findings thus reinforce the idea that the incidence of intermediated export bears relevant implications for aggregate exports' responsiveness to exogenous shocks.

2. Heterogeneity in pricing-to-market

This section aims at validating previous findings on heterogeneity in pricing-to-market strategies by manufacturing firms and providing novel empirical results on the difference between direct exporters and trade intermediaries.

2.1. Data

Our empirical analysis is based on two datasets, both collected by the Italian statistical office (ISTAT): Statistiche del Commercio Estero (COE), and Archivio Statistico Imprese Attive (ASIA).[7] COE contains all cross-border transactions (both exports and imports) of Italian firms over the period 2000-2007. For all export flows, defined at

[6]The resulting setting bears resemblance to the one analyzed in Chatterjee et al. (2013), with the difference that our firms are not multi-product, as theirs; yet export intermediation is here accounted for. Although this alternative setup generates observationally equivalent patterns of exporting strategies, the conditions to impose on model parameters for the emergence of well-consolidated patterns in international trade are more convoluted than in the linear demand setting. This explains why in the main text we prefer to use the latter to illustrate the possible theoretical mechanism at work.

[7]The database has been made available for work after careful screening to avoid disclosure of individual information. The data were accessed at the ISTAT facilities in Rome.

the firm-product-destination level, we observe both annual values (in euro) and quantities (in kilograms).[8] Products are defined as a six-digit category in the Harmonized System (HS6). Because some product categories are assigned different HS6 product codes at different points in time, we use concordance tables provided by Eurostat to harmonize the classifications to the 2002 version. COE data are used to obtain unit-values (UnitValue_{fcpt}) of the exported products as the ratio of export values to export quantities, with the subscripts f, p, c and t denoting firms, HS6 product classes, destination countries and years, respectively.

Using the common firm identifier, we link the firm-level export data to ISTAT's registry of active firms (ASIA), reporting the sectoral classification of businesses for identifying manufacturing and wholesale businesses. We employ the ATECO industrial classification (NACE Rev. 1.1), at five digits. More in detail, we classify firms in sectors 151 to 372 as manufacturers; and firms in sectors 501 to 519 (with the exclusion of 502, which concerns the activity of repair of motor vehicles) as wholesalers or intermediaries. The combined dataset originating from matching COE to ASIA is not a sample, but includes all active firms.

Table 1 reports the overall export values and the number of exporters by firm-type from 2000 to 2007. In 2000, manufacturers were responsible for the 85% of Italian aggregate exports, whereas wholesalers accounted for approximately 10%. Wholesalers are on average smaller, as the 10% export share is generated by 26% of exporters classified as intermediaries, versus the 85% that is due to 57% of manufacturing exporters. The share of intermediated trade was slightly but constantly growing over time.

Direct exporters and export intermediaries differ along several and relevant features. The top panel of Figure 1 shows the distribution of exports (left panel) and exports per employee (right panel) for wholesale and manufacturing firms in 2006, the last year for which information on employment is available. While the value of wholesalers' exports tend to be smaller than that of manufacturing exporters, this difference largely disappears when considering exports per employee, as wholesalers require fewer employees to attain a given level of export value. In the bottom panel of Figure 1 we look instead at the relationship between geographic and product diversification of the firm (left and right panel, respectively) and its size, summarized in the export value.

[8] ISTAT collects data on imports and exports based on transactions. The European Union sets a common framework of rules but leaves some flexibility to Member States. Although only annual values exceeding a certain threshold are reported in the present dataset, this is unlikely to affect our analyses, as the transactions collected cover about 98% of the total of Italian trade flows (http://www.coeweb.istat.it/default.htm).

Table 1: Exports and number of exporting firms (share by type of firms, 2000-2007)

Year	Total Exports (billion)	Manuf	Whol	Retail	Others
		Share (%)			
2000	246.79	85.09	9.85	0.74	4.32
2001	258.99	86.49	9.88	0.86	2.76
2002	260.75	84.75	10.93	0.83	3.49
2003	254.91	85.52	10.71	0.86	2.91
2004	274.38	85.65	10.5	0.82	3.04
2005	286.56	85.5	10.75	0.85	2.9
2006	319.01	84.95	11.32	0.85	2.88
2007	350.57	85	11.27	0.84	2.88
Year	Exporters (N. of firms)	Manuf	Whol	Retail	Others
		Share (%)			
2000	137347	57.3	26.43	7.67	8.6
2001	141520	56.46	27.01	7.95	8.58
2002	145473	55.64	27.06	8.14	9.16
2003	143421	55.57	27.41	7.72	9.3
2004	139598	55.34	27.61	7.46	9.59
2005	133473	54.96	27.48	7.3	10.26
2006	139360	53.7	28.07	7.31	10.92
2007	128472	54.77	27.91	6.88	10.44

Notes: Table reports the share of exports and the share of exporters by type of firms (Manufacturers, Wholesalers, Retailers and Others). Source: Our elaboration on Italian micro-data.

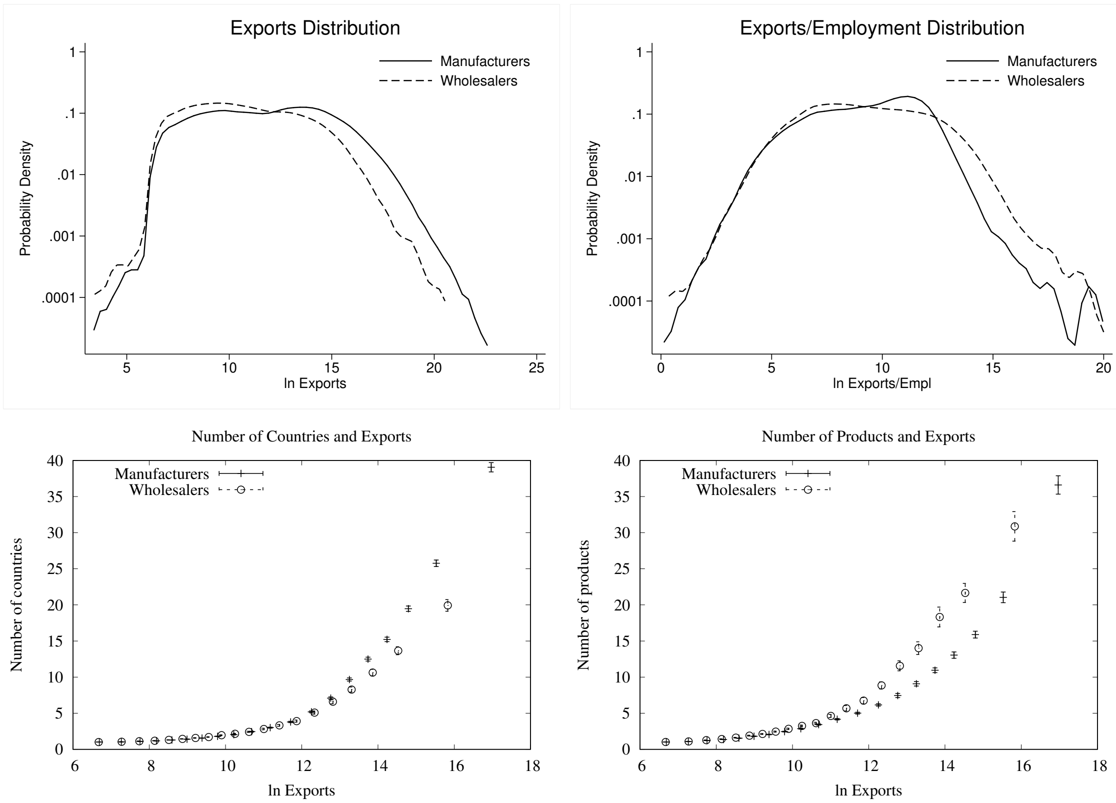
We distinguish again between wholesalers and manufacturers. The evidence suggests that both types of exporters sell several products to each destination, yet the former are active in a wider range of products compared to similarly sized manufacturers.

Firm-level trade data are complemented with information on real exchange rates, obtained from the International Financial Statistics database (IMF, 2010). The real exchange rate, RER_{ct}, is defined as the nominal exchange rate, expressed as the number of foreign currency units per home currency unit (i.e., ER_{ct}), multiplied by the ratio between the domestic consumer price index and the corresponding index abroad (i.e., $\text{CPI}_t/\text{CPI}_{ct}$). Hence, an upward (downward) movement of the RER corresponds to a real appreciation (depreciation) from the perspective of the home country. In our empirical investigation we restrict the sample to non-Eurozone destinations to have a sufficient level of variance of the real exchange rate, which leaves us with a sample of 150 destinations.[9]

We observe important real exchange rate fluctuations over the period of our study. Taking the annual real exchange rate variation (this being the frequency we work

[9]The use of the CPI, over other alternatives such as the Wholesale Price Index (WPI), for instance, is motivated by a much larger coverage of the former, which reports data for 150 countries against the only 65 destinations available for the WPI. Moreover, note that Extra-EU transactions account for around half of total Italian exports.

Figure 1: Top Panel: Empirical density of firm exports (left) and export per employee (right) in 2006. Bottom Panel: Number of countries (left) and products (right) vs. export values in 2006.



Source: Our elaboration on Italian micro-data.

with, in this paper), between 2002 and 2003 we observe that, on average across the 150 destinations, the Euro appreciated by 13%. When taking the real exchange rate with respect to the U.S. dollar (the U.S. being one of the most important non-Euro destination for Italian exporters), annual variation over the period 2000-2007 turns out to have ranged between a minimum of 3% to a maximum of 19%.

2.2. Heterogeneous pricing-to-market across manufacturing firms

We start our empirical investigation by testing whether the evidence provided by Berman et al. (2012) on the heterogeneous reaction of exporting firms to real exchange rate movements holds also for the case of Italian firms. We link the firm-level trade data to Micro.3, a dataset containing balance sheet information on Italian firms with more that 20 employees, available for the period 2000-2006.[10] We measure exporters'

[10]As stressed by Grazzi et al. (2013), to which we refer for further details, the validity of the database is supported by its census nature, which avoids possible biases in the data collection process.

Table 2: Heterogeneous pricing-to-market across manufacturing firms

Dep.var.	ln UV_{fcpt}					
	TFP			Labour Productivity		
	(1)	(2)	(3)	(4)	(5)	(6)
	Main Prod (by value)	Main Prod (by destin.)	Single Prod	Main Prod (by value)	Main Prod (by destin.)	Single Prod
ln RER_{ct}	-0.055	-0.041	-0.030	-0.050	-0.037	-0.027
	(0.012)	(0.011)	(0.015)	(0.012)	(0.011)	(0.015)
$\times \ln \varphi_{t-1}$	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
$\ln \varphi_{t-1}$	0.017	0.019	0.010	0.014	0.016	0.008
	(0.004)	(0.005)	(0.008)	(0.005)	(0.005)	(0.008)
Year FE - γ_t	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Country FE - γ_{fc}	Yes	Yes	Yes	Yes	Yes	Yes
Cluster Country-Year	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.961	0.942	0.953	0.959	0.940	0.951
Observations	559,668	650,694	258,620	598,883	694,631	276,109

Notes: Table reports results of regressions at the firm-product-country level, using cross-border Italian data on unit values of exported products for the period 2000-2006. Custom data are merged with Micro.3, which contains firm-level variables to be used for computing firm-level TFP. We keep *Single Product, Main Product by value and Main Product by destination* observations and we run the regression as in Berman et al. (2012). Asterisks denote significance levels (***: p<1%; **: p<5%; *: p<10%). Source: Our elaboration on Italian micro-data.

productivity by means of the total factor productivity (TFP), computed based on the semi-parametric estimation technique of Levinsohn and Petrin (2003).[11] Alternatively, we employ labour productivity (LP) in form of value added per employee as a measure of firm efficiency.

We restrict our sample to manufacturing firms only, thereby excluding wholesalers, retailers and any other category of firms. Following Berman et al. (2012), we consider different samples to deal with the existence of multi-product firms, so as to detach heterogeneous pricing-to-market from changes in the average price originating from different product composition. A first sample considers only the core-product in terms of export value exported by each firm worldwide (*Main Product by value*). The second one considers again the core-product only, now defined as the product exported to the largest number of destinations (*Main Product by destination*). The last sample contains single product-and-destination specific observations, i.e., observations referred to firms that export only one product to a given location (*Single Product*).

[11] To properly measure firm productivity, one should ideally observe the quantity of output produced by each firm. Since this information is not reported in balance sheet data, empirical literature is used to take deflated sales (or value added) as a proxy for the firm output, assuming that goods produced by firms operating in a given industry are homogeneous.

The estimated equation is then

$$\ln UV_{fct} = \beta_0 + \beta_1 \ln RER_{ct} + \beta_2 \ln \varphi_{ft-1} \times \ln RER_{ct} + \beta_3 \ln \varphi_{ft-1} + \gamma_t + \gamma_{fc} + \nu_{fct} \ , \quad (1)$$

where UV_{fct} is the unit value of the single or main product (depending on the sample employed) sold by firm f to country c at time t. In turn, $\ln \varphi_{ft-1}$ denotes the productivity of firm f in year $t-1$. Following Berman et al. (2012), we normalize firm productivity by the average industry productivity computed in that year. Finally, RER_{ct} is the real exchange rate between Italy and destination country c during year t. The regression includes both year dummies (γ_t) and firm-destination fixed effects (γ_{fc}) capturing, respectively, shocks that are common to all exporters and time-invariant characteristics that vary by destination, by firm or by firm-destination. The coefficient of interest, β_2, captures heterogeneity in pricing-to-market, i.e., the reaction of firms characterized by different level of productivity to common exchange rate variation. We expect a negative sign on both β_1 and β_2; following a real appreciation (i.e., an increase in the RER), manufacturing firms undercut their export price to lower the overall degree of pass-through, the more so the higher their performance.

Columns 1-3 of Table 2 report the results for the three samples when using TFP as a measure of firm productivity, while columns 4-6 show the coefficients when using labour productivity. The estimates obtained across the different specifications reveal that more productive firms, also in Italy, tend to decrease (increase) more their export prices in response to a real appreciation (depreciation).[12] This preliminary exercise validates our data, insofar as the behavior of Italian manufacturing exporters perfectly conforms to the one of the French direct exporters described by Berman et al. (2012), and then further confirmed by later studies, such as Chatterjee et al. (2013) for the case of Brazilian firms or Amiti et al. (2014) for the case of Belgian companies.

2.3. Heterogeneous pricing-to-market across export modes

We now test whether pricing-to-market differs across export channels: do export intermediaries display different price responses to RER shocks than manufacturing exporters? As hinted in the Introduction, a well consolidated pattern in international trade is that firms tend to sort according to productivity in determining their entry mode in the export market, so that more productive firms typically export by

[12] Exchange rates are defined here as units of foreign currency per unit of the domestic currency. A decrease in the exchange rate therefore corresponds to a depreciation. Coefficients in our regression model have then the opposite sign with respect to those reported in Berman et al. (2012).

their own; firms with intermediate levels of productivity resort to a trade intermediary; while less productive firms confine themselves to serve the domestic market only. Based on this fact and given the evidence from Table 2, we would therefore expect direct manufacturing exporters to react more to exchange rate movements than intermediaries, which typically sell abroad goods produced by manufacturers characterized by lower levels of productivity.

We explore the differences between direct exporters and intermediaries in their export price response to annual movements of the RER for a given country-product pair, by estimating the following reduced-form equation:

$$\Delta \ln \mathrm{UV}_{fcpt} = \beta_0 + \beta_1 \mathrm{D}_f^W + \beta_2 \Delta \ln \mathrm{RER}_{ct} + \beta_3 \Delta \ln \mathrm{RER}_{ct} \times \mathrm{D}_f^W + \gamma_t + \gamma_h + \nu_{fcpt} \;, \quad (2)$$

where $\Delta \ln \mathrm{UV}_{fcpt}$ is annual difference between year $t-1$ and t in the (log) unit value of product p sold to country c by firm f. We denote with D_f^W the dummy variable that identifies f as an intermediary firm (W stands for wholesaler). We further introduce year dummies (γ_t) capturing those elements that are common to all exporters, such as shocks to marginal costs. The annual (log) difference in the bilateral real exchange rate is denoted as $\Delta \ln RER_{ct}$. The extent to which direct manufacturing exporters adjust their prices following a RER shock is given by coefficient β_2 in equation (2). The closer $|\beta_2|$ is to 1, the greater the adjustment of the export prices aimed at mitigating ERPT into consumer prices. The coefficient of interest, β_3, reflects the differential reaction of exporting wholesalers to exchange rate fluctuations *vis-à-vis* manufacturing exporters.

In estimating equation (2) we systematically perform within estimations, i.e., we introduce different types and series of fixed effects, summarized above in the generic expression γ_h. Differently from equation (1), we take here annual differences of our variables, so as to get rid of firm-, country- and product- specific determinants that jointly explain the level of firms' unit values as well as the level of the exchange rate. However, a number of omitted variables may still bias the regression.[13] One possible way to limit this problem is to include several dimensions of fixed effects to control for unobserved determinants of export price variation.

We first propose a specification with country (γ_c) and product (γ_p) fixed effects

[13]Potential endogeneity in the price elasticity to exchange rates is more likely caused by omitted variables, rather than by reverse causality and measurement errors. It is hard to think that firms' behavior may influence aggregate exchange rate movements. Moreover, the use of exchange rates taken from official sources may easily limit the concern of measurement errors.

Table 3: Heterogeneous pricing-to-market across export modes

Dep. Var.	$\Delta \ln \text{UV}_{fcpt}$					
	(1)	(2)	(3)	(4)	(5)	(6)
D_f^W	-0.002	-0.002				
	(0.001)	(0.001)				
$\Delta \ln \text{RER}_{ct}$	-0.032	-0.032	-0.029	-0.029	-0.030	-0.030
	(0.011)	(0.012)	(0.009)	(0.011)	(0.013)	(0.015)
$\times \text{D}_f^W$	-0.022	-0.022	-0.031	-0.031	-0.041	-0.041
	(0.011)	(0.010)	(0.013)	(0.013)	(0.018)	(0.018)
Year FE - γ_t	Yes	Yes	Yes	Yes	Yes	Yes
Country FE - γ_c	Yes	Yes	Yes	Yes	No	No
Product FE - γ_p	Yes	Yes	No	No	No	No
Firm-Product FE - γ_{fp}	No	No	Yes	Yes	No	No
Firm-Product(HS4)-Country FE - γ_{fpc}	No	No	No	No	Yes	Yes
Clustering Country-Year	Yes	No	Yes	No	Yes	No
Clustering Country	No	Yes	No	Yes	No	Yes
Adj. R-squared	0.002	0.002	0.033	0.033	0.010	0.010
Observations	4,008,339	4,008,339	4,008,339	4,008,339	4,008,339	4,008,339

Notes: Table reports the results of regressions performed at the firm-product-country level, obtained by using data on unit values between 2000 and 2007. Both the dependent variable and the real exchange rates (RER) are defined as annual differences. D_f^W is a dummy for intermediaries; $\times$ D_f^W denotes the interaction term with $\Delta \ln RER_{ct}$. Firm-product(HS4)-country fixed effects refer to product at the 4-digit level of the Harmonized System classification. Robust standard errors, clustered at country-year level (columns 1,3,5) or country-level (columns 2,4,6), are reported in parenthesis below the coefficients. Asterisks denote significance levels (***: p<1%; **: p<5%; *: p<10%). Source: Our elaboration on Italian micro-data.

to capture the time-invariant part of those characteristics potentially affecting pricing strategies of exporting firms, which might vary either by destination (e.g. size of importing country, trade costs from Italy, distribution costs) or by product (e.g. extent of product differentiation, degree of technological sophistication and complexity, quality level).[14] The first set of results, based on this fixed-effect model, is presented in columns 1 and 2 of Table 3. In column 1 we cluster standard errors at the destination-year level, to allow for correlation of the error terms across destination-years. However, results are robust to alternative clustering at destination level (column 2) which allows for unobserved errors to be correlated over time and across firms within a destination. This way, we take into account potential serial correlation.

The results show that both β_2 and β_3 are negative. For manufacturing firms, the average export price elasticity to exchange rates, captured by β_2, is estimated to be approximately -0.03. This means that following a 10% real appreciation, direct exporters undercut their export price (in Euro) by 0.3% on average. This estimate is in line with the value observed for French exporters by Berman et al. (2012) and Belgian exporters by Amiti et al. (2014). Most importantly, the negative estimated

[14]Results, available upon request, do not change if we include country-product fixed effects.

coefficient of the interaction term, β_3, suggests that following a real appreciation export intermediaries undercut their export prices by more than manufacturing direct exporters. According to columns 1-2, the estimated exchange rate elasticity of export prices for wholesale firms is approximately -0.055, implying a 60% increase in the extent of the price adjustment compared to manufacturing firms.

A potential caveat of the previous identification strategy is that the determinants of firm-product trends in export prices are poorly controlled for, as they might be related to firm and/or firm-product characteristics driving heterogeneous pricing-to-market strategies. In addition, more differentiated products are oftentimes exported directly, while more commodity-type products are more frequently traded through wholesalers (Bernard et al., 2015). At the same time, homogeneous goods tend to be invoiced in widely used vehicle currencies, such as the U.S. dollar, whereas differentiated goods are more invoiced in the local or the producer's currency (Gopinath et al., 2010; Goldberg and Tille, 2009). As a result, the difference in the export price adjustment might be caused by intrinsic characteristics of the different type of exporters, or alternatively by the type of products that are traded along the two export channels available to firms. To take into account this identification problem and check the robustness of our new finding, we consider an alternative specification, in which both firm-product (γ_{fp}) and country (γ_c) fixed effects are included. This allows us to control for the time-invariant component of such characteristics. Columns 3 and 4 of Table 3 report the results under this new specification, which confirms the negative sign (and the size) of β_3. In column 3 standard errors are clustered at destination-year level, while in column 4 simply at destination-level.

A third and last way of treating the potential bias from omitted variables entails including firm-product-country fixed effects (γ_{fpc}), so that coefficients are estimated solely by using the time variation. Because this identification strategy is very demanding, we recover the required degrees of freedom by defining the firm-product-country fixed effects at the 4-digit product level. Columns 5 and 6 of Table 3 report the results of this alternative strategy, where clusters are defined at destination-year and destination level, respectively. To a large extent, our main results remain valid also in this case, as the export price elasticity to RER movements is still higher for wholesale firms than for manufacturers. When accounting for firm-product-destination fixed effects, the export price elasticity for wholesalers becomes slightly larger, about -0.07.

The main shortcoming of our analysis is certainly that we do not observe indirect exporters, i.e., the manufacturing firms producing the goods exported by the wholesalers. This clearly prevents us from establishing a match between the price ad-

Table 4: Heterogeneous PTM across export modes: firms, product and country characteristics

Dep. Var	$\Delta \ln UV_{fcpt}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \ln RER_{ct}$	-0.031**	-0.026**	-0.044***	-0.026**	-0.012	-0.188***	-0.029***	-0.028**
	(0.017)	(0.016)	(0.012)	(0.014)	(0.013)	(0.040)	(0.009)	(0.010)
$\times D_f^W$	-0.030**	-0.020**	-0.040***	-0.048***	-0.033**	-0.042***	-0.035**	-0.034**
	(0.013)	(0.010)	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)
$\times \ln Nce_{ft-1}$	0.001							
	(0.004)							
$\times \ln Npc_{fct-1}$		-0.009**						
		(0.004)						
$\times \ln \#Drop_{pct}$			0.009					
			(0.006)					
$\times \ln Empl_{ft-1}$				-0.010**				
				(0.003)				
$\times$Market $Share_{fpct-1}$					-0.079***			
					(0.018)			
$\times$Market $Costs_c$						0.017		
						(0.016)		
$\times$Governance $Indicator_c$						-0.017		
						(0.017)		
$\times$Min(entry,exit)$_p$						-0.054		
						(0.055)		
$\times$Relation $Specificity_p$						0.205***		
						(0.050)		
Year FE - γ_t	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE - γ_c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Product FE - γ_{fp}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Country-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.034	0.033	0.032	0.034	0.034	0.035	0.064	0.041
Observations	4,008,339	3,852,915	3,652,878	4,008,339	4,008,339	3,843,906	2,205,518	3,807,225

Notes: Table reports results of regressions at the firm-product-country level, using data on unit values of exported products for the period 2000-2006. Both the dependent variable and the real exchange rates (RER) are defined as annual differences. D_f^W is a dummy for intermediaries; $\times D_f^W$ denotes the interaction term with $\Delta \ln RER$. In column 1 we include the interaction of D_f^W with the (log) number of countries a firm is exporting to ($\ln Nce_{ft-1}$); in column 2 with the (log) number of product-countries a firm is exporting to ($\ln Npc_{fct-1}$); in column 3 with the (log) number of manufacturing firms that stop exporting product p in country c between time $t-1$ and t ($\ln \#Drop_{pct}$); in column 4 with the (log) number of employees ($\ln Empl_{ft-1}$); in column 5 with a firm's market share in (Market $Share_{fpct-1}$); in column 6 with product and country characteristics. All the regressions include the interacted variables also in level but they are not shown in the Table. In column 7 we keep only the most important products for all manufacturing direct exporters, while in column 8 we exclude products that are contemporaneously exported and imported by the same firm. Robust standard errors clustered at country-year level are reported in parenthesis below the coefficients. Asterisks denote significance levels (***: p<1%; **: p<5%; *: p<10%). Source: Our elaboration on Italian micro-data.

justment observed for any product exported indirectly (i.e., by an intermediary) and the productivity of its original manufacturer. However, we argue that the absence of an *ad-hoc* control for productivity sorting might eventually lead to underestimating the extent to which price adjustments differ between direct exporters and intermediaries. Since (*i*) less productive (manufacturing) firms adjust less their prices following RER movements and (*ii*) direct manufacturing exporters are typically more productive than indirect ones, then our estimates provide a lower bound for the difference in the average export price elasticity observed between the two export channels.

2.4. Robustness checks

To ensure that our results do not depend on the empirical model employed, we perform several robustness checks in which additional controls are included and alternative samples are selected. First, we estimate a slightly modified version of equation (2) augmented with the inclusion of additional micro- and macro-level characteristics, thereby controlling for a number of alternative mechanisms that could generate observationally equivalent patterns of export price strategies. The new equation to estimate is

$$\begin{aligned} \Delta \ln \mathrm{UV}_{fcpt} = \ & \beta_0 \ + \beta_1 \mathrm{D}_f^W + \beta_2 \Delta \ln \mathrm{RER}_{ct} + \beta_3 \Delta \ln \mathrm{RER}_{ct} \times \mathrm{D}_f^W + \\ + \ & \beta_4 Z + \beta_5 \Delta \ln \mathrm{RER}_{ct} \times Z + \gamma_t + \gamma_{fp} + \gamma_c + \nu_{fcpt} \ , \end{aligned} \tag{3}$$

where Z may be, alternatively, a firm-time variant, a country or a product-level characteristic, while $\Delta \ln \mathrm{RER}_{ct} \times Z$ is the corresponding interaction with the exchange rate. We run these checks including firm-product (γ_{fp}) and country (γ_c) fixed effects in all specifications, to control for firm and/or firm-product idiosyncratic attributes and for characteristics that vary by destination. Year dummies (γ_t) capture instead those elements that are common to all exporters, as above. Standard errors are clustered at the destination-year level.

Our evidence of higher price elasticity for wholesalers could be driven by their higher propensity to shift their export sales to other countries or products in response to RER movements, with clear implications for the level of export prices. To account for these plausible shifts across destinations and products, we interact the exchange rate with either the (log) number of countries to which a firm is exporting (namely $\ln Nce_{ft-1}$) or the (log) number of country-product pairs ($\ln Npc_{fct-1}$) of each exporter, with the obvious exclusion of the partner-country under investigation (even for the same firm, this variable may then take different values across countries). The idea is that the larger the number of destinations or product-country combinations for a given exporter, the higher the likelihood that these shifts occur in response to a RER movement. The results of the new empirical exercises are reported in columns 1 and 2 of Table 4. For both specifications, the main coefficient of interest, β_3, remains negative and statistically significant, suggesting that the export price adjustment is larger for products exported by wholesalers.[15]

[15] In all columns of Table 4, the additional variables included are both in levels and interacted with the real exchange rate; yet for space reasons, we report the coefficient for the interacted term only.

A second possible alternative explanation for our results might consist of the effects from changes in the product mix of wholesalers, as a reflection of a change in the composition of both the pool of direct exporters and that of the indirect exporters resorting to an intermediary firm. Wholesalers, in particular, can ship varieties from a large number of different producers, and most likely they do so. Because we lack information on indirect exporters, we can not rule out the possibility that, following a RER shock, wholesalers modify the varieties handled within each of the product categories that are not discontinued from their channel. To indirectly control for this compositional effect, we compute the (log) number of manufacturing firms that, within each product-country combination, exported directly at time $t-1$ but stop exporting at time t, namely $\ln\#\text{Drop}_{pct}$. This variable proxies for those varieties that, after the RER movement, are no longer exported directly but reach the foreign destination through the intermediated export channel.[16] We then include this rough measure in our empirical specification, together with its interaction with $\Delta\ln\text{RER}_{ct}$. The results are reported in column 3 and show that, even when accounting for their margins of adjustment through a variety-recomposition within each product category, wholesalers feature higher export price elasticity than direct manufacturing exporters.[17]

Note that this compositional effect, *per se*, would not be sufficient to justify the higher elasticity observed for wholesale firms even if considering the different margins of markup adjustment that characterize the different types of exporters. To better grasp the intuition, consider the case of a RER appreciation, such that firms that were used to be direct exporters may find out their productivity level is no longer compatible with direct exporting; and thus they decide to rely on export intermediation to continue reaching the foreign market. Because of productivity sorting, "switching" firms (which convert themselves from being direct to indirect exports) necessarily correspond to marginal direct exporters, i.e., firms featuring lower productivity than the firms that keep exporting directly even in the aftermath of the RER shock. As a result, the products that newly enter the export mix of wholesalers will feature (*i*)

[16] The implicit assumption is that, once they stop exporting directly, firms reach the foreign market through intermediaries, as the sorting model prescribes. Room for these varieties in the export mix of wholesalers is eventually created by dropping varieties produced by marginal indirect exporters.

[17] From Table 2 we note that, among direct manufacturing exporters, higher TFP is associated with higher unit values (i.e., higher export prices). Due to the limitations of our data, we cannot test whether a relationship of this type is present also within the pool of indirect exporters. If it were so, due to productivity sorting varieties discontinued from the direct export channel should be characterized by higher (not lower) unit values than the those previously exported by intermediaries within the same product category. Hence, the possible recomposition effect induce by the RER shock should play against our finding on the larger export price elasticity of intermediaries.

larger margins of price adjustment (all else being equal) than those that were previously exported by the intermediary; but, still, (*ii*) lower margins of adjustment than the products that continue to be exported directly. Summing up, the compositional effect might help closing the gap between the (expected larger) extent of the price adjustment of direct exports and the (lower) one of indirect exporters; but under no circumstances it shall be able to reverse this gap, leading to higher export price elasticity along the intermediated channel, as we actually do observe in our data.

A third element to consider is that including firm-product fixed effects allows us to account for time invariant characteristics, yet time-varying components of omitted variables may play a role. One might argue that the different response in terms of unit values between direct exporters and wholesalers might be driven by the lack of specific controls for those firms' characteristics that vary over time. To address this concern, we include the (log) number of employees ($\ln Empl_{ft-1}$) and its interaction with the RER, so as to control for firm size.[18] Column 4 of Table 4 reports the results. The coefficient of the interaction between the dummy for wholesalers and the RER remains negative and statistically significant, which confirms that export price elasticity is larger for goods traded by intermediaries. Moreover, we observe that bigger firms tend to react to real appreciations by decreasing their export price more than the other firms. Given the consolidated relation between firm size and productivity, this further corroborates the conformity of our findings with those of Berman et al. (2012).

A similar robustness check is provided in column 5, where firm size is captured by the firm's market share at destination ($\text{Market Share}_{fpct-1}$), that we compute as the value of firm's exports of product p to destination country c at time $t-1$ over total exports by all Italian firms in that same product-destination. Consistently with empirical findings in previous related works (e.g. Amiti et al. 2014), the negative and highly significant coefficient β_5 confirms that the larger their market share, the more firms adjust the export price of their products in response to exchange rate shocks.

A fourth concern that we address here is related to previous empirical studies which have shown that trade intermediaries serve different markets and export different products than manufacturing exporters (Ahn et al., 2011; Bernard et al., 2015; Akerman, 2018). In particular, wholesale firms are more likely to serve markets with

[18] This test can be performed using the complete sample of observations, as information on the number of employees at firm-level is available for the entire population of exporting firms, regardless of whether they are manufacturers or wholesalers.

high entry costs and focus on products characterized by lower contract intensity and higher sunk costs. This is because they are able to overcome barriers to international trade at a lower cost than manufacturing firms, as they have the chance to spread country- or product-specific fixed costs over a wider range of products. Omitted product- and destination-specific characteristics might therefore contribute to the differential response of firms' prices to exchange rate movements across the two export channels, with the wholesaler dummy D_f^W reducing to a simple proxy for these omitted variables.

To alleviate this concern, we include within Z in equation (3) a set of proxies of country- and product-specific fixed costs of export. More specifically, for country fixed costs we use (*i*) $Market\ Costs_c$, obtained by using information on the number of documents for importing, cost of importing and time to import from the World Bank Doing Business dataset; and (*ii*) $Governance\ Indicator_c$, built from the World Bank's Governance dataset. An increase in both variables corresponds to an increase in the associated fixed costs required to export to the country of interest. In turn, as proxies of product-fixed costs we use an industry-level measure of contract intensity developed by Nunn (2007), namely $Relation\ Specificity_p$; and a variable, denoted as $Min(entry, exit)_p$, corresponding to the minimum between the entry rate and the exit rate observed in the destination market. The results are shown in column 6 of Table 4 and suggest that, even when controlling for the heterogeneous effects of RER movements across countries and products characterized by higher fixed costs, the export price elasticity to RER movements is larger when the product is traded by a wholesaler.

Table 4 also report the results of further checks that we run to test our results within alternative sub-samples of our dataset, thereby dealing with the coverage of the products exported by Italian firms. First, we address the issue represented by the existence of multi-product (manufacturing) firms, whose productivity may vary with the goods that they produce and export (Mayer et al., 2014, 2020). For these firms, adjustment to exchange rate movements can be heterogeneous across products, with a price response more pronounced for products that are close to the firm's core competency, i.e., those of higher quality or for which the firm attains greater levels of productivity (Chatterjee et al., 2013; Bernini and Tomasi, 2015). Moreover, these firms might want to directly export their core products while indirectly exporting the marginal ones. To take this aspect into account, for each direct manufacturing exporter we keep only the core-product, defined as before as the one associated with the highest export value worldwide (*Main Product by value*), so as to improve the identification strategy through the exclusion of products with a marginal position, for which a lower price response to RER movements is expected. The results in column 7 of Table 4 show that the negative coefficient of the interaction between the RER and the dummy variable for wholesaler is preserved, even in this case.

Finally, we add a sensitivity check, reported in column 8 of Table 4, that deals with the phenomenon of the so-called "carry-along trade", i.e., the increasing propensity of manufacturing firms to export products that they do not produce (Bernard et al., 2019). In principle, one would need information on both production and exports at the product-level to properly identify carry-along firms. Given the lack of information in this regard, we make an approximation by excluding products that are contemporaneously exported and imported by the same firm (either manufacturer or wholesaler), thereby controlling whether the core results of our analysis are driven by the different propensity of producers and intermediaries to engage in pure re-export activity. However, our findings appear largely robust to this check.[19]

2.5. Deciphering the mechanism

Overall, our results show a negative coefficient for both β_2 and β_3, implying that intermediaries are more sensitive to exchange rate movements; and that the entry mode in the export market does actually matter for the extent of the firm-level price adjustment to a RER shock. These results may have relevant implications at a more aggregate level. As shown in Bernard et al. (2015), aggregate exports to destinations characterized by high shares of intermediated exports are indeed less responsive to exchange rate variation than exports to markets served primary by direct exporters. More generally, according to recent contributions in the related literature, firm heterogeneity in pricing behavior is essential to generate realistic aggregate price dynamics and to explain the lack of response of aggregate variables to exchange rate movements (see Amiti et al. (2016) for a recent, comprehensive discussion).

Nonetheless, our main finding is hard to rationalize if one thinks of the evidence from Section 2.2 (i.e., more productive firms absorb more of the RER variation in their markups) combined with productivity sorting in the export mode selection. One obvious way to get on top of this issue would be that productivity sorting is not at work. However, this looks much implausible given the large body of empirical evidence

[19] An additional robustness check, available upon request, considers possible asymmetric effects when disentangling between episodes of appreciation and depreciation. Our findings do not appear to be driven by the direction of the RER movement.

in support of the sorting pattern, even for the case of Italy.[20]

This challenge us to find a proper theoretical explanation for this new fact, going beyond the workhorse model of trade theory –featuring C.E.S. preferences, monopolistic competition and returns to-scale– which clearly appears unfit to this purpose. A natural environment to unravel our theory is the class of models with endogenous price elasticity, recently spotlighted by the analysis of Mayer et al. (2020).[21] Different settings fall into this class –among which many already used in international trade literature– and all of them can in principle be augmented with *ad-hoc* assumptions to accommodate our findings. However, in our opinion the most parsimonious way to bring all facts together is introducing double marginalization on top of a simple model of variable markups and generalized pricing-to-market strategy. The section that follows is to sketch this simple mechanism, showing its ability to generate trade patterns conforming to the evidence documented above. We believe this approach has also the merit to ensure continuity of our analysis with respect to the one of Berman et al. (2012): as our empirical exercise extends their own, our conceptual framework hinges on simple variant of one of the models surveyed in their Appendix.

3. A plausible theoretical mechanism

In Berman et al. (2012) three alternative settings are presented, all featuring heterogeneous markups and pricing-to-market and, therefore, all equally able to explain the evidence stemming from their data on French manufacturers. Here we illustrate one of the possible mechanisms driving our results by considering only one of these three; namely, the model with quadratic utility and linear demand *à la* Melitz and Ottaviano (2008), that we extend by allowing for two possible export modes for man-

[20]Findings consistent with productivity sorting by Italian firms can be found in Razzolini and Vannoni (2011), where firm-level data from Unicredit-Capitalia surveys reveal that *passive exporters* (i.e., firms using sub-contracting in foreign markets) display lower TFP values than direct exporters. Using a survey database gathered in the "European Firms in a Global Economy" (EFIGE) project, also Békés and Muraközy (2018) find evidence supporting productivity sorting in firms' internalization modes. Although Italy is just one of the countries in their sample, no irregular patterns are reported for Italian firms compared to their European counterparts. More generally, evidence consistent with the predictions of the sorting model is given in Bernard et al. (2010); Ahn et al. (2011); Crozet et al. (2013); McCann (2013); Bernard et al. (2015); Davies and Jeppesen (2015); Grazzi and Tomasi (2016), and finally Lu et al. (2017), among others.

[21]As pointed out by Mayer et al. (2020), the workhorse framework falls short in explaining a series of aggregate empirical patterns, mainly because price elasticity is predicted to be constant in this class of models; thus markups do not respond to trade shocks. Consolidated facts such as positive correlation between firm productivity and markups or incomplete pass-through of trade shocks into export prices are indeed intrinsically linked to a different demand's structure, complying with the Marshall's Second Law of Demand, such that price elasticity falls with the quantity consumed.

ufacturing firms, direct and indirect. As shown in the aftermath, double marginalization for goods exported along the intermediated export channel will differentiate the price-setting mechanism that applies over the two modes, leading to different ERPT of intermediated and direct exports in the way suggested by our data.

Observationally equivalent predictions could however be obtained by replicating the mechanism of double marginalization over the other two settings, namely the model with C.E.S. demand and additive local distribution costs *à la* Corsetti and Dedola (2005) (see Appendix D) and the Cournot oligopoly model of Atkeson and Burstein (2008), where imperfect competition induces lower demand elasticity for firms with larger market shares. Similar considerations holds for other partial equilibrium models characterized by endogenous price elasticity, such as models where firm heterogeneity combines with buyer heterogeneity (e.g. Bernard et al., 2018) or models where trade intermediaries are not necessarily symmetric and/or enjoy some market power *vis-à-vis* manufacturers (e.g. Raff and Schmitt, 2009).

3.1. Basic setup with direct export only

To illustrate our preferred theoretical mechanism, we consider a two-country economy, where *Home* is small with respect to *Foreign*; and a tradeable non-homogeneous good is available in many differentiated varieties.[22] We index each of these varieties by i and we assume a quadratic utility function, so that the demand of a domestic variety in the foreign country is

$$q^*(p_i^*) = \frac{a - dQ^* - ep_i^*}{b} \ ,$$

where p_i^* is the export price set by firm i; e denotes the nominal exchange rate between domestic and foreign currency; and Q^* is total spending in the destination market over all varieties available there, taken by firm i as given. Finally, a, b and d are positive constants.[23]

[22]Given the bilateral nature of exchange rates and our interest in shedding light on how firms react to aggregate shocks in this variable, we propose a simplified setting with two countries only, to focus on the basic functioning of the firm-level adjustment. In so doing, we abstract away more convoluted strategies of response (not necessarily viable for any firm), involving shifting products across destinations or exploiting strategic complementary in both pricing and export mode decisions across markets. Empirical tests performed in Section 2.4 to check the robustness of our core findings largely support this choice.

[23]More in detail, a and d regulate substitutability between differentiated varieties and the numeraire that in Melitz and Ottaviano (2008) corresponds to a non-tradeable homogeneous good. In turn, b measures the degree of product differentiation among varieties, with $b = 0$ denoting the limit case of perfect substitutes. As b increases, consumers care more about to the distribution of consumption

Each firm produces a unique differentiated variety according to the linear production technology $q_i = \varphi_i L_i$, where L_i is the labor input and φ_i is the firm's marginal productivity, drawn from a generic distribution $G(\varphi)$ specific to the country of origin. The marginal cost of producing one unit of variety i is therefore w/φ_i, which reduces to $1/\varphi_i$ since we take the wage rate at *home* as our numeraire ($w = 1$). When selling abroad, all firms incur standard iceberg costs $\tau \geq 1$, thus τq_i^* units of variety i must be shipped for q_i^* units to reach the foreign demand. Profit from foreign sales amounts to $\pi_i^* = p_i^* q_i^* - \tau q_i^* / \varphi_i$, which leads the firm to set an export price

$$p_i^*(\varphi_i) = \mu_i^* \cdot \frac{\tau}{\varphi_i} \quad \text{with} \quad \mu_i^* \equiv \frac{1}{2}\left(1 + \frac{\varphi_i}{\Phi}\right) \quad \text{and} \quad \Phi \equiv \frac{w^* \varepsilon \tau}{a - dQ^*}. \tag{4}$$

In the equation above, Φ denotes the productivity threshold at which operating profits from exporting would be positive, if any type of fixed costs were absent. Even though our model features a fixed cost of foreign market entry, we keep using Φ in the formulas to come, yet as a pure reference level for productivity and with the only purpose to save on notation. Finally, we follow Berman et al. (2012) and Chatterjee et al. (2013) when denoting the real exchange rate between the two countries with $\varepsilon = we/w^*$, where $w = 1$ and w^* denotes the wage rate abroad.[24]

Markets are geographically segmented, which allows for pricing-to-market strategies, with firms discriminating between foreign and domestic consumers (and across foreign consumers located in different regions, when considering a natural multi-country extension of our model). *Home* and *Foreign* are not restricted to be symmetric, which together with the presence of iceberg costs induces a different markup in case of foreign and domestic sales (see Appendix A for further details).

So far, our model replicates the one proposed by Berman et al. (2012), with the export-sales markup in equation (4), namely μ_i^*, that increases with firm productivity and the size of the foreign market $(a - dQ^*)$, while decreases with the nominal exchange rate (denoted above as $e = \varepsilon w^*$) and iceberg trade costs. Here, however, equation (4)

levels across varieties, the extent of differentiation being larger.

[24]Following a consolidated approach in the empirical literature, in Section 2 we have defined the RER as the nominal exchange rate adjusted by the relative consumer price index, given that such information is more likely available for a large set of countries. For ease of notation, we follow instead Chatterjee et al. (2013) in adjusting nominal exchange rates for relative wages when defining the RER in our model. Relative wages are, however, notoriously highly correlated with relative consumer price indices. A robustness check for our empirical findings has been carried out by using a wholesale price index (WPI) to construct the RER. Results, available upon request, corroborate the evidence documented in Section 2; yet, the adoption of this alternative price index substantially reduces the number of countries in our sample.

only applies to direct export sales to $Foreign$, while a different pricing scheme is used in the case of intermediated export, as illustrated in the following.

Before introducing the export intermediation technology in this setup, let us discuss the implications of the existence of fixed entry costs in the two different markets. After having developed a new variety, each firm from $Home$ learns about its marginal productivity φ_i (i.e., its draw from the country-specific distribution $G(\varphi)$) and consequently decides on entry in the domestic market, by paying a fixed cost f_D; as well as on entry in the foreign market, by paying a fixed cost $f_X > f_D$. The cost f_X encompasses the cost of establishing a local distribution channel (i.e., the cost of searching and reaching the foreign demand) as well as other costs more related to paperworks and the overcoming of technical and non-tariff barriers to trade. The critical level of productivity required for entry in the domestic market is

$$\varphi_D = \frac{1}{a - dQ - 2\sqrt{bf_D}} \ ,$$

whereas the cut-off for entry in the foreign market evaluates to

$$\varphi_X = \frac{w^* \varepsilon \tau}{a - dQ^* - 2\sqrt{bw^* \varepsilon f_X}} \ . \tag{5}$$

By imposing a lower bound for the size of f_X relative to f_D, we observe that $\varphi_X > \varphi_D$, that is, among firms accessing the domestic market (inasmuch $\varphi_i > \varphi_D$), only those with productivity greater than φ_X will also entry into the foreign market, whereas all other firms with $\varphi_i \in [\varphi_D, \varphi_X]$ will not. This self-selection mechanism corresponds to the sorting pattern that characterizes all quantitative models of trade inspired by Melitz (2003). Nevertheless, the cut-off in equation (5) turns idle when export intermediation is allowed: the critical level of productivity required for direct entry in the export market, namely $\varphi_{X^{dir}}$, is indeed other than φ_X, as shown below.

3.2. Intermediated export

We now introduce export intermediaries. They are homogeneous firms that do not engage in any production activity but operates as wholesalers, buying products that manufacturing firms are unable to profitably export directly for the sole purpose of resale in the foreign market. Following Akerman (2018), we assume that intermediaries face the same fixed cost of entry in the foreign market as any other manufacturing firm located at $Home$. Yet, as opposed to the latter, they own a technology for exporting more than one good, and possibly many, which creates room for trading products that would never reach the foreign market otherwise. Given the purpose of our analysis and for sake of simplicity, we consider here the simplest scenario with no strategic interaction between manufacturers and wholesalers. Both decisions on entry/exit in the foreign market and the entry mode to use therefore rest entirely upon the firm producing each variety, with the intermediary that comes into play only once this second decision has been taken.[25]

The timing of events is then the following. First, each producer learns about its marginal productivity and decides whether to export directly or indirectly. In the first case, it pays the cost of accessing directly the foreign market, namely $f_{X^{dir}} = f_X$, and prices according to equation (4). In the second case, instead, the producer stipulates an export contract with one among the bunch of symmetric intermediaries available on the marketplace, such that (*i*) the producer sells to the intermediary the amount demanded of its variety in the foreign market; and (*ii*) the appointed intermediary, based on the price paid for provision of the units to export, finally sets the (export) price to charge to the local importer/foreign customer. This arrangement also entails the intermediary making available its overseas distribution network to the producer, with the fixed cost of foreign market entry, namely f_X, split as follows. A fraction $(1 - \lambda)$ of this burden, representing the cost of setting up a distribution channel into $Foreign$, is relieved from the responsibility of the producer. The remaining fraction λ, relating to bureaucracy and non-tariff barriers, is still borne by the manufacturer.[26,27]

In words, by exporting indirectly, manufacturing firms face a fixed cost $f_{X^{ind}} = \lambda f_X$, where $\lambda \in (0, 1)$ is a measure of the canonical fixed-cost advantage of an *indirect* exporter over a *direct* one.[28] Since $f_{X^{ind}} < f_{X^{ind}}$, our setting rests with the

[25]Given our assumptions, the equilibrium in the intermediation sector simply reflects the outcome of all individual choices made by manufacturers. In the second part of Appendix A we sketch both the firm and market equilibrium conditions for trade intermediaries, building on Akerman (2018).

[26]These assumptions conform to the evidence based on survey data reported by Peng and Ilinitch (2001) and Peng and York (2001), according to which "through export intermediaries, exporters gain access to international markets while not having to incur the up-front costs associated with searching for new markets, negotiating contracts, and monitoring those contracts to ensure performance".

[27]The presence of a residual fixed cost for the indirect exporter creates room for a set of non-traded goods, consistently with observational evidence from basically any country in the world. In the lack of any fixed cost of indirect export, all tradeable varieties supplied at $Home$ would be shipped also to $Foreign$. An alternative rationale for this residual cost comes from Ahn et al. (2011), according to whom manufacturers pay "a sort of membership fee to deposit varieties at the warehouse where the intermediaries are located". This fee might likely involve also a sort of no-competition clause on the domestic market, preserving the producer's monopolistically competitive rent at $Home$.

[28]Using custom data, Bernard et al. (2011); Ahn et al. (2011) and finally Akerman (2018) show that, while active in a wider range of products, intermediaries focus on a smaller number of countries compared to similarly-sized manufacturers. Such evidence is supportive of their ability to spread country-specific fixed costs across products, enjoying relevant economies of scope when handling more product. Indirectly, it also relates to the hypothesis that intermediary firms play an important

standard producer's trade-off between saving on fixed costs by exporting indirectly; and earning higher variable profits by exporting directly. This second aspect originates in our model from the fact that any intermediary "inherits" the market power from the indirect manufacturing exporter, when getting the exclusive right to sell its differentiated variety in the overseas market. This allows the former to impose its own markup over the procurement price, thereby creating a discrepancy between the price applying in case of direct export sales, see equation (4), and the (higher) one for the same variety that applies in case of indirect export. Due to inefficient double marginalization, quantities sold abroad are lower in this second circumstance.

To look in much more details at the pricing mechanism along the intermediated export channel, consider a manufacturing firm j (other than i, the direct exporter from Section 3.1) which decides to export indirectly. The wholesale firm handling variety j faces the same foreign demand that firm j would face by its own, if it were exporting directly. The intermediary must therefore source τq_j^{**} units of this variety at the price p_{jW} set by the indirect exporter, in order for q_j^{**} units to reach *Foreign* (double asterisk in our notation distinguishes prices and quantities in case of indirect export from their counterparts in the case of direct export). To maximize its profit, namely $\pi^W = p_j^{**} q_j^{**} - p_{jW} \tau q_j^{**}$, the intermediary prices at

$$p_j^{**} = \mu^W \tau \, p_{jW}, \text{ where } \mu^W \equiv \frac{1}{2}\left(1 + \frac{1}{\Phi \, p_{jW}}\right), \tag{6}$$

thereby imposing a markup μ^W (where the subscript W stands for *wholesaler*) over the procurement price p_{jW} paid to firm j. Such markup is monotonically decreasing with the price p_{jW}, i.e., the higher the cost of sourcing the variety from the indirect exporter, the lower the margin of the intermediary. By backward induction, firm j therefore sets the procurement price of its variety so as to maximize its own profit from indirect export sales, namely $\pi^{**} = (\rho_{jW} - 1/\varphi_j)\tau q_j^{**}$. The profit-maximizing price for indirect exporter j is then

$$p_{jW}(\varphi_j) = \mu_{jW} \cdot \frac{1}{\varphi_j}, \text{ where } \mu_{jW} \equiv \frac{1}{2}\left(1 + \frac{\varphi_j}{\Phi}\right), \tag{7}$$

implying that a markup μ_{jW} is imposed over the marginal cost of production when procuring each unit to the intermediary.

For any product j exported by a wholesale firm, the price at the dock is the result

role in solving the firms' fixed cost problem.

of double marginalization, as one sees by combining equations (6) and (7) so as to derive the *unconditional* optimal export price along the intermediated export channel,

$$p_j^{**}(\varphi_j) = \underbrace{\frac{1}{2}\left[1+\frac{1}{\Phi\cdot\underbrace{\frac{1}{2}\left(1+\frac{\varphi_j}{\Phi}\right)\cdot\frac{1}{\varphi_j}}_{=p_{jW}}}\right]}_{\equiv\mu^W}\cdot\underbrace{\underbrace{\frac{1}{2}\left(1+\frac{\varphi_j}{\Phi}\right)}_{\equiv\mu_{jW}}\cdot\frac{1}{\varphi_j}}_{=p_{jW}}\cdot\tau =$$

$$= \underbrace{\frac{1}{4}\left(\frac{\Phi+3\varphi_j}{\Phi}\right)}_{\equiv\mu_j^{**}}\cdot\frac{\tau}{\varphi_j}\,. \tag{8}$$

To summarize, for products exported by trade intermediaries, the overall markup imposed on foreign customers/local importers, namely

$$\mu_j^{**} = \mu_{jW}\cdot\mu^W = \frac{1}{4}\left(\frac{\Phi+3\varphi_j}{\Phi}\right),$$

is the result of the multiplicative interaction between (i) the *indirect exporter's markup*

$$\mu_{jW} = \frac{1}{2}\left(1+\frac{\varphi_j}{\Phi}\right),$$

which increases with firm j's productivity; and (ii) the *intermediary's markup*,

$$\mu^W = \frac{1}{2}\left(1+\frac{1}{\Phi\cdot p_{jW}(\varphi_j)}\right) = \frac{1}{2}\left(\frac{\Phi+3\varphi_j}{\Phi+\varphi_j}\right),$$

which is also increasing in the indirect exporter's productivity.[29]

A series of theoretical results follows from equations (4) and (6)-(8). To begin with, a manufacturing firm charges the same markup when choosing different modes of export. As a matter of fact, the markup imposed on the intermediary, namely μ_{jW}, is equal to the markup μ_j^* that, according to equation (4), the same firm would charge in case of direct export sales. This is because of two elements. First, due to iceberg trade

[29]Higher productivity φ_j induces a larger indirect exporter's markup μ_{jW} and a higher procurement price p_{jW}. All else being equal, this should reduce the margin of the intermediary firm. Nonetheless, higher productivity φ_j also reduces the marginal cost of producing each unit of variety j, with this second effect prevailing. As a result, the intermediary's markup μ^W definitely increases with φ_j.

costs, for each variety the intermediary source more units than those sold into $Foreign$. The indirect exporter obtains instead a revenue from every unit produced of its variety, and then sold to the intermediary. Alternative formulations (such that iceberg costs deplete the indirect exporter's revenue) would not affect the key predictions of our model anyhow. Second, and most importantly, $\mu_{jW} = \mu_j^*$ is a direct implication of linear demand *á la* Melitz and Ottaviano (2008). Different results would come up under analogous assumptions on iceberg trade costs, but different mechanisms for generating heterogeneous pricing-to-market (see the model in Appendix D).

A further important result, unfortunately not testable on our data, is that $\mu^W > 1$ implies that the overall markup applying to goods exported by intermediaries, namely $\mu_j^{**} = \mu_{jW} \cdot \mu^W$, is systematically larger than the markup that would be imposed if the same variety were exported directly, i.e., μ_j^*. It follows that, in our narrative, the export price of a given variety is invariably differentiated across export modes.

Before proceeding with our analysis, let us further ponder the hypothesis of double marginalization. A well-known result in the theory of industrial organization is that firms engaged in a vertical relation might seek to get rid of the inefficiency due to double marginalization by means of a two-part tariff (TPT), which can reproduce, under vertical separation, the same (efficient) outcome as the vertically integrated firm. However, in the case of export intermediation, the adoption of non-linear pricing schemes –or, for that matter, of similar tools– is complicated by the high propensity of intermediaries to change their product mix even unconditionally from exchange rate movements, as documented in Bernard et al. (2011). Their low commitment to exporting a given variety *vis-à-vis* the producer (of that variety) naturally plays against the arrangement of stable relationships between the parties. In turn, this plays against the adoption of contractual arrangements more sophisticated than standard sequential linear price setting. For these reasons, double marginalization (or at least, some degrees of it) appears as a plausible feature for many of the transactions taking place over the intermediated export channel.[30]

3.3. Export mode selection

Exporting indirectly entails a trade-off for the manufacturing firm between the penalty represented by double marginalization and savings on fixed export costs. To

[30]Some authors have focused on the potentially large bargaining power enjoyed by export intermediaries. Raff and Schmitt (2009), for instance, shed light on the (non-trivial) trade liberalization effects originating from the existence of intermediaries with sufficient market power to make *take-it-or-leave-it* offers to the producers.

reproduce a standard sorting pattern –according to which producers self-select based on their productivity as non-exporter, indirect exporter or direct exporter–, we impose an upper bound on the fixed cost advantage of indirect export, in form of $\lambda \in (0, \bar{\lambda})$. In the model with linear demand, this upper bound corresponds to $\bar{\lambda} = 1/2$, i.e., the cost of establishing a foreign distribution network (corresponding to $(1-\lambda)f_X$) must account for at least one half of the overall fixed cost of entry, f_X. Given $\lambda \in (0, 1/2)$, the cut-off for direct entry in the export market,

$$\varphi_{X^{dir}} \equiv \frac{w^* \varepsilon \tau}{a - dQ^* - 2\sqrt{2bw^* \varepsilon (1-\lambda) f_X}} \ , \tag{9}$$

is higher than the cut-off level for indirect entry,

$$\varphi_{X^{ind}} \equiv \frac{w^* \varepsilon \tau}{a - dQ^* - 2\sqrt{2bw^* \varepsilon \lambda f_X}} \ . \tag{10}$$

It then follows that more productive firms ($\varphi_i > \varphi_{X^{dir}}$) will export by their own; firms with intermediate levels of productivity ($\varphi_i \in [\varphi_{X^{ind}}, \varphi_{X^{dir}}]$) will resort to intermediaries; finally, less productive firms ($\varphi_i < \varphi_{X^{ind}}$) will serve the domestic market only.[31] For international trade to occur, f_X must be bounded from above, implying that both $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ are strictly positive. Indeed, according to equations (9) and (10), and given $\lambda < 1/2$, both export cut-offs $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ take positive values if and only if

$$f_X < \bar{f}_X \equiv \frac{(a - dQ^*)^2}{8bw^* \varepsilon (1-\lambda)} \ .$$

3.4. Export price elasticities across export modes

The different pricing structure over the two export channels bears relevant implications on the firm-level adjustment to external shocks such as RER movements. In this regard, we put forth a set of predictions, derived from equations (4), (7) and (8), that specifically refer to the different RER elasticity of export prices for direct and intermediated exports; and, most importantly, perfectly fit with the empirical evidence documented in Section 2. Given equation (4), for a product exported directly by a manufacturing firm i, the partial export price elasticity to the real exchange rate is

$$E_{p_i^*;\varepsilon} = -\frac{\varphi_i}{\varphi_i + \Phi} \in (-1, 0), \tag{11}$$

[31] Although largely popular in trade literature, we formally prove the sorting model in Appendix A for the purpose of showing how the conditions to impose here for the emergence of this pattern have similar implications to those required in simpler models with constant Dixit-Stiglitz markups.

while the corresponding elasticity for product j, exported through an intermediary, is

$$E_{p_j^{**};\varepsilon} = -\frac{3\varphi_j}{3\varphi_j + \Phi} \in (-1, 0). \tag{12}$$

Irrespectively of the export mode, the price of an exported product tends to react to real exchange rate variation, leading to incomplete pass-through into consumer prices along both export channels. Moreover, and again independently of the selected export mode of each variety, the RER elasticity of the export price increases with the manufacturer's productivity, implying larger adjustment (and lower ERPT) for goods produced by more efficient firms.[32] This paves the way for a first Proposition, which largely conforms with both the findings of Berman et al. (2012) and the similar evidence obtained from our data (see Table 2).

Proposition 1. *For both varieties exported directly and indirectly, a price adjustment takes place in response to exchange rate movements, so as to limit the transmission of such variation into the final consumer price. If the exchange rate appreciates (depreciates), the export price set in the domestic currency decreases (increases), whatever the mode of export is. Within each export channel, the extent of the adjustment increases with the productivity of the manufacturing firm producing the exported variety.*

According to our theory, the price response to RER shocks originates for intermediated exports from two different adjustments. The indirect exporter reacts to the shock by adjusting its markup μ_{jW} over the marginal cost of production of variety j when procuring the units to be exported to the intermediary. This implies a change in the procurement price p_{jW} paid by the latter, which in turn induces the intermediary to adjust its own markup μ^W. To assess the relative contribution of these two adjustments over the overall price response observed for variety j, we calculate the RER elasticity of these two markups, respectively,

$$E_{\mu_{jW};\varepsilon} = -\frac{\varphi_j}{\varphi_j + \Phi} \in (-1, 0); \tag{13}$$

$$E_{\mu^W;\varepsilon} = -\frac{2\Phi\ \varphi_j}{(\Phi + \varphi_j)(\Phi + 3\varphi_j)} \in (-1, 0). \tag{14}$$

By comparing the two equations above, it is easily proved that $|E_{\mu_{jk};\varepsilon}| > |E_{\mu_k^*;\varepsilon}|$, i.e., along the intermediated export channel, most of the weight of the overall price

[32]The extent of the adjustment also increases with the size of the foreign market, while it decreases with the level of iceberg trade costs (recall $\Phi \equiv w^*\varepsilon\tau/(a - dQ^*)$).

adjustment to a RER shock is borne by the indirect exporter.[33]

In the last sentence of Proposition 1 we refer to a comparison among varieties produced with different levels of efficiency by their producers, but all exported along the same export channel, either the direct or intermediated one. We now come at the comparison between two varieties, say i and j, traded in a different manner, with i exported directly, and hence featuring the price elasticity in equation (11); and j exported indirectly, so that the corresponding elasticity is the one in (12). Because of productivity sorting (Section 3.3), the export mode assumed for each variety implies i to be manufactured by a more productive firm than the one producing j, i.e., $\varphi_j < \varphi_i$. All else being equal, the direct exporter of i will then be able to absorb more of the exchange rate variation in its markup, compared to the indirect exporter producing j. Yet, when comparing equations (11) and (12), we observe that

$$|E_{p^*_{jk};\varepsilon}| > |E_{p^*_i;\varepsilon}| \quad \text{for all } \varphi_j \in \left(\frac{1}{3}\, \varphi_i, \varphi_i \right) \,, \tag{15}$$

that is, if the productivity gap between the indirect and direct exporter is reasonably limited, i.e., $\varphi_j > \varphi_i/3$, then the overall RER elasticity is higher for variety j, exported indirectly, than for variety i, exported directly. A new Proposition can therefore be established.

Proposition 2. *As a result of double marginalization and thus because of the combination of the two price adjustment mechanisms, the partial elasticity of the export price to the real exchange rate can be larger for products exported by intermediaries, than for those exported directly by their producers, despite of productivity sorting. This implies relatively lower exchange rate pass-through (ERPT) for intermediated exports.*

The result above holds for a sufficiently wide range of productivity differences between direct and indirect exporters. It therefore appears an empirical issue to test Proposition 2 and to attest whether the effect due to the double markup adjustment along the intermediated export channel indeed overwhelms the "productivity effect" *à la* Berman et al. (2012). Nevertheless, the maximum gap admissible in (15) is large enough that, also in light of the restrictions requested by productivity sorting, it would be hard to envisage the case, in the reality, where the sign of the inequality in (15) is reversed. Nedless to say, Proposition 2 provides a theoretical background for the new

[33] Unfortunately, also this model prediction cannot be tested empirically, in the lack of any information about procurement prices in our data. We then leave this exercise to further work.

facts highlighted by our empirical analysis, as it goes in the very same direction of the results shown in Table 3 and 4 of Section 2.

Lastly, there are two relevant considerations to make. First, in addition to adjusting their markup, manufacturing firms may react to RER shocks also along a different margin, i.e., their choice of whether serving the foreign market and, if so, whether doing this directly or indirectly. This additional margin of firm-level adjustment bears important implications as regard to the relative number of products traded along the two export channels; and how this relative number varies in the aftermath of a RER movement. Given suitable assumptions on how firm productivity is distributed, our model deliver clear predictions in this regard, related to the level of country fixed costs. Such predictions are derived in Appendix B, and tested on our data in Appendix C, so as to provide a further empirical validation of our theory.

Second, our model is able to generate a higher markup responsiveness of intermediaries' exports also when other sources of exogenous shock are considered. In Appendix E, for instance, we look at the export price elasticity to variation in tariffs (modelled as variable trade costs), again comparing the elasticities observed in the two cases of direct and intermediated export. Double marginalization on top of heterogeneous pricing-to-market is confirmed, also in this case, to provide export intermediation with a key role in stabilizing trade patterns across countries.

4. Conclusions

This article brings into the international trade literature novel evidence on the heterogeneous response of exporting firms to a common external shock such as a RER movement. Earlier studies have shown that firm characteristics (such as productivity, size, quality of inputs and output, import content of export, etc.) matters to explain this form of heterogeneity. Yet, an additional source has been identified here, namely the firm's entry mode into the export market.

Using data on Italian export transactions at the firm-product-country level over the period 2000-2007, the article documents new empirical facts. Our estimates show that both direct exporters and wholesalers decrease (increase) their export prices in response to real appreciations (depreciations), yet price adjustment is larger for intermediaries. The paper proposes a relatively parsimonious model of trade which accommodate this finding in a way consistent with other consolidated facts in trade literature, such as productivity sorting in the export mode selection and the larger extent of markup adjustment by more productive firms. Linear demand is used as a mechanism for generating heterogeneous pricing-to-market. Taking inspiration from the literature of industrial organization, the setting is augmented by introducing double marginalization as a mechanism for lowering ERPT in case of export through intermediaries. Further predictions on the adjustment of the direct and intermediated export channels at their product extensive margin have successfully been tested in the Appendix to assess the overall empirical support for our theory.

Taken together, our findings provide micro-foundation for the evidence of Bernard et al. (2015), that is, aggregate exports are less responsive to RER shocks, the higher the incidence of intermediated export. Most of all, these findings suggest and explain why, in addition to facilitating trade for less efficient firms, export intermediation may serve as a vehicle for stabilizing trade patterns across countries. Incidentally, note that this stabilizing effect is at work also in the event of shocks other than RER movements (see Appendix E for the case of increased import tariffs).

A few relevant questions still remain open for further research. Here we have assumed independence, at the firm-level, among export, entry mode and pricing decisions across both markets and products. More sophisticated variants of our model, augmented with the inclusion of multi-product firms and featuring a multiple-layers structure for the fixed export cost would help clarifying (*i*) to what extent these costs are sunk or not; and (*ii*) to what extent they are product- and/or market- specific, with clear implications as regard to the type of adjustment that firms may adopt in response to exogenous shocks. In so doing, it might be worth accommodating also new evidence, e.g. from Lenoir et al. (2018), according to which large and highly productive firms tend to serve more buyers in foreign markets, yet with numbers that display significant degrees of heterogeneity across products and destinations.

References

Ahn, J., A. K. Khandelwal, and S.-J. Wei (2011): "The role of Intermediaries in Facilitating Trade," *Journal of International Economics*, 84, 73–85.

Akerman, A. (2018): "Wholesalers and Economies of Scope in International Trade," *Canadian Journal of Economics*, 51, 156–185.

Amiti, M., O. Itskhoki, and J. Konings (2014): "Importers, Exporters, and Exchange Rate Disconnect," *American Economic Review*, 104, 1942–78.

——— (2016): "International Shocks and Domestic Prices: How Large Are Strategic Complementarities?" NBER Working Papers 22119, National Bureau of Economic Research, Inc.

Atkeson, A. and A. Burstein (2008): "Pricing-to-Market, Trade Costs, and International Relative Price," *American Economic Review*, 98, 1998–2031.

Auer, R. A., T. Chaney, and P. Sauré (2018): "Quality pricing-to-market," *Journal of International Economics*, 110, 87 – 102.

Auer, R. A. and R. S. Schoenle (2016): "Market structure and exchange rate pass-through," *Journal of International Economics*, 98, 60–77.

Békés, G. and B. Muraközy (2018): "The ladder of internationalization modes: evidence from European firms," *Review of World Economics*, 154, 455–491.

Berman, N., P. Martin, and T. Mayer (2012): "How do Different Exporters React to Exchange Rate Changes?" *The Quarterly Journal of Economics*, 127, 437–492.

Bernard, A. B., E. J. Blanchard, I. V. Beveren, and H. Y. Vandenbussche (2019): "Carry-Along Trade," *The Review of Economic Studies*, 86, 526–563.

Bernard, A. B., M. Grazzi, and C. Tomasi (2011): "Intermediaries in International Trade: Direct versus indirect modes of export," Tech. Rep. 17711, National Bureau of Economic Research, Inc.

——— (2015): "Intermediaries in International Trade: Products and Destinations," *The Review of Economics and Statistics*, 97, 916–920.

Bernard, A. B., J. B. Jensen, S. J. Redding, and P. K. Schott (2010): "Wholesalers and Retailers in U.S. Trade," *American Economic Review*, 100, 408–13.

Bernard, A. B., A. Moxnes, and K. H. Ulltveit-Moe (2018): "Two-Sided Heterogeneity and Trade," *Review of Economics and Statistics*, 100, 424–439.

Bernini, M. and C. Tomasi (2015): "Exchange Rate Pass-through and Product Heterogeneity: Does Quality Matter on the Import Side?" *European Economic Review*, 77, 117–138.

Bonnet, C., P. Dubois, S. B. V. Boas, and D. Klapper (2013): "Empirical Evidence on the Role of Nonlinear Wholesale Pricing and Vertical Restraints on Cost Pass-Through," *The Review of Economics and Statistics*, 95, 500–515.

Burstein, A. and G. Gopinath (2014): "Chapter 7 - International Prices and Exchange Rates," in *Handbook of International Economics*, ed. by G. Gopinath, E. Helpman, and K. Rogoff, Elsevier, vol. 4 of *Handbook of International Economics*, 391 – 451.

Caselli, M., A. Chatterjee, and A. Woodland (2017): "Multi-product exporters, variable markups and exchange rate fluctuations," *Canadian Journal of Economics/Revue canadienne d'économique*, 50, 1130–1160.

Chaney, T. (2008): "Distorted Gravity: the Intensive and Extensive Margins of International Trade," *American Economic Review*, 98, 1707–1721.

Chatterjee, A., R. Dix-Carneiro, and J. Vichyanond (2013): "Multi-product Firms and Exchange Rate Fluctuations," *American Economic Journal: Economic Policy*, 5, 77–110.

Corsetti, G. and L. Dedola (2005): "A Macroeconomic Model of International Price Discrimination," *Journal of International Economics*, 67, 129–155.

Crozet, M., G. Lalanne, and S. Poncet (2013): "Wholesalers in International Trade," *European Economic Review*, 58, 1–17.

Davies, R. and T. Jeppesen (2015): "Export Mode, Firm Heterogeneity, and Source Country Characteristics," *Review of World Economics (Weltwirtschaftliches Archiv)*, 151, 169–195.

Eaton, J., S. Kortum, and F. Kramarz (2011): "An Anatomy of International Trade: Evidence From French Firms," *Econometrica*, 79, 1453–1498.

Felbermayr, G. and B. Jung (2011): "Trade Intermediation and the Organization of Exporters," *Review of International Economics*, 19, 634–648.

Garetto, S. (2016): "Firms' heterogeneity, incomplete information, and pass-through," *Journal of International Economics*, 101, 168–179.

Goldberg, L. and C. Tille (2009): "Macroeconomic interdependence and the international role of the dollar," *Journal of Monetary Economics*, 56, 990–1003.

Gopinath, G., O. Itskhoki, and R. Rigobon (2010): "Currency Choice and Exchange Rate Pass-Through," *American Economic Review*, 100, 304–336.

Grazzi, M., R. Sanzo, A. Secchi, and A. Zeli (2013): "The Building Process of a new Integrated System of Business Micro-data 1989-2004," *Journal of Economic and Social Measurement*, 38, 291–324.

Grazzi, M. and C. Tomasi (2016): "Indirect Exporters and Importers," *Review of World Economics (Weltwirtschaftliches Archiv)*, 152, 251–281.

Hastings, J. S. and R. J. Gilber (2005): "Market Power, Vertical Integration and the Wholesale Price Of Gasoline," *The Journal of Industrial Economics*, 53, 469–492.

Head, K., T. Mayer, and M. Thoenig (2014): "Welfare and Trade without Pareto," *American Economic Review*, 104, 310–16.

Hellerstein, R. and S. B. Villas-Boas (2010): "Outsourcing and pass-through," *Journal of International Economics*, 81, 170 – 183.

Hong, G. H. and N. Li (2017): "Market Structure and Cost Pass-Through in Retail," *The Review of Economics and Statistics*, 99, 151–166.

IMF (2010): "World Economic Outlook Database," Tech. rep., International Monetary Fund.

Lenoir, C., I. Mejean, and J. Martin (2018): "Search Frictions in International Good Markets," 2018 meeting papers no. 878, Society for Economic Dynamics.

Levinsohn, J. and A. Petrin (2003): "Estimating Production Functions Using Inputs to Control for Unobservables," *Review of Economic Studies*, 70, 317–41.

Lu, J., Y. Lu, Y. Sun, and Z. Tao (2017): "Intermediaries, Firm Heterogeneity and Exporting Behaviour," *The World Economy*, 40, 1381–1404.

Mayer, T., M. J. Melitz, and G. I. Ottaviano (2014): "Market Size, Competition, and the Product Mix of Exporters," *American Economic Review*, 104, 495–536.

——— (2020): "Product Mix and Firm Productivity Responses to Trade Competition," *The Review of Economics and Statistics*, forthcoming.

McCann, F. (2013): "Indirect Exporters," *Journal of Industry, Competition and Trade*, 13, 519–535.

Melitz, M. J. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 71, 1695–1725.

Melitz, M. J. and G. I. P. Ottaviano (2008): "Market Size, Trade, and Productivity," *Review of Economic Studies*, 75, 295–316.

Mrázová, M., J. P. Neary, and M. Parenti (2015): "Sales and Markup Dispersion: Theory and Empirics," Department of economics economics series working papers, 774, University of Oxford.

Neiman, B. (2010): "Stickiness, synchronization, and passthrough in intrafirm trade prices," *Journal of Monetary Economics*, 57, 295 – 308.

Nunn, N. (2007): "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade," *The Quarterly Journal of Economics*, 122, 569–600.

Peng, M. W. and A. Y. Ilinitch (2001): "Export Intermediary Firms: A note on export development research," *Journal of International Business Studies*, 29, 609–620.

Peng, M. W. and A. S. York (2001): "Behing Intermediary Performance in Export Trade: Transactions, Agents, and Resources," *Journal of International Business Studies*, 32, 327–346.

Raff, H. and N. Schmitt (2009): "Buyer power in international markets," *Journal of International Economics*, 79, 222–229.

Razzolini, T. and D. Vannoni (2011): "Export Premia and Subcontracting Discount: Passive Strategies and Performance in Domestic and Foreign Markets," *The World Economy*, 34, 984–1013.

Appendix - For Online Publication

A. The linear demand model

A1. Productivity sorting

In this appendix we derive the standard result according to which firms sort based on productivity in selecting their entry mode in the export market, considering the theoretical setting proposed in Section 3.

For producer i, profits from domestic sales amount to $\pi_i = (p_i - 1/\varphi_i) \cdot q(p_i) - f_D$, the quantity sold at *home* being $q(p_i) = [a - dQ - p_i]/b$. The profit-maximizing price in the domestic market is indeed $p_i = \mu_i/\varphi_i$ with $\mu_i = \varphi_i/[2(a - dQ)]$. In turn, expected profits from direct and indirect exports to *Foreign* evaluate, respectively, to $\pi_i^* = (p_i^* - \tau/\varphi_i)q^*(p_i^*) - f_{X^{dir}}$ and $\pi_i^{**} = (\rho_{iW} - 1/\varphi_i)\tau q^*(p_i^{**}) - f_{X^{ind}}$, where p_i^*, ρ_{iW} and p_i^{**} correspond to the prices in equations (4), (7) and (8).

Given the fixed export cost f_X, we assume $f_{X^{dir}} = f_X$ and $f_{X^{ind}} = \lambda f_X$ with $\lambda \in (0,1)$. We go beyond the condition $f_D < f_X$, assuming that $f_D < \lambda f_X$, that is, accessing *Home* is cheaper then accessing *Foreign*, whatever the entry mode in this market.[34] For firm i, exporting directly is profitable, i.e., it generates strictly positive profits, provided that $\varphi_i > \varphi_X$, where the latter is the threshold defined in equation (5). In turn, exporting indirectly is profitable if $\varphi_i > \varphi_{X^{ind}}$, where $\varphi_{X^{ind}}$ is the cut-off reported in (10). When firm i is productive enough to comply with both conditions, we observe that $\pi_i^* > \pi_i^{**}$ if and only if $\varphi_i > \varphi_{X^{dir}}$, where $\varphi_{X^{dir}}$ corresponds to the threshold in equation (10). If the fixed-cost advantage of indirect export is sufficiently large (i.e., $\lambda < \bar{\lambda}$, with $\bar{\lambda} = 1/2$ in the model with linear demand under consideration), we observe that $\varphi_{X^{dir}} > \varphi_{X^{ind}}$ and a standard productivity sorting pattern arises:

- the most productive firms ($\varphi_i > \varphi_{X^{dir}}$) prefer to export directly;
- firms with intermediate productivity, i.e., $\varphi_i \in (\varphi_{X^{ind}}, \varphi_{X^{dir}})$, export indirectly;
- the least productive firms ($\varphi_i < \varphi_{X^{ind}}$) do not export and serve *Home* only.

The existence of a range of non-traded products, in particular, hinges on the condition $\varphi_D < \varphi_{X^{ind}}$, where $\varphi_D = 1/(a - dQ - 2\sqrt{bf_D})$ is the lowest attainable level of productivity such that a firm located in *Home* may afford the cost f_D and start doing business in the domestic market. For such condition to hold, a lower bound

[34] The cost f_D that a domestic firm pays in order to enter the home market is other then the (necessarily higher) cost faced by a firm located in *Foreign* to entry at *Home*. This grants a fixed-cost advantage for domestic firms in their national market over foreign competitors.

for the level of f_X must be imposed, relative to f_D. Furthermore, $\lambda < \bar{\lambda}$ implies also $\varphi_{X^{dir}} > \varphi_X$ and $\varphi_{X^{ind}} < \varphi_X$. Hence, we pose

$$\lambda \in (0, 1/2) \quad \Rightarrow \quad \varphi_{X^{ind}} < \varphi_X < \varphi_{X^{dir}}.$$

This result can be interpreted as follows. Whenever indirect export is viable and manufacturers may save enough on their fixed export costs, then the basket of products exported indirectly (i.e., by wholesalers) includes both (*i*) varieties produced by firms that would be able to export directly, even in the absence of an intermediation sector, yet earn higher profits by resorting to intermediaries, when the latter are available; and (*ii*) varieties produced by firms that, because of a lower marginal productivity, would not be able export by their own. This conforms to predictions and/or empirical observations from several studies, e.g. Ahn et al. (2011) or Akerman (2018).

A2. Scope and number of export intermediaries in equilibrium

It is indeed from Akerman (2018) that we take inspiration for modeling the sector of export intermediation. We assume free entry in this sector and we treat intermediaries as homogeneous. They face the same entry cost in the foreign market, namely f_X, as any manufacturer. We assume that f_X compounds the cost of setting up a local retail channel (representing a fraction $\lambda \in (0, 1)$ of f_X) with other items of expenditure required to operate into $Foreing$ (representing the residual fraction $1 - \lambda$). At odds with manufacturers, intermediaries own a technology to export many goods, yet with some form of convexity in their cost function to avoid infinite economies of scope, which would induce the existence of one (big) intermediary only in the market. The fixed export cost of an intermediary firm k is

$$f_X^{W_k} = f_X + (n^{W_k})^{\delta}/\delta,$$

where n^{W_k} is the measure of varieties handled by this firm (and, correspondingly, the measure of indirect exporters from which intermediary k source its products), while $\delta > 1$ regulates the degree of convexity, i.e., the pace at which adding one variety more to the export basket of the wholesaler makes operations more complex (due to increased heterogeneity of the goods handled) and therefore costlier. Since wholesalers are homogeneous and monopolistic competition implies atomistic manufacturing firms, the scope of each wholesaler is

$$n^{W_k} = \frac{N^M}{N^W} \cdot \frac{G(\varphi_{X^{dir}}) - G(\varphi_{X^{ind}})}{1 - G(\varphi_D)},$$

where N^W and N^M denote the number of wholesale and manufacturing firms on the marketplace, respectively; whereas $G(\varphi)$ is the productivity distribution across manufacturing firms located at $Home$, evaluated at the cut-off levels for direct ($\varphi_{X^{dir}}$) and indirect ($\varphi_{X^{ind}}$) entry into $Foreign$, as well as for entry in the domestic market (φ_D). In the equation above, the second ratio multiplied by N^M give us the mass of producers that self-select as indirect exporters. A zero profit condition applies,

$$f_X^{W_k} = n^{W_k}\ \pi_{\hat{j}}^{W_k},$$

where $\pi_{\hat{j}}^{W_k} = (p_{\hat{j}}^{**} - p_{\hat{j}W}\tau) \cdot q^*(p_{\hat{j}}^{**})$ denotes the "average" operating profit of wholesaler k, across all varieties handled (summarized in the "representative" variety $\hat{j}$). The optimal scope of each intermediary is implicitly defined by the following condition,

$$\frac{\partial}{\partial n^{W_k}}(f_X^{W_k}) = \frac{\partial}{\partial n^{W_k}}(n^{W_k}\ \pi_{\hat{j}}^{W_k}).$$

The last two equations, taken together, imply that $n^{W_k} = [\delta f_X/(\delta - 1)]^{1/\delta}$, i.e., the optimal number of varieties handled by any intermediary increases with the fixed cost of entry in the foreign market (yet in a way inversely related to the degree of cost convexity, $\delta > 1$). Operating profits per variety increase with the fixed export costs as well, inasmuch $\pi_{\hat{j}}^{W_k} = (n^{W_k})^{\delta-1}$.

We keep following Akerman (2018) noting that the two expressions for n^{W_k} imply

$$\frac{N^M}{N^W}\ \frac{G(\varphi_{X^{dir}}) - G(\varphi_{X^{ind}})}{1 - G(\varphi_D)} = \left(\frac{\delta}{\delta - 1} f_X\right)^{1/\delta},$$

from which the number of intermediaries, N^W, can finally be obtained. More convoluted steps lead us to pin down also the mass of indirect exporters, N^M, given the firm productivity distribution observed in $Home$. We refer the reader to Akerman (2018) for the methodology to employ to get closed form solutions for the equilibrium, particularly for the case of Pareto distribution.

B. From firm-level to aggregate adjustments over export channels

B1. Relative number of products traded indirectly

The theoretical setting outlined in Section 3 does not just accommodate the evidence of larger export price elasticity under intermediated exports but also allows us to investigate an additional margin of firm-level adjustment to RER shocks. We focus here on the adjustment that any producer puts in place as regard to the choice of whether serving the foreign market and, if so, whether doing this directly or indirectly. In this respect, the model delivers clear predictions which can be indirectly tested on our data at a more aggregate level, compared to what has been done so far. This gives us the chance to further validate our theory.

To this purpose, we introduce a simplifying assumption on how firm productivity is distributed. With limited loss of generality, it is enough to assume that both export cut-offs in equations (9) and (10) are located in the domain of the density function over which firm density is strictly decreasing and convex in the level of marginal productivity. Quite obviously, the more restrictive case in which $G(\varphi)$ is Pareto with shape $\theta > 0$ would ensure this condition to be always fulfilled.[35]

According to equations (9) and (10), both export cut-offs are increasing with the level of entry costs in the export market, f_X. Hence, the more costly and difficult is to access the foreign market, the higher the level of productivity required for either direct or indirect entry; and the fewer the domestic varieties that will manage to reach $Foreign$ along any of the two channels. Under Pareto, this also implies a larger measure of varieties exported indirectly (N^{ind}) over the total measure of varieties exported –either directly or indirectly– to the foreign destination (N^{tot}). More specifically, the measure of varieties exported indirectly to $Foreign$ evaluates to

$$N^{ind} = \int_{\varphi_{X^{ind}}}^{\varphi_{X^{dir}}} \frac{\theta}{(\varphi_i)^{\theta+1}} \; d\varphi_i = -\left[\varphi^{-\theta}\right]_{\varphi_{X^{ind}}}^{\varphi_{X^{dir}}} = \left(\varphi_{X^{ind}}\right)^{-\theta} - \left(\varphi_{X^{dir}}\right)^{-\theta} \; ,$$

while the total measure of varieties exported there, either directly or indirectly, is

$$N^{tot} = \int_{\varphi_{X^{dir}}}^{+\infty} \frac{\theta}{(\varphi_i)^{\theta+1}} \; d\varphi_i = -\left[\varphi^{-\theta}\right]_{\varphi_{X^{dir}}}^{+\infty} = \left(\varphi_{X^{dir}}\right)^{-\theta} \; .$$

[35]In the literature on heterogeneous firms and monopolistic competition inspired by Melitz (2003), assuming C.E.S. preferences and Pareto productivity in the manner of Chaney (2008) largely increases model tractability, yet at the cost of firm sales being Pareto-distributed, too. This is challenged by the empirical evidence, which appears more in favor of log-normal distribution (Head et al., 2014; and Eaton et al., 2011). However, the Pareto matches quite well the upper tail of the observed sales distribution, where most of global trade actually occurs (exporting firms are indeed typically larger and more productive than the others). Moreover, Mrázová et al. (2015) show that, to explain sales and markup distributions, assumptions about the structure of the demand function are far more relevant than the choice between Pareto and log-normal distribution for firm productivity. For all these reasons, the class of monotonically decreasing distributions, hence including Pareto, appears appropriate for our purposes.

The ratio between these two measures can prove to correspond to

$$\frac{N^{ind}}{N^{tot}} = 1 - \left(\frac{\varphi_{X^{ind}}}{\varphi_{X^{dir}}}\right)^{\theta} = 1 - \left(\frac{c - \xi\sqrt{(1-\lambda)f_X}}{c - \xi\sqrt{\lambda f_X}}\right)^{\theta},$$

with $c \equiv a - dQ^*$ and $\xi \equiv 2\sqrt{2bw^*\varepsilon}$. Given $\lambda < \bar{\lambda}$ $(= 1/2)$, the ratio N^{ind}/N^{tot} turns out to be strictly increasing with f_X, at least over the range of the admissible values of this variable (recall, $f_X < \bar{f}_X$). In words, the more difficult accessing the foreign location, the higher is the proportion of varieties exported indirectly (N^{ind}) over the total measure of varieties exported (N^{tot}). A direct empirical validation of this result can be found in Appendix C.

B2. Adjustment at the product extensive margin across export channels

We now turn the attention to the predicted effects of a RER shock on the mass of varieties traded along the two export channels. Given equations (9) and (10), exchange rate variation necessarily implies a shift of the export cut-offs. Both $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ are increasing with the RER, thus real appreciations (i.e., higher ε) will induce marginal direct exporters to switch into indirect exporters; and marginal indirect exporters to exit the export market, falling back on the domestic market only.

There are two considerations to make as regard to the partial elasticity of the export cutoffs with respect to ε, namely

$$E_{\varphi_{X^{dir}};\varepsilon} = 1 + \frac{\xi\sqrt{(1-\lambda)f_X}}{2c - \xi\sqrt{(1-\lambda)f_X}} > 0 \ ,$$

in the case of direct export; and

$$E_{\varphi_{X^{ind}};\varepsilon} = 1 + \frac{\xi\sqrt{\lambda f_X}}{2c - \xi\sqrt{\lambda f_X}} > 0 \ ,$$

in the case of indirect export. The first is that all restrictions that we have imposed so far imply that both elasticities are increasing with f_X. Hence, a larger measure of varieties will switch from being exported directly to being exported indirectly, the less accessible is the overseas market with respect to which a real appreciation occurs; and the larger also the measure of varieties switching from being exported indirectly to exiting this foreign market.[36] The second crucial consideration is that, given $\lambda \in (0, \bar{\lambda})$

[36]Following our closest relatives (e.g. Ahn et al. 2011; Akerman 2018; Chatterjee et al. 2013), we

and $f_X \in (0, \bar{f}_X)$, the direct export cut-off is more sensitive to RER variation than the cut-off for indirect export, i.e., $E_{\varphi_{X^{dir}};\varepsilon} > E_{\varphi_{X^{ind}};\varepsilon}$. Any change in the RER (i.e., ε) thus originates a wider shift of $\varphi_{X^{dir}}$, compared to $\varphi_{X^{ind}}$. Even more so, this should be observed when f_X is large, insofar as higher fixed costs amplify the RER elasticity of both cut-offs.

This last remark generates ambiguous implications on the change in the relative number of varieties exported directly and indirectly to $Foreign$ that occurs in response to the RER movement. To unravel the reasoning, let us denote the change in the RER as a movement from ε to $\varepsilon' = \gamma\varepsilon$ with $\gamma > 0$, which may correspond to either a real appreciation or depreciation. The productivity cut-offs will consequently move from $\varphi_{X^{dir}}$ to $\varphi'_{X^{dir}}$; and from $\varphi_{X^{ind}}$ to $\varphi'_{X^{ind}}$ respectively. The new levels of the thresholds are easily obtained from equations (9) and (10) by simply plugging $\varepsilon' = \gamma\varepsilon$ in place of ε. Some of the varieties keep being exported to the foreign market, yet switching from the indirect to the direct export channel, in case of depreciation; or from the direct to the indirect channel, in case of appreciation. Under Pareto, the measure of these "switching" varieties is

$$\Delta^{dir} = \int_{\varphi_{X^{dir}}}^{\varphi'_{X^{dir}}} \frac{\theta}{(\varphi_i)^{\theta+1}}\, d\varphi_i = -\left[\varphi^{-\theta}\right]_{\varphi_{X^{dir}}}^{\varphi'_{X^{dir}}} = \left(\varphi_{X^{dir}}\right)^{-\theta} - \left(\varphi'_{X^{dir}}\right)^{-\theta}.$$

Other varieties will enter (or re-enter) the foreign market in the event of a depreciation; or will exit in the event of an appreciation. Again conditional on assuming Pareto, the measure of these "entry/exit" varieties is

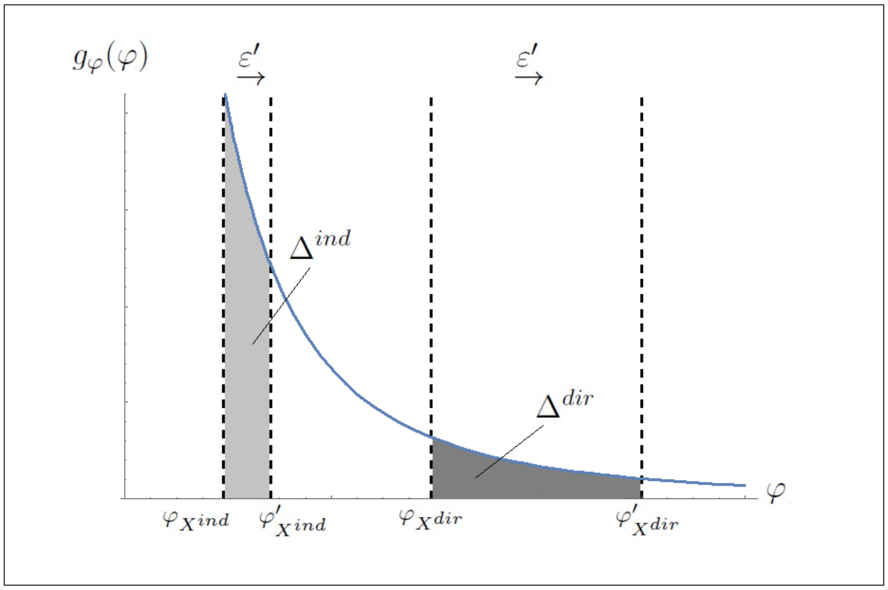
$$\Delta^{ind} = \int_{\varphi_{X^{ind}}}^{\varphi'_{X^{ind}}} \frac{\theta}{(\varphi_i)^{\theta+1}}\, d\varphi_i = -\left[\varphi^{-\theta}\right]_{\varphi_{X^{ind}}}^{\varphi'_{X^{ind}}} = \left(\varphi_{X^{ind}}\right)^{-\theta} - \left(\varphi'_{X^{ind}}\right)^{-\theta}.$$

The two measures above have a graphical representation in Figure B1, where we plot the density of firm productivity and we show the location of the two cut-off levels, $\varphi_{X^{ind}}$ and $\varphi_{X^{dir}}$, both before and after a real appreciation occurs (the figure considers the case where the RER moves from ε to $\varepsilon' = \gamma\varepsilon$, with $\gamma > 1$).

---

abstract away any inter-temporal element which might drive the firm's choice to stay in the foreign market or leave it, possibly related to the incidence of the *sunk cost* component over the total fixed export costs. We also neglect to the presence of long-term contracts of export intermediation. All these elements, the second in particular, can delay a firm's transition from the status of indirect to that of direct exporter, giving rise to some overlap between the productivity distribution of direct and indirect exporters, respectively (and of exporters and non-exporters, analogously). However, this does not undermine the general validity of sorting model.

Figure B1: Effects of a real appreciation



As Figure B1 should reveal, in principle no one can assess whether the measure of "switching" varieties (Δ^{dir}) is larger or smaller than the measure of "entry/exit" varieties (Δ^{ind}). On one hand, $\varphi_{X^{dir}}$ is more elastic so that –all else being equal– Δ^{dir} tends to be larger. On the other hand, this cutoff is located more to the right of the productivity distribution, where firm density is thinner. This, *per se*, tends to reduce Δ^{dir} compared to Δ^{ind}.

Nonetheless, some testable predictions can be retrieved from our model by considering the ratio between the two measures, namely

$$\frac{\Delta^{ind}}{\Delta^{dir}} = \frac{(\varphi_{X^{ind}})^{-\theta} - (\varphi'_{X^{ind}})^{-\theta}}{(\varphi_{X^{dir}})^{-\theta} - (\varphi'_{X^{dir}})^{-\theta}} = \frac{-\left[c - \phi_1\sqrt{f_X}\right]^{\theta} + \left[\gamma c - \phi_2\sqrt{f_X}\right]^{\theta}}{-\left[c - \phi_3\sqrt{f_X}\right]^{\theta} + \left[\gamma c - \phi_4\sqrt{f_X}\right]^{\theta}}\ , \tag{B.1}$$

where coefficients ϕ_j with $j = 1, ..., 4$ collect all variables and model parameters other than f_X. More precisely, their analytical expressions are the following:

- $\phi_1 \equiv \xi\sqrt{\gamma\lambda}$;
- $\phi_2 \equiv \xi\gamma\sqrt{\lambda}$;
- $\phi_3 \equiv \xi\sqrt{\gamma(1-\lambda)}$;
- $\phi_4 \equiv \xi\gamma\sqrt{1-\lambda}$.

Given $\lambda < 1/2$, it is easily proved that $\phi_3 > \phi_1$ and $\phi_4 > \phi_2$. Moreover, if we set $\gamma > 1$ (so that a real appreciation occurs, with the RER moving from ε to $\varepsilon' = \gamma\varepsilon$), we obtain $\phi_1 < \phi_2$ and $\phi_3 < \phi_4$. Given this hierarchy among the coefficients, for any

$\theta > 0$ and $f_X < \bar{f}_X$, we conclude that the ratio $\Delta^{dir}/\Delta^{ind}$ is inversely related to f_X.[37]

The same conclusion holds also in the case of a real depreciation, when Δ^{ind} denotes the measure of varieties that switch from being not exported to reaching the foreign market via intermediaries (i.e., entering the foreign market); and Δ^{dir} denotes the measure of varieties that switch from the indirect to the direct export channel (i.e., change the mode of export). We observe that $\gamma < 1$ implies both $\phi_1 > \phi_2$ and $\phi_3 > \phi_4$ in equation (B.1). A new Proposition can be established.

Proposition 3. *In the event of a real appreciation (depreciation), the measure of varieties that switch from being exported indirectly to exiting the foreign market (that enter the foreign market through the intermediated channel) increases, compared to the measure of varieties that switch from being exported directly to being exported indirectly (from the indirect to the direct export channel), the higher the level of entry costs in the foreign market.*

Intuitively, when the overseas market is difficult to access (high f_X), both $\varphi_{X^{ind}}$ and $\varphi_{X^{dir}}$ are located more to the right of the productivity distribution, where firm density is thinner. Following a real appreciation, the direct export cut-off ($\varphi_{X^{dir}}$) increases by relatively more than the cut-off for indirect export ($\varphi_{X^{ind}}$); the more so, the higher is f_X. At the same time, however, the rightward shift of the two cut-offs implies a reduction in firm density, which is disproportionately smaller in the class of direct exporters, their relevant cut-off being located more to the right, i.e., toward the tail of the distribution. Provided that f_X is sufficiently high, this effect dominates the first and opposed one induced by the larger shift of $\varphi_{X^{dir}}$ with respect to $\varphi_{X^{ind}}$.

Note that the result established as Proposition 3 does not imply anything as regard to Δ^{dir} being necessarily larger or smaller than Δ^{ind} at given levels of the entry cost f_X. Likewise, we remained agnostic regarding N^{dir} being larger or smaller than N^{ind} conditional on the size of f_X. We therefore let empirical evidence shed light on the possible outcomes in these respects.

Finally, it is worth pointing out that while our analysis has been developed under the mathematically convenient assumption of Pareto-distributed productivity, the fact that $\Delta^{dir}/\Delta^{ind}$ is decreasing with f_X also holds under productivity distributions other

[37]For sufficiently small changes in ε (i.e., a value of γ sufficiently close to 1), the relation among coefficients is $\phi_4 > \phi_3 > \phi_2 > \phi_1$ whenever $\gamma > 1$ (real appreciation) and $\phi_3 > \phi_4 > \phi_1 > \phi_2$ whenever $\gamma < 1$ (real depreciation). If the RER movement gets disproportionately large, up to become quite unrealistic, the order may turn into $\phi_4 > \phi_2 > \phi_3 > \phi_1$ in the event of real appreciation; and $\phi_3 > \phi_1 > \phi_4 > \phi_2$ in the event of a real depreciation. Notwithstanding, even in these extreme cases, the ratio $\Delta^{dir}/\Delta^{ind}$ can still prove to be strictly increasing with f_X.

than Pareto, such as the log-normal, for instance. In these cases, however, we should verify first whether the two cut-offs, namely $\varphi_{X^{ind}}$ and $\varphi_{X^{dir}}$, are located –both before and after the RER shock– in the part of the domain of density function $g_\varphi(\varphi)$ where firm density is strictly decreasing and convex in level of productivity φ.

C. Empirical validation of additional predictions in Appendix B

C1. Evidence on the relative number of products traded indirectly

Armed with the additional predictions retrieved in Appendix B, we go back to our data for a final empirical validation of our theory. We start by testing whether the ratio between the number of varieties exported indirectly (N^{ind}) and the whole number of varieties exported (N^{tot}) to a given location actually increases with country fixed costs, as postulated in Appendix B1 upon assuming Pareto-distributed productivity.

Due to multitude of trade-partner countries, in our empirical investigation we consider a natural multi-country extension of our model, where firms' export decisions are fully independent across locations. Furthermore, in our data a relevant share of the manufacturing exporters reaches a given location with more than one product category, while in our theoretical setting manufacturers are modeled as single-product firms. To fill the mismatch, we assume that every product exported by a firm to a certain destination (i.e., a firm-product-country combination in our data) corresponds to a *variety* of the differentiated good traded in our model. Most importantly, we assume that products –even when produced by the same firm– corresponds to lines of business that are fully independent from each other, insofar as the relevant component of the fixed cost of exporting to a certain destination is product(variety)-specific.[38]

For each destination, we then compute the total number of varieties (firm-product combinations) exported, as well as the number of varieties exported indirectly, i.e., through wholesalers. The ratio between the two measures is regressed on a set of country characteristics, according to the following equation:

$$N^{ind}/N^{tot} = \beta_0 + \beta_1 Country\ Fixed\ Costs_c + \beta_2 X_c + d_t + d_p + \epsilon_{ic},$$

where *Country Fixed Costs*$_c$ stands for *Market Costs*$_c$ and/or *Governance Indicator*$_c$,

[38]In principle, neither a pure firm-specific nor a variety-specific formulation for the fixed entry cost appears as fully satisfactory. In particular, under pure firm-level entry costs, it would be hard to justify why multi-product firms tend to react to external shocks (included real appreciations) by continuing to export their core products only, while dropping the marginal products in their portfolio, as documented by Chatterjee et al. (2013) based on Brazilian customs data.

i.e., the two measures already introduced in Section 2.4. The vector X_c includes a set of country-level controls such as GDP per capita; the level of population; the corruption perceptions index (taken from the Transparency International Organization); the geographical distance between the two trading partners (taken from the CEPII dataset) which captures variable trade costs related to product transportation; a dummy for continents; and, finally, the average import tariff rate. We also include year (namely γ_t) and product (γ_p) fixed effects. The results are reported in Table C1.

Table C1: Number of varieties exported by wholesalers over total the number exported, by country

Dep. Var	N^{ind}/N^{tot}
Market Costs$_c$	0.025***
	(0.001)
Governance Indicator$_c$	0.034***
	(0.001)
ln GDPpc$_{ct}$	-0.010***
	(0.000)
ln POP$_{ct}$	-0.013***
	(0.001)
ln Dist$_c$	0.025***
	(0.000)
Corruption Index$_c$	0.010***
	(0.003)
Continent$_c$	-0.003***
	(0.000)
Tariff$_{ct}$	0.001
	(0.001)
Year FE - γ_t	Yes
Product FE γ_p	Yes
Clustering Country	Yes
Adj. R-squared	0.19
Observations	1,072,523

Notes: Table reports the results of regressions obtained by using Italian trade data between 2000 and 2007. Robust standard errors clustered at country level are reported in parenthesis below the coefficients. Asterisks denote significance levels (***: p<1%; **: p<5%; *: p<10%). Source: Our elaboration on Italian micro-data.

Consistently with our theory, in the aftermath of RER movements the adjustment in the number of varieties reaching a foreign destination through the intermediary sector is proportionally larger, the higher the entry cost in that market. While the Table below provides direct evidence in support for the conclusions drawn in Appendix B1, indirect evidence stems instead from the findings of Bernard et al. (2015), that is, the incidence of wholesale exports in a given location is higher, the higher the level of trade barriers incurred to access that country.

Note, however, that we look here at the measure of varieties exported, rather than at the value of the corresponding export transactions.

C2. Evidence on the adjustment at the product extensive margin across export channels

We now test whether Proposition 3 from Appendix B finds empirical support in our data on Italian exports. Ideally, testing Proposition 3 would require us to observe both the measures Δ^{dir} and Δ^{ind}, as defined in Appendix B, i.e., we should be to track whether, in response to real appreciations, (*i*) a firm that used to export directly now serves the foreign market via intermediaries; and, similarly, (*ii*) a firm that used to export indirectly stops serving the foreign market in any form. In the absence of such information, we can only provide indirect evidence on this further margin of firm-level adjustment.

To accomplish this task, we exploit information on the total number of firms that, either within the manufacturing or the wholesale category, stop exporting a product p in a destination country c between time $t-1$ and t.[39] In our analysis, the number of manufacturing firms that stop exporting in a given product-country combination is used as a proxy for Δ^{dir}, the number of varieties that are no longer exported directly but reach the foreign market via intermediaries (according to what the sorting model prescribes). Likewise, the number of wholesalers that stop exporting in a given product-country combination is used as a proxy for Δ^{ind}, assuming that indirect exporters that were reaching the foreign location through these intermediaries do no longer operate internationally.

We then estimate the following regression model at the product-country level:

$$\begin{aligned}\ln \#\text{Drop}_{wpct} &= \beta_0 + \beta_1 \Delta \ln \text{RER}_{ct} + \beta_2 \Delta \ln \text{RER}_{ct} \times d_w + \\ &+ \beta_3 \Delta \ln \text{RER}_{ct} \times \textit{Country Fixed Costs}_c + \\ &+ \beta_4 \Delta \ln \text{RER}_{ct} \times d_w \times \textit{Country Fixed Cost}_c + \beta_5 d_w + \\ &+ \beta_6 d_w \times \textit{Country Fixed Cost}_c + \beta_7 \text{X}_{wt-1} + \gamma_t + \gamma_{pc} + \nu_{wpct} \ ,\end{aligned}$$

where $\#\text{Drop}_{wpct}$ is the number of either manufacturing or wholesale firms (denoted by the subscript w) that stop exporting product p in country c between $t-1$ and

[39] To avoid capturing firms' mortality rather than exiting from one product-country combination, we restrict the analysis to wholesalers and manufacturers that keep on being in international markets in two consecutive years. Our findings are anyway robust when including firms disappearing between $t-1$ and t. These results, available upon request, are likely driven by relatively few exits of both wholesalers and manufacturers, each year. Firms exiting the market indeed account, on average, for around 5% of the observations.

t. The dummy d_w takes value one for the intermediary category and zero for the manufacturing sector; $\Delta \ln RER_{ct}$ is the (log) change in the real exchange rate between Italy and the partner country c. According to Proposition 3, in the event of a real appreciation the effects in terms of switching from one export mode to another should be stronger in destination countries characterized by larger entry costs. We look for empirical evidence in this respect by including the triple interaction term $\Delta \ln \mathrm{RER}_{ct} \times d_w \times \textit{Country Fixed Cost}_c$, to capture how the differential response between the two sectors (in terms of number of firms that stop exporting in the aftermath of a RER shock) varies across markets with different level of accessibility.[40]

The regression model includes year (γ_t) and product-country (γ_{pc}) fixed effects to control for the propensity of wholesale firms to export to specific countries a given category of products that are inherently more likely to be dropped. As argued in Section 2.3, Bernard et al. (2011) report indeed significant differences between wholesale and manufacturing exporters in terms of both product and geographic diversity, with the former more likely to export to countries with high fixed export costs and weak contracting institutions; and sell products that are more homogeneous and characterized by lower relationship specificity. We also add a vector of time-variant controls, denoted as X_{wt-1}, including a proxy for product diversification ($\ln \mathrm{NP}_{wct-1}$) defined as the log-number of products exported to country c by each category w; and a proxy for geographic diversification ($\ln \mathrm{NC}_{wpt-1}$) defined as the log-number of countries served with product p by each category w. We finally include $\textit{Deviation}_{wpct-1}$, a measure of the relative importance of a category of firms in the overall export of a given product to a certain location. This variable corresponds to the log difference between the total and average export of product p to country c.

Table C2 report our estimates. Columns 1 to 3 show the results when using $\textit{Market Cost}_c$ as a proxy for country fixed costs, whereas columns 4 to 6 when using $\textit{Governance Indicator}_c$. In columns 1-2 and 4-5, $\textit{Market Cost}_c$ and $\textit{Governance Indicator}_c$ are expressed in form of dummy variables, taking value one if the destination country features high fixed costs, and zero otherwise. We define such dummies using the median (column 1 and 4) or, alternatively, the mean (column 2 and 5) as a threshold to disentangle between high and low entry-cost countries. The coefficients β_1 and $\beta_1 + \beta_2$ capture the effect of RER movements when exporting to countries with low fixed costs for the categories of manufacturers and wholesalers, respectively. On

[40] As in Section 2.4, the term $\textit{Country Fixed Costs}_c$ stands for $\textit{Market Cost}_c$, from the World Bank Doing Business dataset; or $\textit{Governance Indicator}_c$, from the World Bank's Governance dataset.

Table C2: Product dropping in the aftermath of exchange rate movements

	ln # Drop_{wpct}					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln \text{RER}_{ct}$	0.098	0.073	0.036	0.064	0.076	0.067
	(0.010)	(0.010)	(0.007)	(0.012)	(0.012)	(0.007)
$\times\ d_w$	-0.028	0.006	0.006	-0.041	-0.058	-0.032
	(0.015)	(0.015)	(0.010)	(0.021)	(0.021)	(0.011)
$\times$ Market Costs_c	0.109	0.079	0.015			
	(0.011)	(0.010)	(0.003)			
$\times d_w \times$ Market Costs_c	0.082	0.040	0.010			
	(0.017)	(0.017)	(0.005)			
$\times$Governance Indicator_c				0.052	0.063	0.045
				(0.013)	(0.013)	(0.005)
$\times d_w \times$ Governance Indicator_c				0.052	0.070	0.044
				(0.022)	(0.022)	(0.008)
d_w	0.236	0.281	0.306	0.246	0.229	0.312
	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)
$d_w \times$ Market Costs_c	0.110	0.111	0.084			
	(0.004)	(0.004)	(0.003)			
$d_w \times$ Governance Indicator_c				0.135	0.146	0.077
				(0.004)	(0.004)	(0.002)
$\ln \text{NP}_{wct-1}$	0.274	0.297	0.272	0.286	0.279	0.270
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$\ln \text{NC}_{wpt-1}$	0.309	0.308	0.309	0.309	0.310	0.312
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\text{Deviation}_{wpct-1}$	0.129	0.130	0.129	0.128	0.128	0.127
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Year FE - γ_t	Yes	Yes	Yes	Yes	Yes	Yes
Product-Country FE - γ_{pc}	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Product-Country	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.715	0.715	0.715	0.714	0.714	0.714
Observations	1,272,941	1,272,941	1,272,941	1,305,283	1,305,283	1,305,283

Notes: Table reports the results of regressions at product-country-category level, where category refers either to manufacturing or intermediary sector. The dependent variable ln # Drop_{wpct} is the number of firms that export product p in country c in year $t-1$ but not in year t. d_w is a dummy for wholesaler sector; $\ln \text{NP}_{wct-1}$ and $\ln \text{NC}_{wpt-1}$ are the number of products exported within country c and the number of countries served with product p, respectively; $\text{Deviation}_{wpct-1}$ measures the relevance of product p in the exports to destination c. Interaction terms, denoted by $\times$, are included in the regressions. Robust standard errors in parentheses are adjusted for clustering by product-country. Asterisks denote significance levels (***: p<1%; **: p<5%; *: p<10%). Source: Our elaboration on Italian micro-data.

the contrary, when exporting to destinations more difficult to access, the effect of a RER shock is measured by $\beta_1 + \beta_3$ for the category of manufacturing firms; and by $\beta_1 + \beta_2 + \beta_3 + \beta_4$ for the category of wholesalers. Finally, in columns 3 and 6, *Market Cost*$_c$ and *Governance Indicator*$_c$ are expressed as continuous variables.

Based on the relative size of the estimated coefficients, we can relate the total effect of a RER shock for the two categories of exporters to the level of country fixed costs. By taking column 1, as example, we observe that in markets more difficult to access (*Market Costs*$_c = 1$), a 10% increase in the RER induces a 2.6% drop in the measure proxying for the overall number of varieties exported by wholesalers ($\beta_1 + \beta_2 + \beta_3 + \beta_4$), while the effect is reduced to -2% for the manufacturing sector ($\beta_1 + \beta_3$). This result holds across different specifications and using any of the two proxies for the explanatory variable *Country Fixed Costs*$_c$. For both categories of exporters, the adjustment is weaker when serving countries with lower fixed entry costs. Indeed again from column 1, we observe that, when exporting to more accessible markets (*Market Costs*$_c = 0$), a 10% real appreciation reduces the overall number of varieties exported by wholesalers and manufacturers by 0.7% ($\beta_1 + \beta_2$) and 0.9% (β_1), respectively. These effects are much smaller than those reported above for markets characterized by high entry costs, which conforms to the prediction of our theory, particularly to Proposition 3. All these findings prove to be robust to alternative model specifications.[41]

D. An alternative model with heterogeneous pricing-to-market

This appendix describes a model featuring an alternative source of heterogeneous markups and pricing-to-market, other than a linear demand system *á la* Melitz and Ottaviano (2008). We assume here C.E.S., instead of quadratic utility; and we introduce distribution costs in each market to be paid in the local currency, in the spirit of Corsetti and Dedola (2005). The resulting setup is similar to the one analyzed in Chatterjee et al. (2013), except for our firms being single- rather than multi-product. We allow instead for export intermediation, regulated by the same assumptions put forth in Section 3 for the case of the linear demand model.

In this alternative setting, production technology is still linear in the amount of labor services; and firm productivity is still drawn from a country-specific distribution $G(\varphi)$, that we conveniently continue to assume Pareto with shape $\theta > 0$. The foreign demand for variety i is simply $q_i^* = A^*(\widetilde{p}_i^*)^{-\sigma}$, where A^* is a demand shifter; $\sigma > 2$ is the elasticity of substitution among varieties; and $\widetilde{p}_i^*$ is the consumer price (in the foreign currency) of the variety, which relates to the border price p_i^* (in the home currency) set by the exporter as follows:

$$\widetilde{p}_i^* = ep_i^* + \eta^* w^*,$$

where e is the nominal exchange rate between the two currencies and $\eta^* w^*$ is the

[41] Our results on the adjustment at the product extensive margin of each export channel are consistent with the idea that intermediaries are less committed to exporting their products compared to direct manufacturing exporters and also face lower fixed costs per product. As a consequence, they can adjust more easily to a negative shock, dropping relatively more products than manufacturing exporters. Moreover, because wholesalers feature a cost advantage and are more prevalent in markets with higher destination-specific fixed costs (Bernard et al., 2011), this effect should be more pronounced for exports to countries that are more difficult to access.

distribution cost expressed in terms of the wage rate abroad, w^*.

D1. Pricing

Due to iceberg costs $\tau \geq 1$, a direct exporter (denoted by i) optimally prices at

$$p_i^* = \mu_i^* \cdot \frac{\tau}{\varphi_i} \;, \;\; \text{where} \;\; \mu_i^* \equiv \frac{\sigma}{\sigma - 1}\left(1 + \frac{\eta^* \varphi_i}{\sigma \varepsilon \tau}\right),$$

whereas sequential price setting implies that the export price of a variety produced by indirect exporter j, and then sold abroad by some intermediary firm is

$$p_j^{**} = \mu_j^{**} \cdot \frac{\tau}{\varphi_j} \;, \text{where } \mu_j^{**} \equiv \frac{\sigma}{\sigma - 2}\left(1 + \frac{2\eta^* \varphi_j}{\sigma \varepsilon \tau}\right).$$

In the equations above, $\varepsilon = ew/w^*$ (with $w = 1$) denotes the RER between $Home$ and $Foreign$. Assuming $\varphi_j \in (0, \varphi_i)$ in anticipation for standard productivity sorting, we note that

$$|E_{p_j^{**};\varepsilon}| = \frac{2\eta^* \varphi_j}{\sigma \varepsilon \tau + 2\eta^* \varphi_j} > \frac{\eta^* \varphi_i}{\sigma \varepsilon \tau + \eta^* \varphi_i} = |E_{p_i^*;\varepsilon}|, \quad \forall \varphi_j \in \left(\frac{1}{2}\,\varphi_i, \varphi_i\right),$$

which confirms that both Propositions 1 and 2 –as stated in Section 3.4– hold also under a different mechanism for generating heterogeneous pricing-to-market. Proposition 2, in particular, stands on the condition that indirect exporter j attains at least half of the marginal productivity of direct exporter i.

The main difference with respect to the model outlined in the main text is that, here, manufacturing firms discriminate between foreign customers and export intermediaries, i.e., they apply different markups across export modes. When exporting indirectly, the markup imposed on the intermediary firm indeed evaluates to

$$\mu_{jW} \equiv \frac{\sigma - 1}{\sigma - 2}\left(1 + \frac{\eta^* \varphi_j}{(\sigma - 1)\,\varepsilon \tau}\right),$$

which differs from the markup μ_i^* (reported above) that the same firm would impose in case of direct export sales. For any admissible parametrization, we note that $\mu_{jW} > \mu_i^*$. Given the structure of the C.E.S. demand, the additional markup set by the wholesaler disproportionately reduces the quantity sold in the foreign market, thus also the revenue that indirect exporter j obtains from its additional indirect sales to $Foreign$. By internalizing this, the indirect exporter raises its own markup compared to the level applying in case of direct export, thereby extracting more of the surplus of the intermediary. Such effect is not observed in the baseline model with linear demand, as linearity implies that the reduction in sales due to inefficient double marginalization is exactly proportional. For completeness, the intermediary's own markup evaluates to

$$\mu^{W} \equiv \frac{\sigma}{\sigma-1}\left(1+\frac{\eta^{*}}{\sigma\tau\varepsilon p_{jW}}\right)=\frac{\sigma\varepsilon\tau+2\eta^{*}\varphi_{j}}{(\sigma-1)\,\varepsilon\tau+\eta^{*}\varphi_{j}},$$

where p_{jW} is still the price at which the wholesaler sources variety j from the indirect exporter, for the purpose of resale into $Foreign$. All results derived in Section 3 as regard to the pricing behavior of the different categories of exporters still hold.

D2. Export mode selection

We consider a second series of results, i.e., those referring to export-entry decisions and the measure of varieties traded along the two channels. Productivity sorting requires again a cap on the fixed cost advantage for indirect exporters, in form of

$$\lambda<\bar{\lambda}=2\Big(\frac{\sigma-2}{\sigma-1}\Big)^{\sigma-1},$$

thus in this setup the upper bound for λ (namely $\bar{\lambda}$) depends on the degree of substitutability among varieties. Under this mild restriction, more productive firms have strict preferences for exporting directly, inasmuch the cut-off for direct entry,

$$\varphi_{X^{dir}} \equiv \frac{\varepsilon\tau}{(w^{*})^{-\frac{\sigma}{\sigma-1}}\left(\frac{\Psi A^{*}}{\varepsilon(1-\lambda)f_{X}}\right)^{\frac{1}{\sigma-1}}-\eta^{*}}\ ,\ \text{ with } \Psi\equiv\frac{(\sigma-1)^{\sigma-1}-2\,(\sigma-2)^{\sigma-1}}{\sigma^{\sigma}}\ ,$$

corresponds to a higher level of productivity than the cut-off for indirect entry,

$$\varphi_{X^{ind}} \equiv \frac{\varepsilon\tau}{(w^{*})^{-\frac{\sigma}{\sigma-1}}\left(\frac{\Omega A^{*}}{\varepsilon\lambda f_{X}}\right)^{\frac{1}{\sigma-1}}-\eta^{*}}\ ,\ \text{ with } \Omega\equiv\frac{2(\sigma-2)^{\sigma-1}}{\sigma^{\sigma}}\ .$$

Assuming $\lambda\in(0,\bar{\lambda})$ has two important implications, the same analyzed in the model with linear demand. First, the export cut-off φ_X that applies in the lack of export intermediation lies between $\varphi_{X^{ind}}$ and $\varphi_{X^{dir}}$. Accordingly, wholesale firms handle both (*i*) products that would not be exported without an intermediation technology, and (*ii*) products that would be exported anyway, but are more profitably traded along the intermediated channel. Second, the RER elasticities of the two cut-offs are such that $|E_{\varphi_{X^{dir}};\varepsilon}| > |E_{\varphi_{X^{ind}},\varepsilon}|$, i.e., the cut-off for direct entry is more elastic to RER movements than the cut-off for indirect entry.[42]

However, also in this alternative setup, the higher is the level of entry costs at destination, the larger the measure of products that entry/exit the foreign market following a RER movement (i.e., Δ^{ind}) in proportion to the measure of products switching from one export mode to the other (i.e., Δ^{dir}). Following the same steps reported in Appendix B2, the ratio between these two measures can be expressed as

$$\frac{\Delta^{ind}}{\Delta^{dir}} = \frac{\left[\phi_1 \left(\frac{1}{f_X}\right)^{\frac{1}{\sigma-1}} - \eta^*\right]^\theta - \left[\phi_2 \left(\frac{1}{f_X}\right)^{\frac{1}{\sigma-1}} - \gamma\eta^*\right]^\theta}{\left[\phi_3 \left(\frac{1}{f_X}\right)^{\frac{1}{\sigma-1}} - \eta^*\right]^\theta - \left[\phi_4 \left(\frac{1}{f_X}\right)^{\frac{1}{\sigma-1}} - \gamma\eta^*\right]^\theta},$$

where ϕ_j (with $j = 1, ..., 4$) are positive coefficients collecting all variables and model parameters other than f_X and η^*. For any admissible combination of such variables and parameters, the hierarchy of the ϕ coefficients is such that $\Delta^{ind}/\Delta^{dir}$ is always monotonically increasing with f_X. Given suitable assumptions on how firm productivity is distributed (e.g. Pareto, again), Proposition 3 in Appendix B2 remains valid.

E. Export price elasticities to trade shocks

In this last appendix we go back to the theoretical setting proposed in Section 3 to assess whether other common exogenous shocks –such as changes in the level of import tariffs– may have similar implications than RER movements as regard to the pricing-to-market strategy of exporting firms and the relative extent of the price adjustment observed along the two export channels. To this purpose, we interpret iceberg trade costs τ as a measure of tariff rates and/or tariffs' *ad-valorem* equivalents. Consider again the export price p_i^* in equation (4) set by firm i that exports directly under a liner demand system; and the price p_{jk}^* in equation (8) set by the intermediary selling abroad the variety produced by indirect exporter j. The partial elasticity to tariffs of these two prices evaluates, respectively, to

$$E_{p_i^*;\tau} = \frac{\Phi}{\Phi + \varphi_i};$$

[42]Both elasticities are positive insofar as $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ take strictly positive vales. Given $\lambda \in (0, \bar{\lambda})$, this occurs when limiting the size of export fixed costs, $f_X < \bar{f}_X = \Psi\eta^* A^*\lambda/[2(1-\lambda)\varepsilon(\eta^* w^*)^\sigma]$.

$$E_{p^*_{jk};\tau} = \frac{\Phi}{\Phi + 3\varphi_j}.$$

Both elasticities are positive, implying that increased tariffs (higher τ) necessarily induce higher export prices, whatever the entry mode in the export market for the product under consideration. For a meaningful comparison between the two elasticities above, it must be recalled that productivity sorting entails firm i being more productive than firm j, i.e., $\varphi_i > \varphi_j$. We then observe that

$$E_{p^*_{jk};\tau} < E_{p^*_i;\tau} \quad \forall\ \varphi_j \in \left(\frac{1}{3}\ \varphi_i, \varphi_i\right),$$

that is, for reasonable productivity gaps between direct and indirect exporters –the same identified in equation (15)–, the increase in export prices is larger along the direct export channel. This is because, again, indirect exporters and intermediary firms overall absorb more of the effects of the shock in their prices (compared to direct exporters) through their joint markup adjustment.

This confirms that the stabilizing role of export intermediation –detected in this paper and traced back to the mechanism generated by double marginalization on top of heterogeneous pricing-to-market– is not limited to the case of RER movements only, but has more general validity, extending also to different types of exogenous trade shocks.