

Export Modes and Firms' Adjustments to Exchange Rate Movements

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Abstract

The paper provides novel evidence on the heterogeneous response of exporting firms to a common external shock, such as an exchange rate movement. Using firm-level data on Italian exports by product and destination, the empirical analysis reveals that export price elasticity to exchange rate variation is larger for export intermediaries than for direct manufacturing exporters. The paper rationalizes this evidence in a way consistent with consolidated facts in trade literature, proposing a model of heterogeneous pricing-to-market where intermediated trade features double marginalization. This theory is further validated by testing additional predictions on the adjustment in the relative number of products traded along the direct and intermediated export channels. Overall, the results suggest that, in addition to facilitating trade, export intermediation plays a relevant role in stabilizing trade patterns across countries.

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

JEL codes: F12, F14, D22, L22

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1. Introduction

A large bulk of literature in international trade, recently surveyed in a comprehensive manner by 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 consumer (import) 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. This firm heterogeneity in pricing behavior has 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

Starting from the result of heterogeneity in firms' price adjustments to exchange rate movements provided by Berman et al. (2012), this article brings into the literature on PTM the difference in pricing behavior between direct exporters on one hand, and export intermediaries on the other.² A well-established theoretical and empirical fact in trade literature is that manufacturing firms sort according to productivity in determining their export-entry mode, with most productive firms exporting by their own; and less productive ones 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 this class of models has been well 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 the role of intermediaries, one would expect export prices to react more to exchange rate movements when 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 more than firms with weaker performance, and (ii) intermediaries tend to trade goods produced by manufacturing firms with 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 and puzzling evidence on the impact of exchange rate movements on the pricing strategy of the exporters. Empirically, the unit value is used as a proxy for the free-on-board (FOB) export price. When

¹After the seminal work by 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 deeply investigated the issue of heterogeneity in pricing-to-market strategies.

²Export intermediaries are firms that do not engage in production activities, yet report foreign sales as they operate as pure intermediaries, enabling manufacturing firms to export their products indirectly. Many producers indeed seem to opt for this entry mode in the export market. The quantitative relevance of wholesalers' exports has been documented by Bernard et al. (2010): 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), whereas the shares of intermediaries' exports are even larger (respectively, 15% and 20%), in Sweden (Akerman, 2018) and France (Crozet et al., 2013). In China, approximately one quarter of the country's total exports are generated through wholesalers (Ahn et al., 2011). Quite lower numbers are observed when considering retailers, albeit this category of firms might play a more significant role as importers. As we focus here on the behavior of exporting firms, we will then use the terms *intermediaries* and *wholesalers* as interchangeable throughout all this paper.

restricting the sample to exports of manufacturing firms only, our empirical analysis confirms that firms with better performance absorb exchange rate movements in their markups more than firms with weaker performance. In this regard, the behavior of Italian direct exporters conforms to that of their French counterparts, analysed by Berman et al. (2012). Nevertheless, when considering also wholesalers, the estimates from our reduced-form equation show that both direct exporters and intermediaries decrease (increase) their export prices in response to real exchange rate (RER) appreciations (depreciations), but the export price elasticity is higher for the latter. Differences in the price response across the two types of exporters are statistically and economically significant: following a 10% real appreciation, direct exporters, on average, undercut their export price by 0.3%, whereas for intermediaries 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 changes, and to the addition of firm, country, and product characteristics whose lack of control might bias our findings.

Intermediaries' export prices are therefore more sensitive to exchange rate movements, a result which 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 wholesalers. Hence, we can not directly control for productivity sorting. However, since direct manufacturing exporters are typically more productive than indirect ones (as well documented by previous empirical analyses); and given that less efficient producers adjust less their prices following exchange rate movements (as confirmed by our data), we conclude 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. In other words, our estimates provide a lower bound for the difference in the average export price elasticity between the two export channels.

To reconcile our empirical puzzle with the known facts and theories, we propose a relatively parsimonious model of trade, building on one of the three frameworks outlined in the appendix of Berman et al. (2012). We consider a model featuring heterogeneous markups and pricing-to-market strategy generated by a linear demand system *à la* Melitz and Ottaviano (2008), which predicts heterogeneous reaction of exporters to RER shocks, as documented in our data as well as in Berman et al. (2012). This setting is then augmented by introducing a simple export intermediation technology. We model firms' pricing along the intermediated export channel getting inspired by 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 (e.g. Hastings and Gilber, 2005; Hellerstein and Villas-Boas, 2010; Neiman, 2010; Bonnet et al., 2013; Hong and Li, 2017).⁴ Although this evidence mainly relates to the retail sector, the effects produced

³Although the average export price elasticity for direct exporters might appear small at the first sight, our result is comparable to estimates from other countries: around 0.08 for French manufacturing firms (Berman et al., 2012) and 0.05 for Belgian companies (Amiti et al., 2014). Moreover, average value hides a considerable amount of heterogeneity across firms with different levels of productivity, market shares, import intensity, output quality and the like.

⁴In 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 the cost pass-through being larger in this market, compared

by the vertical structure of the market might be likely the same at work in the sector of export intermediation.

In our monopolistic competition model, manufacturing firms face the standard trade-off between the fixed cost-advantage and the lower variable profit associated with indirect entry in the export market (e.g. Raff and Schmitt, 2009; Ahn et al., 2011; Felbermayr and Jung, 2011, among others). In modeling the fixed-cost advantage, we stick to the conventional assumption within the trade literature. By contracting one of the (symmetric) intermediaries available on the marketplace, the indirect exporter gains access to the intermediary’s network in the foreign location, thereby saving on the cost of searching and reaching local consumers or customers. While the indirect exporter only pays the residual part of the entry cost (e.g. the product-specific component), the direct exporter faces this fixed cost entirely, i.e. inclusive of the search and distribution costs. The intermediary, in turn, enjoys a standard technology-advantage over any manufacturer, in form of possible economies of scope when handling more products.⁵ As far as variable profits are concerned, their lower level in case of indirect export originates from (inefficient) double marginalization, in a manner similar to Akerman (2018). The intermediary indeed enjoys some market power by getting the exclusive right, from the indirect exporter, to sell a differentiated variety in the foreign market. Along the intermediated export channel, both the indirect manufacturing exporter and the intermediary then apply their own markup sequentially.

A novel feature of our model is that double marginalization operates on top of an endogenous and heterogeneous strategy of pricing-to-market, which is key to deliver theoretical predictions in line with the empirical evidence stemming from our data. In addition to replicate standard productivity sorting in the export mode selection, our model predicts that both the manufacturing exporter and the intermediary adjust their own markup following a RER shock. Among manufacturing firms, the extent of this adjustment is larger for high performance ones, as in Berman et al. (2012), 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. As a result, the overall price adjustment is systematically larger than the one observed along the direct export channel.⁶

The model also delivers clear predictions on the adjustment in the relative number of prod-

to the case where standard linear pricing applies. Using scanner data from a large U.S. retailer, Hong and Li (2017) document instead the lower degree of cost pass-through that characterizes 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.

⁵Assuming lower fixed costs associated to indirect entry is also consistent with the empirical evidence based on survey data, provided by Peng and Ilinitich (2001) and Peng and York (2001), according to which “overall, through export intermediaries, exporters gain access to international markets while not having to incur the upfront costs associated with searching for new markets, negotiating contracts, and monitoring those contracts to ensure performance”. 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. This evidence is supportive of their ability to spread country-specific fixed costs across products and, indirectly, relates to the hypothesis that intermediary firms play an important role in solving the firms’ fixed cost problem.

⁶As detailed in Section 3.4, this result holds regularly, unless assuming unrealistic productivity gaps between direct and indirect exporters.

ucts traded along the two channels. Manufacturing exporters indeed react to variation in real exchange rates not only by modifying their markups, but also revising, for any variety, their previous choices about the entry-exit decision in the foreign market and the export-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 the exchange rate depreciates or appreciates; and (ii) some varieties exported indirectly that newly enter or exit the foreign market, correspondingly. Under mild assumptions on the firm productivity distribution (e.g. under Pareto) a clear-cut result is established, such that the higher the fixed cost for foreign market entry, the larger the second effect compared to the first. Our theory is further validated empirically. We observe that, in the aftermath of a real appreciation, the number of products exported to the partner country that are discontinued from the wholesale sector (the intermediated export channel) is proportionally larger than the number of products dropped by the manufacturing sector (the direct export channel), the higher the measures proxying for the level of entry costs in the destination market. The estimates from this reduced-form equation go again in the direction suggested by our theory.

Note that all these predictions are not specific to a linear demand setting, but to the more general class of models adopting any of the alternative mechanisms surveyed by Berman et al. (2012) in their appendix, all generating pricing-to-market and variable markups. In our own appendix, we show that observationally equivalent predictions can be obtained by applying the double marginalization scheme on a different basic setup, featuring CES preferences and local distribution costs *à la* Corsetti and Dedola (2005).⁷ Moreover, our theory is developed by considering the simplest setup, i.e. a setting with no strategic interaction between intermediaries and indirect exporters. However, all our results can be plausibly reproduced under more sophisticated forms of bargaining between the two parts involved, as long as the export price for the wholesaler does not replicate the one applying in case of direct export.

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 manufacturing firms. Although we do not provide a quantitative assessment of the welfare effects of the existence of export intermediation, the observed differences 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 primarily by direct exporters. Our findings then reinforce the idea that the incidence of intermediated export bears relevant implications for aggregate exports' responsiveness to exogenous shocks.

This paper contributes to various strands of trade literature. First, our results contribute

⁷The resulting model 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. While this alternative setup generates observationally equivalent patterns of exporting strategies, the conditions to be imposed on model parameters for the emergence of well-consolidated patterns in international trade are more convoluted than in the model with linear demand of Melitz and Ottaviano (2008). We therefore use the latter as a baseline model for our analysis, while leaving the other as a variant, reported in Appendix A3.

to the literature on pricing-to-market and, in particular, to the recent line of research that explores how the heterogeneity in firm-level determinants of export prices affect firm-specific PTM strategies. Berman et al. (2012) represents a milestone in this strand of the literature. Chatterjee et al. (2013) extend the analysis of Berman et al. (2012) to the case of multi-product exporters: within each firm, the price response to exchange rate movements is larger for the core products, i.e. for the products for which firm productivity is greater. Caselli et al. (2017) delve further into the adjustment in markups within firms across products. In turn, Amiti et al. (2014) emphasize the role of imported inputs in affecting firms' pricing decision, whereas Bernini and Tomasi (2015) show that pricing-to-market strategies are influenced by the quality of both the imported inputs and the exported product. Finally, Garetto (2016) shows that, when controlling for the impact of firms' market shares on their export pricing decisions, firms operating with less information about their competitors exhibit a lower exchange rate pass-through. Our paper contributes to this literature by providing new evidence on the differential adjustment that takes place along the direct and intermediated export channels, in the aftermath of RER movements.

Second, our paper also contribute to the literature investigating the role of intermediaries in international markets. A well-established body of research has shown that exports through intermediaries increase the number of manufacturing firms reaching foreign markets with their products; and they are often preparatory to a direct involvement of the manufacturer in international trade activities. Furthermore, intermediaries facilitate exports in particular to relatively "difficult-to-access" markets and tend to focus on products that are overall less differentiated. These stylized facts are documented in a series of papers which includes Bernard et al. (2010); Ahn et al. (2011); Bernard et al. (2015); Crozet et al. (2013); Davies and Jeppesen (2015) and Grazzi and Tomasi (2016), among others.

The paper is organized as follows. In Section 2 we briefly describe our data and we show that Italian exporters' behavior conforms with consolidated patterns in trade literature when considering manufacturing firms only; whereas a more puzzling evidence arises if comparing direct versus intermediated exports. In Section 3 we propose a simple model that accommodates our findings and we derive additional predictions. Further empirical validation is provided in Section 4, while Section 5 concludes.

2. Heterogeneity in pricing-to-market

This section aims at validating previous findings on the heterogeneity in pricing-to-market strategies across manufacturing firms and providing novel empirical results on the difference between direct exporters and intermediaries. We first describe the data; then, we test whether the evidence provided by Berman et al. (2012) on the heterogeneous response of manufacturing exporters to real exchange rate movements holds also within the Italian context. New findings are then presented on the differences between direct exporters and intermediaries in their export price elasticity to RER shocks, along with a battery of robustness checks. We conclude the section by discussing the underlying mechanisms that could be at work behind our result.

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*

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.

(ASIA).⁸ COE contains all cross-border transactions (both exports and imports) of Italian firms over the period 2000-2007. For all export flows, defined at the firm-product-destination level, we observe both annual values (in euro) and quantities (in kilograms).⁹ 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_{fcp}) 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, derived from 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 largest share (85%) of Italian

⁸The 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.

⁹ISTAT collects data on trade based on transactions. The European Union sets a common framework of rules but leaves some flexibility to member states. Although only annual values which exceeds 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 Italian trade flows (<http://www.coeweb.istat.it/default.htm>).

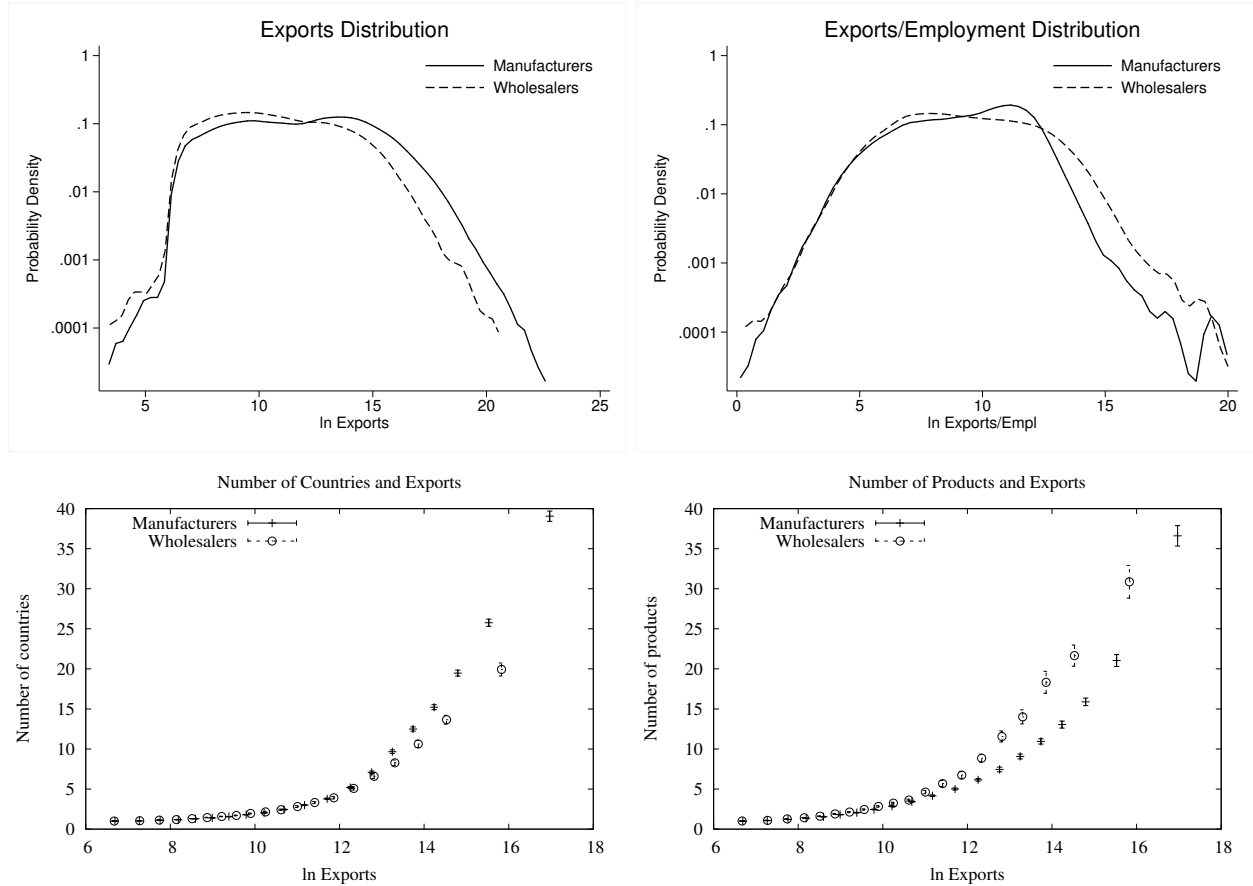


Figure 1: Top Panel: Empirical density of firm exports (left) and exports per employee (right) in 2006. Bottom Panel: Number of countries (left) and number of products (right) vs. export values in 2006.

Source: Our elaboration on Italian micro-data.

aggregate exports; wholesalers accounted approximately 10%; the share of retail firms was less than 1%, with other firms accounted for the remaining 4%. The share of exports generated by intermediaries was slightly but constantly growing from 9.85% in 2000 to 11.27% in 2007. In 2000, the intermediaries' export share of 10% was originating from 26% of Italian exporters classified as wholesalers, whereas the manufacturers' export share of 85% from 57% of Italian exporters recorded as manufacturing firms.

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. 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., CPI_t/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. 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 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. is one of the most important non-Euro destination for the Italian exporters), the 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 exporters to real exchange rate movements holds also for the case of Italian firms. To study how firm productivity affects the price response of exporters, we replicate their analysis. We link the firm-level trade data to Micro.3, a dataset containing balance sheet information on Italian firms with more than 20 employees, available for the period 2000-2006.¹⁰ We measure exporters' productivity by means of the total factor productivity (TFP), computed applying 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 firms' 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 multi-product firms, so as to properly capture heterogeneous pricing-to-market and isolate possible changes in average prices originating from 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, yet the latter is 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*).

The estimated equation is then

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

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

¹¹To properly measure firms' productivity, one would ideally need to observe the quantity of output produced by a firm. Because this information is not reported in balance sheet data, to partially solve this problem the empirical literature has used deflated sales (or value added) as a proxy for firm production, assuming that goods produced by firms in a given industry are homogeneous.

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

Dep.var.	ln UV_{fct}					
	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*** (0.012)	-0.041*** (0.011)	-0.030** (0.015)	-0.050*** (0.012)	-0.037*** (0.011)	-0.027* (0.015)
$\times \ln \varphi_{t-1}$	-0.003** (0.001)	-0.003** (0.001)	-0.003* (0.001)	-0.003* (0.002)	-0.003* (0.002)	-0.003* (0.002)
ln φ_{t-1}	0.017*** (0.004)	0.019*** (0.005)	0.010 (0.008)	0.014*** (0.005)	0.016*** (0.005)	0.008 (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 the 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.

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, $\ln \varphi_{t-1}$ 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 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 the heterogeneity in pricing-to-market, that is, the reaction of firms with different level of productivity to exchange rate variation. We expect a negative sign on both β_1 and β_2 : following a real appreciation (a rise in the RER), manufacturing firms undercut their export price so as to lower the overall pass-through, the more so the higher their performance.

Columns 1-3 of Table 2 report the results for the three samples using TFP as a measure of firms' productivity, while columns 4-6 show the coefficients using labour productivity. The estimates of the different specifications are fully coherent with the findings of Berman et al. (2012) on French direct exports. 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 exporters classified as manufacturers perfectly conforms to the pattern revealed 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.

¹²Note that exchange rates are defined here as the price of the foreign currency, in units of the domestic currency. A depreciation corresponds to a decrease in the exchange rate. The coefficients have therefore the opposite sign with respect to those reported in Berman et al. (2012).

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 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 stylized fact and considering the evidence from Table 2 (according to which more productive firms have more margin to adjust their markups), we would therefore expect direct manufacturing exporters to react more to exchange rate movements than intermediaries, which typically sell abroad goods produced by manufacturing firms 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

$$\Delta \ln UV_{fcpt} = \beta_0 + \beta_1 D_f^W + \beta_2 \Delta \ln RER_{ct} + \beta_3 \Delta \ln RER_{ct} \times D_f^W + \gamma_t + \gamma_h + \nu_{fcpt} , \quad (2)$$

where $\Delta \ln UV_{fcpt}$ is annual difference, between year $t - 1$ and t , in the (log) unit value of product p sold to country c by individual 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) that capture those elements that are common to all exporters, such as shocks to marginal costs. The annual 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 real exchange rate shock is given by the coefficient β_2 in equation (2). The closer $|\beta_2|$ is to 1, the greater the adjustment of export prices aimed at mitigating ERPT into consumer prices. The coefficient of interest, β_3 , captures 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 the 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 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, to capture the time-invariant part of those characteristics which might affect pricing strategies of exporting firms and 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

¹³Note that potential endogeneity in the price elasticity to exchange rate fluctuations 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.

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

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

Dep. Var.	$\Delta \ln UV_{fcpt}$					
	(1)	(2)	(3)	(4)	(5)	(6)
D_f^W	-0.002 (0.001)	-0.002 (0.001)				
$\Delta \ln RER_{ct}$	-0.032*** (0.011)	-0.032** (0.012)	-0.029*** (0.009)	-0.029** (0.011)	-0.030** (0.013)	-0.030* (0.015)
$\times D_f^W$	-0.022** (0.011)	-0.022** (0.010)	-0.031** (0.013)	-0.031** (0.013)	-0.041** (0.018)	-0.041** (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.

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) allowing for unobserved errors to be correlated over time and across firms within a destination; in this way, we take into account the potential presence of serial correlation. The results show a negative coefficient on both β_2 and β_3 . For manufacturing firms, the average elasticity of export prices to exchange rate variation, captured by β_2 , is estimated to be approximately -0.3: following a 10% real appreciation, direct exporters, on average, undercut their export price (in Euro) by 0.3%. This estimate is in line with the value observed for the French manufacturing exporters by Berman et al. (2012) and for the Belgian ones by Amiti et al. (2014). More importantly, the negative estimated 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 wholesalers indeed raises to approximately -0.055, implying a 60% increase in the extent of the price adjustment with respect 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 that determine heterogeneous pricing-to-market strategies. In addition, more differentiated products are often exported directly, while more commodity-type products are more frequently shipped 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 finding, we consider an alternative specification, where both firm-product (γ_{fp}) and country (γ_c) fixed effects are included. This allows us to control for the time-invariant component of these 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. Our main results remain, to a large extent, valid also in this case, as the export price elasticity to RER movements is still higher for wholesalers, than for manufacturers. When accounting for firm-product-destination fixed effects, the export prices elasticity for wholesalers gets 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, which prevents us from establishing a match between the price adjustment 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) lower 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 between the two 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. As a first set of robustness checks, 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

$$\begin{aligned} \Delta \ln UV_{fcpt} = & \beta_0 + \beta_1 D_f^W + \beta_2 \Delta \ln RER_{ct} + \beta_3 \Delta \ln RER_{ct} \times D_f^W + \\ & + \beta_4 Z + \beta_5 \Delta \ln RER_{ct} \times Z + \gamma_t + \gamma_{fp} + \gamma_c + \nu_{fcpt} , \end{aligned} \quad (3)$$

where Z may be, alternatively, a firm-time variant, a country or a product-level characteristic, while $\Delta \ln RER_{ct} \times Z$ 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.

Table 4: Heterogeneous pricing-to-market 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** (0.017)	-0.026** (0.016)	-0.044*** (0.012)	-0.026** (0.014)	-0.012 (0.013)	-0.188*** (0.040)	-0.029*** (0.009)	-0.028** (0.010)
$\times D_f^W$	-0.030** (0.013)	-0.020** (0.010)	-0.040*** (0.014)	-0.048*** (0.014)	-0.033** (0.013)	-0.042*** (0.013)	-0.035** (0.013)	-0.034** (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) W 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.

First, our result on the higher price elasticity for wholesalers could be driven by their higher propensity to shift their export sales to other countries or other products in response to RER movements, with clear implications in terms 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, such variable may then take different values across countries). The idea is that the larger is the number of countries or product-country combinations to which a firm is exporting, the higher the likelihood that these shifts actually occur in response to a RER movement. The results of these two exercises are reported in columns 1 and 2 of Table 4, respectively. 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

Second, an alternative possible explanation for our result 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 indirect exporters resorting to any intermediary firm. Wholesalers, in particular, can potentially ship varieties from different producers, and most likely they do so. Because we do not have information on indirect exporters, we can not rule out the possibility that, following a RER shock, wholesalers modify the varieties handled within each product category that is 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 market 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 grasp the intuition, consider the case of a RER appreciation, such that firms that used to be direct exporters may find out that their productivity level is no longer compatible with direct exporting; and they consequently decide to rely on intermediaries to continue reaching foreign destinations. Because of productivity sorting, these “switching” firms (that convert from direct to indirect exports) necessarily correspond to marginal direct exporters, i.e., firms featuring lower productivity levels than those that keep exporting directly even in the aftermath of the RER shock. As a result, the products that newly enter the export mix of wholesale firms will feature (i) 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 versus indirect ones; 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.

Third, 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

¹⁵In 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.

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

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

that the different response in terms of unit values between direct exporters and wholesalers is potentially 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 result: the coefficient of the dummy for wholesalers interacted with the RER remains negative and statistically significant, confirming 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, i.e. a further confirmation of the findings of Berman et al. (2012) given the well-known relationship between firm size and productivity. A similar robustness check is provided in column 5, where firm size is reflected in the firm's market share at destination ($Market\ Share_{fpct-1}$), defined 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 the empirical findings in previous works (e.g. Amiti et al. 2014), the negative and highly significant coefficient β_5 confirms that firms with higher market shares adjust more the export price of their products following exchange rate variation.

Fourth, previous empirical studies have also shown that export 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 featuring high entry costs and typically focus on products with lower contract intensity and higher level of sunk costs. This is because they are able to overcome barriers to international trade at a lower cost than manufacturing firms, having 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 variable D_f^W reducing to a 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 rise 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*, which corresponds 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 larger fixed costs, the export price elasticity to RER movements is higher when the exporter is a wholesaler.

As a second set of exercises, we further check the robustness of our results within alternative sub-samples of our dataset, dealing with the coverage of the products exported. First, we address the issue of multi-product manufacturing firms, whose productivity may vary with the

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

goods that they produce and export (Mayer et al., 2014, 2016). For these firms, the adjustment to exchange rate movements can be heterogeneous across products, with a price response more pronounced for products close to the firm’s core competency, i.e. those with 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 (for which they have highest productivity/quality) while indirectly exporting the marginal ones (those with lower productivity/quality). To take into account this aspect, 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 by excluding those products with a marginal position, for which a lower price response to RER shocks is expected. The results in column 7 of Table 4 show that the negative coefficient for the interaction between the RER and the dummy for wholesaler is preserved, even in this case.

Second, 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. In the lack of any 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 activities. However, our findings appear robust to this check.¹⁹

2.5. Deciphering the mechanism

Overall our results show a negative coefficient on both β_2 and β_3 , implying that intermediaries are more sensitive to exchange rate movements. This finding makes it clear that the entry mode in the export market does actually matter for the extent of the firm-level price adjustment that follows a RER shock, a result that might 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 primarily by direct exporters. More generally, according to recent contributions in the literature on firms in international trade, 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).

Yet, our finding is hard to rationalize if one thinks of the evidence from Section 2.2 (i.e., more productive firms absorbing more of the RER variation in their markups) combined with productivity sorting in the export mode selection (i.e., more productive firms export directly, whereas less productive ones resort to intermediaries). 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 in support of productivity sorting, even for the case of Italy.²⁰

¹⁹An additional robustness check, available upon request, considers possible asymmetric effects when disentangling between episodes of appreciation and depreciation. Results confirm that our findings are not affected by the direction of RER movements.

²⁰Findings consistent with a form of productivity sorting among Italian firms can be found in Razzolini

This challenge us to find a proper theoretical explanation for this new fact, most likely related to some peculiar feature of the price-setting mechanism that applies along the intermediated export channel, that substantially amplifies the margin of price adjustment for goods exported by wholesalers as compared to direct exports.

3. An integrated theory of direct vs. indirect trade

This section presents a simple partial equilibrium model that integrates two different export modes for manufacturing firms, direct and indirect, and the presence of intermediaries in international trade. In setting up a theory consistent with the new facts empirically documented in Section 2, we build on the appendix of Berman et al. (2012), where three alternative settings are proposed, all featuring heterogeneous markups and pricing-to-market, in line with the evidence stemming from their French data. As Italian trade data replicate such findings, a natural starting point is the adoption of one of these setups, that we further enrich so as to explain the higher export price elasticity to exchange rate movements detected for intermediaries over direct manufacturing exporters. For sake of simplicity, we consider here the basic setup where heterogeneous pricing-to-market is the endogenous outcome of a linear demand system, while we refer to Appendix A3 for the alternative model based on a different mechanism, featuring CES utility and local distribution costs.²¹

3.1. Basic setup with direct export only

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 *à la* Melitz and Ottaviano (2008), such that the demand of a domestic variety in the foreign country is

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

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 as compared to 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.

²¹Since our baseline model and the alternative one in the appendix are shown to deliver observationally equivalent predictions as regard to the different ERPT of intermediated and direct exports, we do not propose here a further alternative, surveyed by Berman et al. (2012) and consisting in the Cournot oligopoly model of Atkeson and Burstein (2008), where imperfect competition induces lower demand elasticity for firms with larger market shares.

²²Given the bilateral nature of exchange rates and our interest in shedding light on how firms react to aggregate shocks in this variable, we propose here a simplified setting with two countries only, to focus on the basic functioning of the firm-level adjustment. In so doing, we abstract away from more convoluted strategies of response (not necessarily available to all firms), involving shifting products across destinations or exploiting strategic complementarity 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.

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 global 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

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 $1/\varphi_i$ as 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 optimally pricing at

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

whenever exporting to *Foreign*. 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 among foreign consumers located in different regions, when considering a natural multi-country extension of our model). *Home* and *Foreign* are indeed not restricted to be symmetric, which together with the presence of iceberg costs induces a different markup that applies to foreign and domestic sales.²⁵

So far, our model replicates the one outlined in Berman et al. (2012), with the export-sales markup in equation (4), namely μ_i^* , that is increasing with firm productivity and with the size of the foreign market ($a - dQ^*$), while decreasing with the nominal exchange rate (denoted above as $e = \varepsilon w^*$) and the level of iceberg trade costs. Note, however, that equation (4) only applies to direct export sales to *Foreign*, while a different pricing scheme is used in the case of intermediated exports, as shown in the aftermath.

²³More 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 the distribution of consumption levels across varieties, the extent of differentiation being larger.

²⁴Following 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 indices, as this 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. The two variables (relative wages and relative consumer prices) are, however, notoriously highly correlated. A robustness check for our empirical findings has been carried out by using a wholesale price index to construct the RER. The results, available upon request, confirm the evidence documented in Section 2; yet, the use of this alternative price index substantially reduces the number of countries in our sample.

²⁵Further details on firms' price discrimination between *Home* and *Foreign* are given in Appendix A1.

Before introducing the export intermediation technology to differentiate our model from the existing ones, 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 paper-works 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

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

Conditional on 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 (as $\varphi_i > \varphi_D$), only those with productivity greater than φ_X will also entry the foreign market, whereas all other firms with $\varphi_i \in [\varphi_D, \varphi_X]$ will not. This self-selection mechanism corresponds to the familiar productivity sorting pattern characterizing a large class of quantitative models of trade, inspired by Melitz (2003). Nonetheless, the cut-off in (5) turns idle as export intermediation is allowed, as 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 in the next sections.

3.2. Intermediated export

We now depart from Berman et al. (2012) by introducing the intermediary sector, populated by homogeneous firms that do not engage in any production activity but simply operate as wholesalers, i.e. they buy products that manufacturing firms do not find it profitable to 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 the sake of simplicity, we consider here the simplest scenario with no strategic interaction between manufacturers and wholesalers. Hence, both the decisions on entry/exit in the foreign market and the entry mode to use rest entirely upon the firm producing each variety, with the intermediary that comes into play only once this second decision has been taken.²⁶

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 follows pricing as reported

²⁶Because of our assumptions, the equilibrium in the intermediation sector simply reflects the outcome of all individual choices made by manufacturing firms. We sketch in Appendix A1 both the firm and market equilibrium conditions for trade intermediaries, building on Akerman (2018), to which we refer for more details.

in 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 the 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 foreign distribution network, implying that the fixed cost of foreign market entry, namely f_X , is split as follows. A fraction of this burden, namely $(1 - \lambda)f_X$, representing the cost of setting up a distribution channel into *Foreign*, is relieved from the responsibility of the producer. The remaining part, corresponding to λf_X and relating to bureaucracy and non-tariff barriers, is still borne by the manufacturer.

This implies that, by exporting indirectly, manufacturing firm faces a fixed cost $f_{X^{ind}} = \lambda f_X$, where $\lambda \in (0, 1)$ provides a measure for the canonical fixed-cost advantage of an *indirect* exporter over a *direct* one.²⁷ Since $f_{X^{ind}} < f_X$, our setting rests with the standard manufacturers' 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 foreign market. This allows the former to impose its own markup over the procurement price, which creates a gap between the price that applies in case of direct export sales, given in equation (4), and the (higher) one applying for the same variety in case of indirect export. As a result of inefficient double marginalization, quantities sold abroad are lower in this second case.

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) that 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 variety j 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 then prices at

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

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 profits from indirect export sales, which evaluate to $\pi^{**} = (\rho_{jW} - 1/\varphi_j) \tau q_j^{**}$. The profit-maximizing price for indirect exporter j is then

²⁷The presence of a residual fixed cost sunk by the indirect exporter creates room for a set of non-traded goods, in a way consistent with observational evidence from basically any country in the world: in the absence of any fixed cost of indirect export, all tradeable varieties supplied at *Home* would in fact be shipped also to *Foreign*. Furthermore, 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 also involve a sort of no-competition clause on the domestic market, so that the producer's monopolistically competitive rent at *Home* is preserved.

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

which requires a markup μ_{jW} to be imposed over the marginal cost of production, when procuring each unit of the differentiated variety to the intermediary.

For any product j exported by a wholesaler, the price at the dock is then the result of a double marginalization, as it is easily proved by combining equations (6) and (7) so as to derive the *unconditional* optimal export price along the intermediated export channel,

$$\begin{aligned} p_j^{**}(\varphi_j) &= \underbrace{\frac{1}{2} \left[1 + \frac{1}{\underbrace{\Phi \cdot \frac{1}{2} \left(1 + \frac{\varphi_j}{\Phi} \right) \cdot \frac{1}{\varphi_j}}_{=p_{jW}}} \right]}_{\equiv \mu^W} \cdot \underbrace{\frac{1}{2} \left(1 + \frac{\varphi_j}{\Phi} \right) \cdot \frac{1}{\varphi_j} \cdot \tau}_{\substack{\equiv \mu_{jW} \\ =p_{jW}}} = \\ &= \underbrace{\frac{1}{4} \left(\frac{\Phi + 3\varphi_j}{\Phi} \right)}_{\equiv \mu_j^{**}} \cdot \frac{\tau}{\varphi_j}. \end{aligned} \quad (8)$$

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

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

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 is clearly increasing in 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.²⁸ This implies that the overall markup μ_j^{**} is increasing in the indirect exporter's productivity.

A series of theoretical results then 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

²⁸Higher productivity φ_j leads to a higher indirect exporter's markup μ_{jW} , hence to 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, so that the intermediary's markup μ^W turns out to be overall increasing with φ_j .

is because of two elements. First, due to iceberg trade costs, for each variety the intermediary source more units than those sold into *Foreign*. The indirect exporter obtains instead a revenue for any unit produced of its variety, then sold to the intermediary. Alternative formulations (where iceberg costs reduce the revenue of the indirect exporter) would not affect the key-predictions of our model, anyhow. Second, and most importantly, $\mu_{jW} = \mu_j^*$ is an implication of linear demand *à la* Melitz and Ottaviano (2008), as a different result would come up under the same assumption on iceberg trade costs, but different mechanisms for generating heterogeneous pricing-to-market (see Appendix A3, where we consider a variant of our model, with CES utility and local distribution costs).

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 μ_j^* , i.e. the markup that would be imposed if the same variety were exported directly. It follows that, in our model, the export price of a given variety is inevitably differentiated across export modes.

Before proceeding with the rest of the analysis, let us further ponder the hypothesis of double marginalization. A well-known result in the literature of industrial organization is that firms engaged in a vertical relationship might seek to get rid of the inefficiency typically associated with 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 intermediaries and indirect exporters. This, in turn, 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) thus appears as a plausible feature for many of the transactions taking place over the intermediated export channel.²⁹

3.3. Export mode selection

Exporting indirectly entails a trade-off between the penalty of double marginalization and the advantage of saving on fixed export costs. To reproduce the well-known sorting pattern (according to which producers self-select according to their productivity as non-exporter, indirect exporter or direct exporter), we impose an upper bound on the fixed-cost advantage of indirect export, in the form of $\lambda < \bar{\lambda}$. In the model with linear demand, this upper bound is $\bar{\lambda} = 1/2$, 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 $\lambda < \bar{\lambda} = 1/2$, the cut-off for direct entry in the export market,

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

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

²⁹Some 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.

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

Hence, the most productive firms ($\varphi_i > \varphi_{X^{dir}}$) export by their own; firms with intermediate levels of productivity ($\varphi_i \in [\varphi_{X^{ind}}, \varphi_{X^{dir}}]$) resort to intermediaries; finally, the least productive firms ($\varphi_i < \varphi_{X^{ind}}$) serve the domestic market only.³⁰

To proceed further with the analysis, 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.³¹ Moreover, for trade to occur, f_X must be bounded from above, implying that both $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ are strictly positive (see Appendix A2).

According to equations (9) and (10), both export cut-offs are increasing with the level of entry costs in the export market, f_X . The more costly (and difficult) 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 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}). As shown in Appendix A2, the ratio between these two measures,

$$\frac{N^{ind}}{N^{tot}} = 1 - \left(\frac{\varphi_{X^{ind}}}{\varphi_{X^{dir}}} \right)^\theta , \quad (11)$$

is indeed strictly increasing with f_X . While a direct empirical validation of this result is reported in Appendix B1, indirect evidence stems from the findings of Bernard et al. (2015): the incidence of wholesale exports in a given location tends to be higher, the higher the level of trade barriers incurred in that country. Note, however, that we look here at the measure of varieties exported, rather than at the value of the corresponding export transactions.

3.4. Export price elasticities across export modes

The different pricing structure characterizing the two export channels bears relevant implications on the firm-level adjustment in the event of external shocks, such as RER movements. In this regard, we put forth a set of predictions, derived from equations (4), (7) and (8), that

³⁰This sorting model is very popular in trade literature; nonetheless, we report a derivation of this result in Appendix A1, for the purpose of showing how the conditions to be imposed here for the emergence of this pattern have similar implications to those required in simpler models with constant Dixit-Stiglitz markups.

³¹In the literature on heterogeneous firms and monopolistic competition inspired by Melitz (2003), assuming CES 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 seems to be more in favor of a log-normal distribution (Head et al., 2014; and Eaton et al., 2011). However, the Pareto matches 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, a recent work of Mrázová et al. (2015) shows that, to explain sales and markup distributions, the assumptions about the structure of the demand function are far more relevant than the choice between a Pareto and a log-normal distribution for firm productivity. For all these reasons, the class of monotonically decreasing distributions, hence including Pareto, appears appropriate.

specifically refer to the different RER elasticity of export prices for direct and intermediated exports and, most importantly, perfectly fit with the empirical evidence reported 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

$$E_{p_i^*; \varepsilon} = -\frac{\varphi_i}{\varphi_i + \Phi} \in (-1, 0), \quad (12)$$

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

$$E_{p_j^{**}; \varepsilon} = -\frac{3\varphi_j}{3\varphi_j + \Phi} \in (-1, 0). \quad (13)$$

Both elasticities take value in the interval $(-1, 0)$: whatever the export mode is, the price of exported varieties react to real exchange rate variation, implying incomplete pass-through into consumer prices along any of the two channels. Moreover, again independently of the export mode that is used for each variety, the RER elasticity of export prices is increasing with the manufacturer's productivity, implying larger adjustment (and lower ERPT) for goods produced by more efficient firms. This paves the way for our first Proposition, that largely conforms with both the findings of Berman et al. (2012) and the similar evidence obtained from our data, reported in Table 2.

Proposition 1. *For both varieties exported directly and indirectly, a price adjustment takes place in response to real 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 will decrease (increase), whatever the mode of export is. Within each export channel, the extent of the price adjustment increases with the productivity of the manufacturing firm producing the exported variety.*

Note that the extent of the adjustment is also increasing with the size of the foreign market, while decreasing with the level of iceberg trade costs (recall $\Phi \equiv w^* \varepsilon \tau / (a - dQ^*)$).

We delve further into the price response to RER shocks for intermediated exports. According to our theory, this response originates 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 transfer 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 global price response observed for variety j , we calculate the RER elasticity of these two markups, respectively,

$$E_{\mu_{jW}; \varepsilon} = -\frac{\varphi_j}{\varphi_j + \Phi} \in (-1, 0) ; \text{ and} \quad (14)$$

$$E_{\mu^W; \varepsilon} = -\frac{2\Phi \varphi_j}{(\Phi + \varphi_j)(\Phi + 3\varphi_j)} \in (-1, 0) . \quad (15)$$

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 adjustment to a RER

shock is borne by the indirect exporter.³²

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, hence featuring the price elasticity in (12); and j exported indirectly, so that the corresponding elasticity is the one in (13). 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 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 (12) and (13), we observe that

$$|E_{p_{jk}^*, \varepsilon}| > |E_{p_i^*, \varepsilon}| \quad \text{for all } \varphi_j \in \left(\frac{1}{3} \varphi_i, \varphi_i \right), \quad (16)$$

that is, if the productivity gap between the indirect and the 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. This implies relatively lower exchange rate pass-through (ERPT) for intermediated exports.*

The result laid down in Proposition 2 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 (16) is large enough that, also in light of the restrictions required by productivity sorting, it would be hard to envisage the case, in the reality, where the sign of inequality in (16) is reversed. Needless to say, Proposition 2 provides a theoretical background for the new 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, it is worth mentioning that our model is able to generate a higher markup responsiveness of intermediaries’ exports also when other sources of exogenous shock are considered. In Appendix A4, 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 cases of direct and intermediated exports. 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.

3.5. Adjustment at the product extensive margin across export modes

Our model is not limited to accommodate the evidence available on the larger export price elasticity of intermediated exports, but also allows us to investigate an additional margin of

³²Unfortunately, also this prediction of our model cannot be tested empirically, in the lack of any information about procurement prices in our data. We then leave this exercise to further work.

firm adjustment to RER shocks. We focus here on the adjustment that any manufacturer puts in place with respect to the choice of whether serving the foreign market and, if so, whether doing this directly or indirectly. In this regard, the model delivers clear predictions which can be indirectly tested on our data at a more aggregate level. This gives us the chance to further validate our theory.

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. Furthermore, the RER elasticity of both $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ is increasing with the level of a country fixed cost, namely f_X (see Appendix A2). Hence, the more difficult is accessing the foreign market, the larger the measure of varieties that, following a real appreciation, will switch from being exported directly to being exported indirectly; and from being exported indirectly to exiting the foreign market.³³

There is a caveat, though. Given $\lambda < \bar{\lambda} = 1/2$ (the assumption introduced in Section 3.3 for observing productivity sorting), $\varphi_{X^{dir}}$ turns out to be more elastic to RER movements than $\varphi_{X^{ind}}$. In the event of a real appreciation, we therefore expect the cut-off for direct entry into *Foreign* to shift by more than the cut-off for indirect entry. Even more so, this should be observed when f_X is large, since higher fixed costs tend to amplify the RER elasticity of both cut-offs. This fact generates ambiguous implications on the change in the relative number of varieties exported directly and indirectly to *Foreign* that we observe in response to the RER movement. Some predictions in this regard, however, can be derived from the model relying again on the properties of the Pareto distribution, in full analogy with Section 3.3.

To unravel the reasoning, let us assume that a real appreciation occurs, so that domestic products reaching the foreign location are now fewer. We denote with $\varphi'_{X^{ind}}$ and $\varphi'_{X^{dir}}$ the new levels of the export cut-offs in the aftermath of the shock; with Δ^{ind} the overall measure of varieties that switch from being exported indirectly to being supplied in the domestic market only (i.e. exiting the foreign market); and with Δ^{dir} the measure of varieties that switch from being exported directly to being exported indirectly (i.e. changing their mode of export).

When $G(\varphi)$ is Pareto, the ratio between the two measures,

$$\frac{\Delta^{ind}}{\Delta^{dir}} = \frac{(\varphi_{X^{ind}})^{-\theta} - (\varphi'_{X^{ind}})^{-\theta}}{(\varphi_{X^{dir}})^{-\theta} - (\varphi'_{X^{dir}})^{-\theta}}, \quad (17)$$

is proved to be strictly increasing with the level of the fixed entry cost f_X .³⁴

³³Following the approach used in most of our closest relatives (e.g. Ahn et al. 2011; Akerman 2018; Chatterjee et al. 2013), our theory abstracts away from any inter-temporal element which might affect 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 cost; or, alternatively, to the presence of long-term contracts of export intermediation. Note that all these elements (the second in particular) can delay a firm's transition from the status of indirect to that of direct exporter, thereby giving rise to some overlap between the productivity distributions of direct and indirect exporters (and of exporters and non-exporters, analogously). Yet, this would not be sufficient to undermine the general validity of the standard model of productivity sorting.

³⁴As already pointed out above (and, at greater detail, in Appendix A2), the same prediction might be obtained under log-normal or other distributions than Pareto, even though restricting the location of both $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ in the domain of the density function over which firm density is strictly decreasing and convex in the level of firm productivity.

The same applies 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 through intermediaries (i.e. entering the foreign market) and Δ^{dir} the measure of varieties that switch from the indirect to the direct export channel (i.e. change the mode of export).

While a more formal argumentation is provided in Appendix A2, we convey here the basic intuition. 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. In the event of 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 that is disproportionately smaller in the class of direct exporters, as their relevant cut-off is the one located more to the right, where firm density is thinner. With f_X is high, this effect dominates the first and opposed one, induced by the larger shift of $\varphi_{X^{dir}}$ with respect to $\varphi_{X^{ind}}$. A final Proposition on the predicted effects of a RER movement is then derived.

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.*

4. Further empirical validation

Armed with this additional prediction of our model, we now go back to our data for a final validation of the theory outlined in Section 3. We test here, in particular, whether Proposition 3 finds empirical support in Italian export data.

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 the foreign market with more than one product category, while in our theoretical setting manufacturers are modelled as single-product firms. To fill this mismatch, we assume that each product exported by a firm to a certain destination (i.e. a firm-product-country combination in our data) corresponds to the differentiated *variety* of 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, as the relevant component of the fixed cost of exporting to a specific destination is the product/variety-specific one.³⁵

Ideally, testing Proposition 3 would require us to observe both the measures Δ^{dir} and Δ^{ind} , as defined in Section 3.5, that is, it would require us 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.

³⁵In principle, neither assuming 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) on their Brazilian customs data.

In the absence of such information, we provide however indirect evidence on this further margin of firm-level adjustment. To do this, 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 .³⁶ In our analysis, the number of manufacturing firms that stop exporting in a given product-country combination proxies for the number of varieties that no longer are exported directly but reach the foreign market through intermediaries (Δ^{dir}), as the model of sorting prescribes. Likewise, the number of wholesalers that leave the export market, relative to a given product and destination, proxies for Δ^{ind} , assuming that indirect manufacturing exporters that were reaching the foreign location through these intermediaries no longer operate internationally.

We therefore estimate the following regression model at the product-country level,

$$\begin{aligned} \ln \#Drop_{wpct} = & \beta_0 + \beta_1 \Delta \ln RER_{ct} + \beta_2 \Delta \ln RER_{ct} \times d_w + \\ & + \beta_3 \Delta \ln RER_{ct} \times \text{Country Fixed Costs}_c + \\ & + \beta_4 \Delta \ln RER_{ct} \times d_w \times \text{Country Fixed Cost}_c + \beta_5 d_w + \\ & + \beta_6 d_w \times \text{Country Fixed Cost}_c + \beta_7 X_{wt-1} + \gamma_t + \gamma_{pc} + \nu_{wpct} , \end{aligned} \quad (18)$$

where $\#Drop_{wpct}$ 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 t . The dummy d_w takes value one for the intermediary category and zero for the manufacturing sector; $\Delta \ln RER_{ct}$ is the change in the (log) 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 mode of export 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, namely $\Delta \ln RER_{ct} \times d_w \times \text{Country Fixed Cost}_c$, so as to capture how the differential response between the two sectors (in terms of number of firms that stop exporting in the aftermath of the RER shock) varies across markets with different level of entry costs.³⁷

The regression 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 environments; and sell products that are more homogeneous and characterized by lower relationship specificity. Furthermore, we add a vector of time-variant controls, denoted as X_{wt-1} , which includes a proxy for product diversification ($\ln NP_{wct-1}$), defined as the log-number of products exported to country c by each category w ; and a proxy for geographic diversification ($\ln NC_{wpt-1}$), defined as the log-number of countries

³⁶To 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 the fact that, both among wholesalers and manufacturers, relatively few firms exit each year, accounting on average for around 5% of the observations.

³⁷As in Section 2.4, *Country Fixed Costs* _{c} is proxied either by *Market Cost* _{c} , from the World Bank Doing Business dataset; or by *Governance Indicator* _{c} , from the World Bank's Governance dataset.

Table 5: Product dropping in the aftermath of exchange rate movements

	ln # Drop _{wpct}					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln RER_{ct}$	0.098*** (0.010)	0.073*** (0.010)	0.036*** (0.007)	0.064*** (0.012)	0.076*** (0.012)	0.067*** (0.007)
$\times d_w$	-0.028* (0.015)	0.006 (0.015)	0.006 (0.010)	-0.041** (0.021)	-0.058*** (0.021)	-0.032*** (0.011)
$\times \text{Market Costs}_c$	0.109*** (0.011)	0.079*** (0.010)	0.015*** (0.003)			
$\times d_w \times \text{Market Costs}_c$	0.082*** (0.017)	0.040** (0.017)	0.010** (0.005)			
$\times \text{Governance Indicator}_c$				0.052*** (0.013)	0.063*** (0.013)	0.045*** (0.005)
$\times d_w \times \text{Governance Indicator}_c$				0.052** (0.022)	0.070*** (0.022)	0.044*** (0.008)
d_w	0.236*** (0.006)	0.281*** (0.005)	0.306*** (0.005)	0.246*** (0.005)	0.229*** (0.006)	0.312*** (0.005)
$d_w \times \text{Market Costs}_c$	0.110*** (0.004)	0.111*** (0.004)	0.084*** (0.003)			
$d_w \times \text{Governance Indicator}_c$				0.135*** (0.004)	0.146*** (0.004)	0.077*** (0.002)
$\ln NP_{wct-1}$	0.274*** (0.003)	0.297*** (0.003)	0.272*** (0.003)	0.286*** (0.003)	0.279*** (0.003)	0.270*** (0.003)
$\ln NC_{wpt-1}$	0.309*** (0.002)	0.308*** (0.002)	0.309*** (0.002)	0.309*** (0.002)	0.310*** (0.002)	0.312*** (0.002)
$\text{Deviation}_{wpct-1}$	0.129*** (0.001)	0.130*** (0.001)	0.129*** (0.001)	0.128*** (0.001)	0.128*** (0.001)	0.127*** (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 and intermediary sector. The dependent variable $\ln \# \text{Drop}_{wpct}$ 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; $\ln NP_{wct-1}$ and $\ln NC_{wpt-1}$ 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.

served with product p by each category w . We finally include $\text{Deviation}_{wpct-1}$, a measure of the relative importance of a category of firms in the exports of a given product to a certain destination. The variable corresponds to the log difference between the total and the average exports in product p to country c .

Estimation results are reported in Table 5. Columns 1 to 3 show the results when using Market Cost_c as a proxy for the country fixed cost of entry, whereas columns 4 to 6 when using $\text{Governance Indicator}_c$. In columns 1-2 and 4-5, Market Cost_c and $\text{Governance Indicator}_c$ are expressed in form of dummy variables, taking value one if the destination country is characterized by 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 for the categories of manufacturers and wholesalers, respectively, when exporting to a country with low fixed costs. On 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. In columns 3 and 6, *Market Costs_c* and *Governance Indicator_c* are finally expressed as continuous variables.

Based on the relative magnitude of the estimated coefficients, we can relate the total effect of the 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 characterized by high entry costs (*Market Costs_c* = 1), a 10% increase in the RER implies 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 variable labelled as *Country Fixed Costs_c*. For both categories of exporters, the adjustment to RER movements is weaker when serving countries characterized by relatively lower fixed costs. Again from column 1, we observe that, when exporting to less “difficult” 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 model, particularly to Proposition 3. All these findings are robust to alternative specifications.³⁸

5. 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, represented by the firms’ 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 provides new empirical findings. Our estimates show that both direct exporters and wholesalers decrease (increase) their export prices in response to real exchange rate (RER) appreciations (depreciations) but price adjustments are higher for intermediaries. The paper proposes a relatively parsimonious model of trade which manages to accommodate this result, in a way consistent with consolidated facts in trade literature, such as productivity sorting in the export mode selection, or the larger extent of markup adjustment for more productive firms. Linear demand is used as a mechanism for generating heterogeneous pricing-to-market. Getting inspired from the literature of industrial organization, the theoretical setting introduces double marginalization as a mechanism for lowering ERPT in the case of exports through intermediaries. Further predictions on the adjustment of the direct and intermediated export channels at their product extensive margin have successfully been tested to assess the overall empirical support for our model.

Taken together, our findings provide micro-foundation for the evidence of Bernard et al.

³⁸Our 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.

(2015), that is, aggregate exports are less responsive to RER shocks, the higher the incidence of intermediated export. Most of all, our 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 (as shown in Appendix A4 for the case of increased import tariffs).

A few relevant questions still remain open for further research. We have assumed here 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 costs 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 for the type of adjustment that firms may adopt in response to exogenous shocks. In so doing, it might be worth accommodating also the new evidence from Lenoir et al. (2018), according to which large firms tend to serve more buyers in foreign markets, yet with numbers that display significant degrees of heterogeneity within a product and destination.

Finally, a deeper comprehension of the exporters' adjustment to external shocks (and perhaps a proper quantification of welfare effects of the existence and size of the export intermediation sector) would require investigating more deeply what sort of relationship is typically established between indirect exporters and trade intermediaries, going beyond the simplifying assumptions of homogeneous wholesale firms and unraveling the strategic interaction between these two categories of firms.³⁹ This would require of course an appropriate set of data, for tracing connections between firms and testing the resulting predictions.

³⁹There are a few studies that specifically address the role of heterogeneity among intermediary firms. For instance, Rauch and Watson (2004) consider a setting in which economic agents are differentiated by the size of their network of contacts abroad and can endogenously decide whether to be intermediaries or producers. In Raff and Schmitt (2006), export intermediaries can instead be of two types, so that manufacturing firms can always choose between exclusive dealing and common agency, their decision depending on the level of trade barriers incurred when shipping goods abroad.

A. Appendix: Theory

A1. The linear demand model

We start this appendix by deriving the standard result according to which firms sort based on productivity in selecting their entry mode in the export market. The framework is the one depicted in Section 3.

For manufacturing firm i , profits from domestic sales amount to $\pi_i = (p_i - 1/\varphi_i) \cdot q(p_i) - f_D$, where the quantity sold is $q(p_i) = [a - dQ - p_i]/b$ with p_i denoting the profit-maximizing price at *Home*, namely $p_i = \mu_i/\varphi_i$ 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 $f_D < \lambda f_X$, i.e. accessing *Home* is cheaper than accessing *Foreign*, irrespectively of the entry mode in the latter.⁴⁰ For firm i , exporting directly is then profitable if $\varphi_i > \varphi_X$, where the latter is the threshold defined in equation (5); while 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 (10). If the fixed-cost advantage of indirect export is sufficiently large (i.e. $\lambda < \bar{\lambda}$, with $\bar{\lambda} = 1/2$ in the case of the linear demand model under consideration), then we obtain $\varphi_{X^{dir}} > \varphi_{X^{ind}}$ and a standard productivity sorting pattern arises:

- the most productive firms ($\varphi_i > \varphi_{X^{dir}}$) prefer to export directly;
- firms with intermediate productivity levels, i.e. $\varphi_i \in (\varphi_{X^{ind}}, \varphi_{X^{dir}})$, export via wholesalers;
- 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 level of productivity required to any firm located in *Home* to afford the cost f_D and start doing business in the domestic market. For this condition to hold, a lower bound 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

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

The above result can be interpreted as follows. When indirect export allows manufacturing firms to save enough on the fixed export cost, then the basket of products exported indirectly (i.e. by wholesale firms) includes both (i) varieties produced by manufacturers that would be able to export directly, even in the absence of an intermediation sector, but find it more profitable to use intermediaries whenever this option is viable; and (ii) varieties produced by firms that, because of a lower marginal productivity, would not be able export by their own. This conforms with predictions and/or empirical observations reported in previous studies, such as Ahn et al. (2011) or Akerman (2018).

⁴⁰Note that f_D , i.e. the cost that a domestic firm pays to enter the home market, is other than the cost (necessarily higher) faced by a firm located in *Foreign* to entry at *Home*. This obviously grants a fixed-cost advantage for domestic firms in their national markets, *vis-à-vis* their foreign competitors.

It is indeed from Akerman (2018) that we take inspiration for modeling the sector of export intermediation, this being the second task accomplished in this section. We assume this sector to be characterized by free entry, and that intermediaries are perfectly homogeneous. They face the same cost of entry in the foreign market, f_X , as any manufacturer, this being the sum of the cost of setting up a local retail channel (λf_X) and other items of expenditure (amounting to $(1-\lambda)f_X$) required to operate into *Foreing*. At odds with manufacturers, however, intermediaries own a technology to export many goods, yet with some form of convexity in their cost function, so as to avoid infinite economies of scope that would lead to one (big) intermediary only present in the market. More in detail, the fixed export cost of an intermediary k is

$$f_X^{W_k} = f_X + \frac{(n^{W_k})^\delta}{\delta}, \quad (19)$$

where n^{W_k} is the measure of varieties handled by this firm (and correspondingly the measure of indirect exporters which intermediary k source from), 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 (by increasing further the heterogeneity of the goods handled) makes operations more complex and therefore costlier. Since wholesale firms are homogeneous and monopolistic competition implies atomistic manufacturing firms, the scope of each wholesaler is easily proved to be

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

where N^W and N^M are the number of wholesale and manufacturing firms on the marketplace, respectively; while $G(\varphi)$ is the productivity distribution across 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, if multiplied by N^M , give us the mass of manufacturers self-selecting as indirect exporters.

A zero profit condition applies,

$$f_X^{W_k} = n^{W_k} \pi_j^{W_k},$$

where $\pi_j^{W_k} = (p_j^{**} - p_{jW}\tau) \cdot q^*(p_j^{**})$ 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 instead determined by the following condition,

$$\frac{\partial}{\partial n^{W_k}}(f_X^{W_k}) = \frac{\partial}{\partial n^{W_k}}(n^{W_k} \pi_j^{W_k}).$$

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, since $\pi_j^{W_k} = (n^{W_k})^{\delta-1}$.

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 productivity distribution observed in *Home*. We refer the reader to Akerman (2018) for the methodology to employ to achieve closed form solutions for the equilibrium, particularly when assuming Pareto.

A2. Adjustment in the number of products per export mode

We provide here a more formal ground for the results in Section 3.5. We first derive the admissible range of values for f_X , i.e. the fixed export cost, such that trade may occur. According to equations (9) and (10), both export cut-offs $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ take positive values if

$$f_X < \min \left\{ \frac{(a - dQ^*)^2}{8bw^*\varepsilon(1 - \lambda)}; \frac{(a - dQ^*)^2}{8bw^*\varepsilon\lambda} \right\},$$

with the minimum corresponding to the first term in brackets for $\lambda < 1/2$; and to the second term otherwise. Note that $\lambda < 1/2$ also implies $\varphi_{X^{dir}} > \varphi_{X^{ind}}$, which perfectly fits with the evidence that more productive firms export by their own. We then set $\bar{\lambda} = 1/2$ as the upper bound for λ , so that $\bar{f}_X = (a - dQ^*)^2/[8b(1 - \lambda)w^*\varepsilon]$ is the upper bound for f_X . Note that:

- for $f_X > (1 - \lambda)\bar{f}_X/\lambda$, exporting is prohibitive, either directly or indirectly; a zero-trade flow is then observed from *Home* to *Foreign*;
- for $f_X \in (\bar{f}_X, (1 - \lambda)\bar{f}_X/\lambda)$, export is viable from *Home* to *Foreign*, but only in form of intermediated export;
- for $f_X < \bar{f}_X$, exports from *Home* to *Foreign* can in principle be conducted either directly or indirectly.

We now invoke the properties of a suitable distribution for $G(\varphi)$, the productivity distribution across all national firms. Let $G(\varphi)$ be Pareto with shape $\theta > 0$. The measure of varieties exported indirectly to *Foreign* is then

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

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

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

The ratio between these measures, given in equation (11), can now be expressed as

$$\frac{N^{ind}}{N^{tot}} = 1 - \left(\frac{c - \xi_1 \sqrt{f_X}}{c - \xi_2 \sqrt{f_X}} \right)^\theta,$$

where $c \equiv a - dQ^*$, while $\xi_1 \equiv 2\sqrt{2bw^*\varepsilon(1 - \lambda)}$ and $\xi_2 \equiv 2\sqrt{2bw^*\varepsilon\lambda}$, with $\xi_1 > \xi_2 > 0$ insofar as $\lambda < \bar{\lambda} = 1/2$.

The ratio N^{ind}/N^{tot} , reported above, is strictly increasing with f_X , at least over the range of the admissible values of this variable (i.e. $f_X < \bar{f}_X$). In words, the more difficult is accessing the foreign market, the higher the proportion of varieties exported indirectly (N^{ind}) over the total measure of varieties reaching *Foreign* (N^{tot}).

We now turn the attention to the predicted effects of a RER shock on the mass of varieties traded along the two export channels. As claimed in Section 3.5, the direct export cut-off $\varphi_{X^{dir}}$ is more sensitive to RER variation than the cut-off for indirect export, $\varphi_{X^{ind}}$. Given $\lambda \in (0, \bar{\lambda})$ and $f_X \in (0, \bar{f}_X)$, the partial elasticity of $\varphi_{X^{dir}}$ with respect to ε ,

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

is larger than the corresponding elasticity of $\varphi_{X^{ind}}$, namely

$$E_{\varphi_{X^{ind}};\varepsilon} = 1 + \frac{\sqrt{2bw^*\varepsilon\lambda f_X}}{a - dQ^* - \sqrt{2bw^*\varepsilon\lambda f_X}} > 0 .$$

Any change in the RER (i.e. ε) thus originates a wider shift of $\varphi_{X^{dir}}$, compared to $\varphi_{X^{ind}}$. Moreover, all restrictions imposed so far imply that both elasticities $E_{\varphi_{X^{dir}};\varepsilon}$ and $E_{\varphi_{X^{ind}};\varepsilon}$ are increasing with f_X . The same percentage change in the RER therefore induces proportionally wider shifts of both export cut-offs in those markets that are more difficult to access (high f_X); and less pronounced shifts in markets more easily accessible (low f_X).

To proceed with the analysis, 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 $\varphi'_{X^{ind}}$, where the new levels of the thresholds are obtained from equations (9) and (10), plugging $\varepsilon' = \gamma\varepsilon$, instead 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. The measure of these “switching” varieties is

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

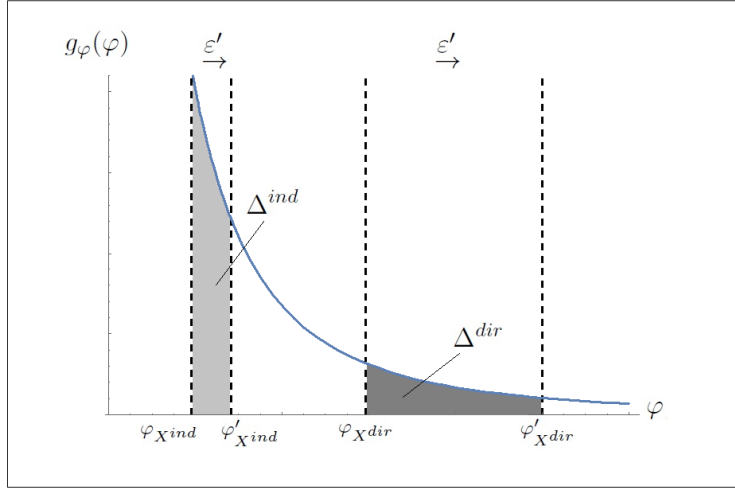
Other varieties will enter (or re-enter) the foreign market in the event of a depreciation; or they will exit in the event of an appreciation. The measure of these “entry/exit” varieties is

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

The two measures above have a graphical representation in Figure A1, where we plot the density of firm productivity and we show the location of the two productivity cut-offs, $\varphi_{X^{ind}}$ 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 $\gamma > 1$).

Both cut-offs are plot for a given level of the fixed cost of foreign market entry, which is arbitrarily set. Since $E_{\varphi_{X^{dir}};\varepsilon} > E_{\varphi_{X^{ind}};\varepsilon}$, the threshold $\varphi_{X^{dir}}$ shifts to a larger extent than $\varphi_{X^{ind}}$. In the figure, the light-grey shaded area corresponds to Δ^{ind} , whereas the dark-grey one to Δ^{dir} . Whether Δ^{ind} is larger or smaller than Δ^{dir} crucially depends on the location of the two export cut-offs along the horizontal axis. Shedding light on this point, analytically, would require specifying the magnitude of the RER movement (parameterized by γ) compared to the level of other variables and model parameters, such as f_X and θ . We can however draw some conclusions on the effects of the RER shocks, without imposing any further assumption.

Figure A1: Effects of a real appreciation



Consider the ratio between Δ^{ind} and Δ^{dir} , as given in equation (17). Under Pareto, this ratio can be reduced to a form of the type

$$\frac{\Delta^{ind}}{\Delta^{dir}} = \frac{-[c_1 - \phi_1 \sqrt{f_X}]^\theta + [c_2 - \phi_2 \sqrt{f_X}]^\theta}{-[c_3 - \phi_3 \sqrt{f_X}]^\theta + [c_4 - \phi_4 \sqrt{f_X}]^\theta},$$

where c_j and ϕ_j (with $j = 1, \dots, 4$) are, respectively, positive constants and positive coefficients collecting all variables and model parameters other than f_X . More precisely, their analytical expressions are the following:

- $c_1 \equiv a - dQ^*$ and $\phi_1 \equiv 2\sqrt{2bw^*\gamma\varepsilon\lambda}$;
- $c_2 \equiv \gamma(a - dQ^*)$ and $\phi_2 \equiv 2\gamma\sqrt{2bw^*\varepsilon\lambda}$;
- $c_3 = c_1$ and $\phi_3 \equiv 2\sqrt{2bw^*\gamma\varepsilon(1-\lambda)}$;
- $c_4 = c_2$ and $\phi_4 \equiv 2\gamma\sqrt{2bw^*\varepsilon(1-\lambda)}$.

As $\lambda < 1/2$, 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 $f_X < \bar{f}_X$, the ratio $\Delta^{dir}/\Delta^{ind}$ turns out to be inversely related to f_X .⁴¹ We come to the same conclusion when considering the case of real depreciation, where $\gamma < 1$ implies both $\phi_1 > \phi_2$ and $\phi_3 > \phi_4$.

Note that the result above, established as Proposition 3 in Section 3.5, does not imply anything as regard to Δ^{dir} to be necessarily larger or smaller than Δ^{ind} at given levels of the entry cost f_X . Neither we have assumed before N^{dir} to be larger or smaller than N^{ind} , conditional on the size of f_X . We thus let empirical evidence shed light on the possible outcomes.

⁴¹For sufficiently small changes in ε (i.e., a value of γ sufficiently close to 1), the relation among coefficients is $\phi_4 > \phi_3 > \phi_2 > \phi_1$ when $\gamma > 1$ (real appreciation) and $\phi_3 > \phi_4 > \phi_1 > \phi_2$ when $\gamma < 1$ (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 $\Delta^{dir}/\Delta^{ind}$ remains strictly increasing with f_X .

It is worth pointing out that $\Delta^{dir}/\Delta^{ind}$ is decreasing with the level of fixed costs of foreign market entry also under productivity distributions other than Pareto, such as the log-normal, for instance. In these cases, however, we should verify first whether the two cut-offs, $\varphi_{X^{ind}}$ 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 .

A3. An alternative model with heterogeneous pricing-to-market

This section proposes a model featuring an alternative source of heterogeneous markups and pricing-to-market, other than a linear demand system *à la* Melitz and Ottaviano (2008). We assume here CES, 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 setting is similar to the one analyzed in Chatterjee et al. (2013), except for 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 framework, 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 $q_i^* = A^*(\tilde{p}_i^*)^{-\sigma}$, where A^* is a demand shifter; $\sigma > 2$ is the elasticity of substitution among varieties; and \tilde{p}_i^* is the consumer price (in the foreign currency) of the variety, which relates to the border price p_i^* set by the exporter (in the home currency) as follows

$$\tilde{p}_i^* = ep_i^* + \eta^* w^* .$$

In the equation above, e is the nominal exchange rate between the two currencies and $\eta^* w^*$ is the distribution cost in terms of the wage rate abroad, w^* .

Pricing. Because of iceberg costs ($\tau \geq 1$), the optimal price for a direct exporter (again denoted by i) is

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

while the export price of a variety produced by indirect exporter j , then sold abroad by some intermediary firm is

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

this being the result of sequential price setting. In the two 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 observe that

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

This 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 the indirect exporter j have at least half of the marginal productivity of the direct exporter i .

The main difference with respect to the baseline model in Section 3 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 evaluates to

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

which differs from μ_i^* , i.e. the markup (reported above) that the same firm would impose on foreign customers/local importers in case of direct export sales. For any admissible parametrization, μ_{jW} is proved to be systematically larger than μ_i^* . Given the structure of the CES demand, the additional markup imposed by the wholesale firm disproportionately reduces the quantity sold in the foreign market, thus also the revenue that the indirect exporter j obtains from the 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, so as to extract more of the surplus of the intermediary. Such effect is not observed in the baseline model with linear demand, as linearity implies that sales reduction induced by (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 source variety j from the indirect exporter, for the purpose of resale into *Foreign*. All the results derived in Section 3 as regard to the pricing of the different categories of exporters are easily proved to be confirmed.

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

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

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

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

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 as in the model with linear demand. First, the export cut-off φ_X that applies in the absence of export intermediaries lies between $\varphi_{X^{ind}}$ and $\varphi_{X^{dir}}$. Accordingly, wholesale firms handle both (i) products that would

not be exported in the lack of 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 measure of products that entry/exit the foreign market following a RER movement (i.e. Δ^{ind}) can be proved to become larger, compared to the measure of products switching from one export mode to the other (i.e. Δ^{dir}), the higher the level of entry costs in the foreign market. Following the same steps reported in Appendix A2, 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 $j = 1, \dots, 4$) 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 a suitable assumption on how firm productivity is distributed (e.g. Pareto, once more), Proposition 3 in Section 3.5 remains valid.

A4. Export price elasticities to trade shocks

In this appendix we assess whether, in our model, 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 to the relative extent of the price adjustment observed along the two export channels.

To this purpose, we refer to the linear demand model outlined in Section 3 and we interpret iceberg trade costs τ as a measure of tariff rates, or tariffs' *ad-valorem* equivalents. Consider again the export prices set by firm i that exports directly; and by the intermediary selling abroad the variety produced by indirect exporter j . The two export prices, namely p_i^* in equation (4) and p_{jk}^* in equation (8), are characterized by a partial elasticity to tariffs that evaluates, respectively, to

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

and

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

Both elasticities are clearly positive, implying that a tariff rise (higher τ) necessarily leads to higher export prices, whatever the entry mode in the export market for the product under consideration. To make a meaningful comparison between the two elasticities above, it must be

⁴²Both elasticities display a positive sign, insofar as both $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$ take positive values. Given $\lambda \in (0, \bar{\lambda})$, this occurs when imposing a cap on the level of fixed export costs, i.e. $f_X < \bar{f}_X = \Psi \eta^* A^* \lambda / [2(1 - \lambda) \varepsilon (\eta^* w^*)^\sigma]$.

recalled that productivity sorting entails firm i being more productive than firm j , i.e. $\varphi_i > \varphi_j$. We then observe that

$$E_{p_{jk}^*; \tau} < E_{p_i^*; \tau} \quad \text{for all } \varphi_j \in \left(\frac{1}{3} \varphi_i, \varphi_i \right),$$

that is, for reasonable productivity gaps between direct and indirect exporters –the same identified in (16)–, the increase in export prices is larger along the direct export channel. Again, through their joint markup adjustment, indirect exporters and intermediary firms overall absorb more of the effects of the shock in their prices, compared to direct exporters.

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 trade shocks.

B. Appendix: Empirics

B1. Relative number of products exported indirectly

This appendix links up with Appendix A2, providing evidence that the ratio between the number of varieties exported indirectly (N^{ind}) and the whole number of varieties exported either directly or indirectly (N^{tot}) tends to increase with country fixed costs. For each destination, we 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,

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

where *Country Fixed Costs_c* stands for *Market Costs_c* and/or *Governance Indicator_c*, i.e. the measures already introduced in Section 2.4. In the vector X_c we include 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 distance (taken from the CEPII dataset) that proxies for variable trade costs related to transportation; a dummy for continents; finally, the average import tariff rate. We also include year (γ_t) and product (γ_p) fixed effects. The results are reported in Table B1. 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 cost of entry in that market.

Table B1: Number of varieties exported by wholesalers over total number of varieties 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.

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