Export intermediaries and adjustments to exchange rate movements *

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Preliminary and incomplete; please do not cite or circulate!

Abstract

Building on a heterogeneous-firm model *à la* Melitz (2003), this paper proposes a relevant theory of intermediaries in international trade, which provides clear micro-foundations for the evidence available on aggregate exports and their responsiveness to exchange rate movements. We introduce double marginalization for goods traded indirectly, i.e. by means of intermediaries, and local distribution costs for all exporting firms, either intermediaries or direct exporters. This leads not only to pricing-to-market and heterogeneous markups, but also to a lower degree of exchange rate pass-through for goods exported by intermediaries, rather than directly. This result is validated on Italian firm-level trade data, and found to be consistent with productivity sorting in the export mode selection; and with the propensity of high productivity firms to absorb more exchange rate movements in their markups. The paper also explores how direct and intermediary export flows to a given destination react to real exchange rate movements along the extensive margin of adjustment. Consistently with our theory, we find evidence of a larger variation in the overall number of varieties traded along the intermediary export channel.

JEL codes: F12, F14, D22. L22.

Keywords: international trade, firms heterogeneity, intermediaries, export entry costs, local distribution costs, heterogeneous markups, product adding and dropping, exchange rate pass-through.

*This paper builds upon the preliminary evidence of a project on intermediaries in international trade (NBER Working Paper No. 17711). We gratefully acknowledge Andrew Bernard who was also involved in that project. The present work has been possible thanks to a research agreement between the Italian Statistical Office (ISTAT) and the Scuola Superiore Sant'Anna. All errors remain our own.

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1 Introduction

A well established body of research has shown that, together with manufacturing firms that directly manage the exchange with their foreign customers, there are firms that do not engage in production activities but simply serve as intermediaries, assisting manufacturing producers in reaching overseas markets. The role of wholesalers in international trade has been investigated both from a theoretical and empirical perspective.[1]

The empirical research has highlighted some key-features of intermediation in trade. First, intermediaries account for a relevant share of activities in international trade.[2] Second, exports through an intermediary increase the number of manufacturing firms that can reach foreign markets with their goods. Moreover, for the indirect manufacturing exporters intermediated trade can be a transition to become direct exporters.[3] Third, manufacturing firms tend to endogenously select their mode of exports -either direct or indirect, i.e. through an intermediary- based on their own productivity. Fourth, intermediaries are relatively more important in markets that are more difficult to penetrate, whereas their incidence declines with both market size and the degree of product differentiation. Fifth, such different characteristics of direct exporters and intermediaries bear relevant consequences on aggregate trade flows. More in detail, aggregate exports to destinations with high shares of intermediary exports are less responsive to changes in the real exchange rates than exports to markets served primarily by direct exporters.

This paper contributes to the existing literature on the role of intermediaries in international trade by bringing new evidence on the reaction of these firms to exchange rate movements, at the micro-level in terms of firms' price and exports elasticity and at the macro level in terms of extensive margins. We propose a theoretical framework that, beyond accommodating and rationalizing most of the stylized facts on intermediaries well established in the literature, it allows to frame our new empirical findings.

We outline a relatively parsimonious model of trade featuring heterogeneous markups and pricing-to-market. A key-feature of our model is that markups also differ by the type of firm (intermediary, indirect manufacturer exporter or direct manufacturer exporter) and this, in turn, leads to a differential response of these types of firms to common external shocks, such as (real) exchange rate movements. At the core of the model there are two set of predictions. First, our theory predicts that exchange rate pass-through not only is incomplete but, most interestingly, is lower for

[1] Among the papers that theoretically address the presence of intermediary firms in international trade, see Rauch and Watson (2004); Raff and Schmitt (2006); Raff and Schmitt (2009); Ahn et al. (2011); Antràs and Costinot (2011);Bai et al. (2016);Akerman (Forthcoming). Empirical analyses are found in Bernard et al. (2010);Ahn et al. (2011); Bernard et al. (2015); Crozet et al. (2013); Grazzi and Tomasi (2016); (Davies and Jeppesen, 2015), among others.

[2] Bernard et al. (2010) report that 35 percent of US exporters are wholesalers, accounting for 10 percent of exports by value. Figures are similar for Italy (Bernard et al., 2015), whereas the shares of intermediaries' exports are larger (respectively, 15 and 20 percent) in Sweden (Akerman, Forthcoming) and France (Crozet et al., 2013). In China around one quarter of the total export value takes place through wholesalers (Ahn et al., 2011).

[3] Using survey data (Grazzi and Tomasi, 2016) show that the possibility to export indirectly increases by more than a quarter the number of firms that can reach foreign markets with their goods. Using data from Ghana, (Ahn et al., 2011) observes that firms using intermediaries have a substantially higher probability of subsequently exporting directly.

products that are sold by intermediaries rather than by direct exporters. Indeed, the exchange rate elasticity of export prices is higher for intermediaries than for direct exporters. Moreover, as a result of the lower degree of exchange rate pass-through that characterizes the wholesalers, exports of intermediaries are less elastic to exchange rate movements as compared to those of direct exporters. Second, in term of extensive margin, the model predicts that the number of varieties exported by intermediaries is more sensitive to exchange rate movements if compared to the number of that traded directly. This is because a change in the domestic currency changes the minimum level of productivity which is required for making exports a profitable activity. However, if the density of firm productivity is monotonically (weakly) decrasing in the level of productivity, when the real exchange rate appreciates the range of varieties dropped by intermediaries exceeds that of direct exporters.

Our theory builds on a standard Melitz's (2003) type of economy with monopolistic competition. As in Corsetti and Dedola (2005), we assume that exporting does not only entail paying a fixed cost of entry in the foreign market and incurring a standard iceberg trade cost, but also entails paying distribution costs in the foreign market that are expressed in the foreign currency. Hence, the price paid by foreign consumers is the sum of two components: the export price set by the producer, inclusive of standard iceberg costs and expressed in the foreign currency, and a local per-unit distribution cost. In the spirit of Akerman (Forthcoming), our model also features double marginalization: intermediaries charge their own markup over the price that they pay for procuring the variety to be sold abroad, this price, in turns, being already inclusive of the producers' markup.

Assuming distribution costs abroad generates pricing-to-market by all type of firms and therefore heterogeneous markups across destination markets, which is key to justify incomplete exchange rate pass-through.[4] However, local distribution costs alone are not enough to motivate the different degree of exchange rate pass-through that characterizes the direct and intermediary export channels. An obvious explanation in this respect is that the higher price adjustment is related to the price setting mechanism in the intermediary channel, that we model as a double marginalization.[5] At odds with manufacturing exporters, intermediaries may spread the fixed cost of export across more than one good, but covering this cost requires them to charge a markup between the procurement price of the goods and what they charge to their foreign customers.[6] In our theoretical setting double marginalization is also what causes productivity sorting in the choice of the export mode. The most productive firms would indeed prefer to incur their own fixed cost of exporting thus avoiding the further increase in price when the transaction is handled by a wholesaler. On the

[4] As shown by Chatterjee et al. (2013), a simple model of intermediation -such as Ahn et al. (2011), for instance- may offer a valid explanation for productivity sorting in the export mode selection, but in the absence of (additive) distribution costs, the exchange rate pass-through is necessarily complete, since markups are neither firm-and-market-specific.

[5] Albeit typically ignored by the literature on intermediation in trade, this assumption is recurrent in the literature of industrial organization, whenever there is a industry organized in form of a supply chain, with (at least) two vertical layers (see Spengler 1950, and the more recent contributions of Janssen and Shelegia 2015 and Gil 2015).

[6] In the eyes of the manufacturing firm, this additional markup represents the main cost of exporting by means of an intermediary, and thus plays an identical role to the per-unit cost to prepare the variety for the foreign market introduced by Ahn et al. (2011). Both these elements generate a trade-off in exporting via intermediary: while the manufacturing firm gets rid of the fixed cost of entry in the foreign market, its sales abroad declines because of the higher price implied by either the additional markup or the *ad-hoc* per-unit cost.

contrary, other producers would accept incurring in double marginalization, as long as their own productivity is not sufficient to gain positive profits once the fixed cost of entry in the foreign market is accounted for.

We test the theoretical predictions of our model using a dataset that collects all cross-border transactions of Italian firms from 2000 to 2007. The same set of data was also employed in Bernard et al. (2015) which however addressed aggregate trade flows of intermediaries and direct exporters. Here instead we focus on the reaction of intermediaries to exchange rate movements in terms of their price and exports and in terms of extensive margin. Consistently with the model our analysis confirms that intermediaries adjust more their export prices to exchange rate movements and therefore they have lower exchange rate pass-through. As a consequence, we observe the elasticity of wholesalers' export sales to exchange rate change is lower than that of direct exporters. As far as the extensive margin is concerned, our evidence suggests that the scope of intermediaries - i.e. the range of varieties that intermediaries sell in a given foreign market - changes in the aftermath of exchange rate movements. Precisely, the number of varieties dropped by intermediaries as a consequence of the appreciation of the real exchange rate is higher than that of direct exporters.

Our paper relates to two strands of the international trade literature. First, our paper is mostly related to the growing literature on intermediated trade. Our paper differentiates from the existing studies, in particular from Akerman (Forthcoming), in at least two main directions. First, we allow for heterogeneous markups, pricing-to-market and incomplete pass-through by introducing a local per-unit distribution cost as in Corsetti and Dedola (2005), Chatterjee et al. (2013) and Bernini and Tomasi (2015). In this way, instead of having the Dixit-Stiglitz markup imposed twice for goods exported through intermediaries, we obtain a more sophisticated configuration in which the markup varies with the firm type. This enables to account for the observed differences in pricing behavior of the various exporting firms, as well as their different response to common external shocks. The second main difference is that we abstract away from assuming an optimal size for intermediaries.[7]

This paper is also related to very recent literature on exporters' heterogeneity and pricing-to-market behavior. The seminal article by Berman et al. (2012) shows that more productive exporters are more capable to reduce the ERPT into the consumer import prices. Amiti et al. (2014) observe that import-intensive exporters have significantly lower exchange rate pass-through. Chatterjee et al. (2013) study the effect of exchange rate shocks on the export behavior of multi-product firms, while Bernini and Tomasi (2015) investigate the heterogeneous response of exporters to real exchange rate fluctuations due to the quality of imported inputs and exported output. Our paper contributes to this literature on the heterogeneous pricing to market strategies of exporters by bringing empirical evidence on the difference between intermediaries and direct exporters in their

[7]In Akerman (Forthcoming), the existence of non-exporting firms in the presence of an intermediary sector is justified by the fact that the fixed cost of the intermediary distribution network is convex and increasing in product scope (the range of exported goods): a more complex product portfolio is more costly to handle. This limit to the economies of scope leads to an optimal scope for wholesalers: given the number of intermediaries available, the least productive manufacturer on the domestic market may find no intermediary firm willing to export its product. In our work, the existence of non-exporting firms is instead granted by assuming a fixed cost that manufacturing firms have to pay to access the intermediary sector. This fixed cost is obviously lower than what required for direct exporting.

response to exchange rate movements.

Interestingly, our findings do not conflict with the key conclusion of Berman et al. (2012), according to which in the aftermath of an exchange rate appreciation, more productive firms decrease producer prices further than less productive firms. Due to productivity sorting in the export mode selection, intermediaries trade goods produced by firms with lower levels of productivity than manufacturing direct exporters; however, the price adjustment is larger in case of goods exported through intermediaries as a result of a double adjustment. The indirect manufacturer exporter adjusts the producer price, although to a lesser extent than a direct exporter. Then, also the intermediary adjusts its own markup over the procurement price that it pays to the indirect exporter. As a result, the overall price adjustment is larger for goods subject to double marginalization, that is those exported via intermediaries.

The paper is organized as follows. Section 2 introduces the model by considering the basic set-up without intermediaries and illustrates the main results for the case of direct export, particularly in terms of pricing. In Section 3 we introduce the presence of intermediaries in international trade and we derive the export price elasticities to exchange rate movements for the two categories of exporters, as well as the extensive margin of adjustment in the number of varieties traded along the two export channels. In Section 4 we describe the data and test the predictions put forth in the theoretical part. Section 5 concludes.

2 The model: the basic set-up without intermediaries

2.1 Preferences, Production, Trade

We consider an economy in which preferences are Cobb-Douglas in the quantities consumed of a homogeneous good O and a non-homogeneous good M, available in many differentiated varieties. We index each of these varieties by $i \in (0, N)$ and we assume that $\sigma > 2$ is the elasticity of substitution among them. Under these assumptions, the demand for variety$i$ is simply $q_i = A \cdot p_i^{-\sigma}$, where p_i is the price of that variety while $A \equiv \mu w L \cdot P^{1-\sigma}$ is a demand shifter which depends on the wage rate w (our numeraire), the labor force L and the CES price-index of the non-homogeneous good, namely P; μ is simply the share of spending in the M sector.

We assume that producing the homogeneous good O requires only labor as an input, and the technology is linear. The good is produced under perfect competition; the unit price is therefore $p_O = w = 1$, while the amount produced is $x_O = L_O$, where L_O is the quantity of labor units employed in this production. In the non-homogeneous good sector, namely M, each firm i produces instead a unique differentiated variety, according to the following production function: $q_i = \varphi_i L_i$, where L_i is the quantity of labor employed by firm i and φ_i is the level of marginal productivity of i, drawn from a generic distribution $G(\varphi)$.

Because of monopolistic competition in sector M, firms charge a constant mark-up over their marginal cost. The profit-maximizing price for domestic sales is the solution of a standard optimization problem, namely $\max \pi_i = p_i \cdot q_i(p_i) - \frac{1}{\varphi} \cdot q_i(p_i) - f_D$, this solution being

$$p_i = \underbrace{\frac{\sigma}{\sigma - 1}}_{\equiv \mu_i} \cdot \frac{1}{\varphi_i} \ . \tag{1}$$

Regardless of productivity heterogeneity, all firms therefore impose the same, usual Dixit-Stigliz markup, namely $\mu_i = \mu \equiv \sigma/(\sigma - 1)$ for any $i \in (0, N)$.

When opening the economy to the rest of world, we consider the existence of local distribution costs in the foreign market, as put forth in Corsetti and Dedola (2005) and Chatterjee et al. (2013). Let international trade be costless in the homogeneous-good sector and costly in the differentiated-good sector. Firm i will charge a price for the products to be exported given by p_i^*, when expressed in the domestic currency. However, due to the presence of transport and distribution costs, the price in the foreign currency actually paid by foreign consumers will be

$$\widetilde{p_i^*} = \tau \varepsilon p_i^* + \eta^* w^* \ ,$$

where τ is a standard iceberg cost, ε is the exchange rate between the two currencies, and $\eta^* w^*$ is the level of distribution costs to be paid in the foreign currency (we express them in terms of the wage rate abroad, denoted as w^*).

Consider now a generic exporting firm i. The profit-maximizing price for its foreign sales, denoted as p_i^*, solves the problem $\max \pi_i^* = p_i^* \cdot q_i^*(\widetilde{p_i^*}) \cdot \tau - \frac{1}{\varphi} \cdot q_i^*(\widetilde{p_i^*}) \cdot \tau$, and turns out to be

$$p_i^* = \underbrace{\frac{\sigma}{\sigma - 1} \left(1 + \frac{\eta^* \varphi_i}{\sigma \tau \epsilon}\right)}_{\equiv \mu_i^*} \cdot \frac{1}{\varphi_i} \ , \tag{2}$$

where $\epsilon \equiv \varepsilon w / w^*$ (with $w = 1$) is the real exchange rate (RER) between the home and the foreign country. As far as markets are segmented due to the presence of local distribution costs, exporting firms engage in price discrimination between the foreign and the national consumer. Given $\eta^* \varphi_i > 0$ and $\sigma \tau \epsilon > 0$, the export-sales markup, denoted as μ_i^*, is indeed larger than μ_i, the Dixit-Stiglitz markup applied on domestic sales. Moreover, μ_i^* also differs across firms, as opposed as μ_i: according to equation (2), the export-sales markup is (i) increasing in a firm's productivity, φ_i, and in the level of local distribution costs, η^*; and (ii) decreasing in the real exchange rate, ϵ, in the level of iceberg trade costs, τ and in the elasticity of substitution, σ.

Notice that, as long as the intermediary sector in not accounted for, our model replicates the framework in Chatterjee et al. (2013) and the export price set by national producers is therefore the same as in their setting. In our model, however, equation (2) only applies to direct export sales; in Section 3, we will show what happens when trade intermediaries are introduced.

2.2 Productivity cut-offs

Firms operating in the non-homogeneous good sector self-select into the foreign market based on the well-known mechanisms described by Melitz (2003). The firm's marginal productivity is drawn from probability distribution $G(\varphi)$, after having sunk f_E units of labor to develop a new variety. Having learned φ_i, each firm 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). Firms simply face a constant Poisson hazard rate of forced exit, denoted as δ.

The critical cut-off level of productivity for entry in the domestic can be proved to be

$$\varphi_D = \frac{1}{\left(\frac{\psi A}{f_D}\right)^{\frac{1}{\sigma-1}}} \quad \text{, where } \psi \equiv \frac{(\sigma-1)^{\sigma-1}}{\sigma^\sigma \delta} \ ,$$

whereas the cut-off level for entry in the foreign market is[8]

$$\varphi'_X = \frac{\tau\varepsilon}{\left(\frac{\psi A^*}{\varepsilon f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} \ .$$

As in Akerman (Forthcoming), we use the notation φ'_X to distinguish the export cut-off in the model without intermediaries from the direct export cut-off, introduced in Section 3.3, that emerges in the presence of a intermediary sector.

When trade intermediaries are ruled out, only firms with a marginal productivity larger than φ'_X will choose to export; firms with productivity between φ_D and φ'_X will serve the domestic market only and firms with productivity lower than φ_D will exit immediately. This sorting pattern corresponds to a well-known result in trade literature, which holds even in a model with local distribution costs, although conditional on imposing the following restriction:

$$f_X > f_D \left[\tau\varepsilon^{\frac{\sigma}{\sigma-1}} + w^*\eta^* \left(\frac{\psi A^*}{\varepsilon f_D}\right)^{-\frac{1}{\sigma-1}}\right]^{1-\sigma} \ . \tag{3}$$

The above condition generalizes the restriction imposed by Akerman (Forthcoming), i.e. $f_X > f_D\tau^{1-\sigma}$.[9]

3 The model with intermediaries

3.1 Pricing to market

We now introduce an intermediary sector, in which firms assisting the non-homogeneous good producers (*manufacturing* producers) in reaching overseas markets have free access. We assume that intermediaries do not engage in any production activity and do not operate in the domestic market, in which manufacturing firms may distribute their products at zero cost.

To gain access to the services of trade intermediation, any producer aimed at reaching the foreign market has to pay a sunk cost $f_J = \lambda f_X$. Hence, $\lambda \in (0, 1)$ is the relative size of the fixed costs associated with the two modes of export that are now available, i.e. the *direct* mode in which

[8] See Appendix A1 for a formal derivation of both the productivity cut-offs.

[9] It can easily be proved that equation (3) generalizes the one imposed by Akerman (Forthcoming): it suffices to consider the case in which distribution costs are zero, as in Akerman (Forthcoming), and therefore the RER plays no role in exporting firms' pricing (the RER is one).

the manufacturing firm itself handles the transaction of the goods abroad and the *indirect* one, in which the producer requires the assistance of an intermediary firm.

Once an intermediary has been contracted by a manufacturer, the former gets the exclusive right to sell abroad the good produced by the latter (*indirect exporter*). With this assumption, we rule out the possibility that a given product i might be exported to a given destination by more than one intermediary. Moreover, as in Akerman (Forthcoming), we assume that indirect exporters are randomly matched with intermediary firms; hence, in equilibrium intermediaries will have, on average, the same productivity distribution among the goods included in their export baskets.

Any intermediary faces the same CES demand faced by manufacturers that export directly. The intermediary firm j pays a price p_{ij} for procuring the good manufactured by producer i and therefore sells the good in the foreign market at the following price (expressed in the foreign currency):

$$\widetilde{p}^*_{ij} = \varepsilon \tau p^*_{ij} + w^* \eta^* \ ,$$

where p^*_{ij} is the FOB export price in the domestic currency, set by intermediary j before shipping abroad. This price is the one that maximizes the intermediary's profit from sales of good i in the foreign market *conditional* to the procurement price p_{ij} paid to the indirect exporter, i.e. the manufacturer of good i. Formally, p^*_{ij} represents the solution to the following problem $\max \pi^*_{ij} = = p^*_{ij} \cdot q_{ij}(\widetilde{p}^*_{ij}) \cdot \tau - p_{ij} \cdot q_{ij}(\widetilde{p}^*_{ij}) \cdot \tau$, and therefore corresponds to

$$p^*_{ij} = \underbrace{\frac{\sigma}{\sigma - 1} \left(1 + \frac{\eta^*}{\sigma \tau \epsilon p_{ij}} \right)}_{\equiv \mu^*_j} \cdot p_{ij} \ , \tag{4}$$

where ϵ is, again, the RER between the two countries.

The optimal export price for intermediary j thus depends on the procurement price p_{ij}, the latter being, in turn, the price that maximizes the profit of the indirect exporter i, i.e. $\pi_{ij} = p_{ij} \cdot q_{ij}(\widetilde{p}^*_{ij}) \cdot \tau + - \frac{1}{\varphi_i} \cdot q_{ij}(\widetilde{p}^*_{ij}) \cdot \tau$. It is straightforward to show that

$$p_{ij} = \underbrace{\frac{\sigma - 1}{\sigma - 2} \left(1 + \frac{\eta^* \varphi_i}{(\sigma - 1)\, \epsilon \tau} \right)}_{\equiv \mu_{ij}} \cdot \frac{1}{\varphi_i} \ . \tag{5}$$

For goods exported through intermediaries, the price paid by foreign consumers is the result of a double marginalization. Indeed, the intermediary firm j charges its own markup, denoted as μ^*_j, over the procurement price paid to the manufacturer of good i. This price, in turn, already includes the markup μ_{ij} that firm i imposes over its marginal cost of production when selling to intermediaries. It is worth noticing that the markup μ_{ij} is larger than the Dixit-Stiglitz markup μ_i that the same manufacturing firm would impose in case of domestic sales to national consumers: when contracting a given intermediary j, producer i "sells" its product to j together with the exclusive right to supply that good to the foreign consumers. This enables i to discriminate between domestic consumers and intermediaries. By internalizing the future sales of the intermediary, firm i will therefore charge j with a markup $\mu_{ij} > \mu_i$, defined hereinafter as the *indirect exporter's markup*.

Double marginalization can be easily illustrated by assembling equations (4) and (5) in order to derive the *unconditional* optimal export price (in the domestic currency) for goods traded through intermediaries, which is

$$p_{ij}^* = \mu_j^* \cdot p_{ij} = \underbrace{\mu_j^* \cdot \mu_{ij}}_{=\mu_{ij}^*} \cdot \frac{1}{\varphi_i} =$$

$$= \underbrace{\frac{\sigma}{\sigma-1}\left[1+\frac{\eta^*}{\sigma\tau\epsilon\underbrace{\frac{\sigma-1}{\sigma-2}\left(1+\frac{\eta^*\varphi_i}{(\sigma-1)\,\epsilon\tau}\right)\frac{1}{\varphi_i}}_{p_{ij}}}\right]}_{\equiv\mu_j^*} \cdot \underbrace{\underbrace{\frac{\sigma-1}{\sigma-2}\left(1+\frac{\eta^*\varphi_i}{(\sigma-1)\,\epsilon\tau}\right)}_{\equiv\mu_{ij}} \cdot \frac{1}{\varphi_i}}_{=p_{ij}} =$$

$$= \underbrace{\frac{\sigma}{\sigma-2}\left(1+\frac{2\eta^*\varphi_i}{\sigma\epsilon\tau}\right)}_{\equiv\mu_{ij}^*} \cdot \frac{1}{\varphi_i}\ . \tag{6}$$

To summarize, in case of goods that are traded through intermediaries, the overall markup imposed on foreign consumers, namely

$$\mu_{ij}^* \equiv \frac{\sigma}{\sigma-2}\left(1+\frac{2\eta^*\varphi_i}{\sigma\epsilon\tau}\right)\ ,$$

is the result of the multiplicative interaction between the indirect exporter's markup, namely[10]

$$\mu_{ij} \equiv \frac{\sigma-1}{\sigma-2}\left(1+\frac{\eta^*\varphi_i}{(\sigma-1)\,\epsilon\tau}\right)\ ,$$

and the intermediary's markup, namely

$$\mu_j^* \equiv \frac{\sigma}{\sigma-1}\left(1+\frac{\eta^*}{\sigma\tau\epsilon p_{ij}}\right) = \frac{\sigma\epsilon\tau+2\eta^*\varphi_i}{(\sigma-1)\,\epsilon\tau+\eta^*\varphi_i}\ ,$$

which is obviously positive and larger than one.[11] A series of theoretical results then follows from equations (2) to (6); the corresponding formal proofs are reported in Appendix A2.[12]

Result 1. The indirect exporter's markup, namely μ_{ij}, is not only larger than μ_i, i.e. the markup that the same firm applies on domestic sales, but also larger than μ_i^*, that is the markup that the same firm would apply on export sales, if it were a direct exporter.[13]

[10] In full analogy with the direct export markup μ_i^*, the indirect exporter's markup, namely μ_{ij}, is (i) increasing in firm productivity, φ_i, and in the level of local distribution costs, η^*; and (ii) decreasing in the real exchange rate, ϵ, in the level of iceberg trade costs, τ and in the elasticity of substitution, σ.

[11] This fact is easily proved by expressing the intermediary's markup as $\mu_j^* = 1 + \frac{\epsilon\tau+\eta^*\varphi_i}{(\sigma-1)\epsilon\tau+\eta^*\varphi_i}$, where the element to be added to one is necessarily positive, given $\sigma > 1$, $\epsilon\tau > 0$ and $\eta^*\varphi_i > 0$, by construction.

[12] Notice that such results involve a comparison among markups; as far as the latter do not show up in standard transaction-level trade data, all these propositions are therefore not directly testable.

[13] Result 1 is a direct implication of double marginalization. The additional markup charged by the intermediary firm will raise the export price of the variety and reduce the quantity sold into the foreign market. By internalizing this, the indirect exporter raises its own markup as compared to the one that would apply if the same product were exported directly, thereby extracting more of the surplus of the intermediary firm.

Result 2. The indirect exporter's markup, namely μ_{ij}, is also larger than the intermediary's markup on the same goods, namely μ_j^*.

Result 3. The overall markup charged on foreign consumer in the case of goods exported through intermediaries, namely μ_{ij}^*, is larger than the markup imposed in the case of goods traded directly, namely μ_i^*.[14]

3.2 Export price and export value elasticities to exchange rate movements

The different pricing structure that characterizes the two modes of export (the direct mode and via wholesalers) bears relevant implications as regard to the margins of adjustment of firms in the event of external shocks. In particular, in this paper we focus on adjustments to exchange rate movements. In this respect, there is a set of predictions, which can be derived from equations (2) and (6), that specifically refers to the different export-price elasticity to RER movements of goods traded directly and goods traded via intermediaries. All these predictions can be directly tested using our data.

For goods that are exported directly by the producers, the export price elasticity with respect to the RER turns out to be

$$E_{p_i^*;\epsilon} = -\frac{\eta^* \varphi_i}{\sigma\epsilon\tau + \eta^* \varphi_i} \ . \tag{7}$$

Given $\eta^* \varphi_i > 0$ and $\sigma\epsilon\tau > 0$, both by construction, we can conclude that $-1 < E_{p_i^*;\epsilon} < 0$, which identifies a first testable prediction of our model.

Proposition 1. *The (real) exchange rate pass-through is incomplete for direct exporters: if the domestic currency appreciates (depreciates), manufacturing firms will reduce (increase) their markup -and therefore the price in domestic currency- applied on direct-export sales.*

For goods exported through intermediaries, the export price elasticity with respect to the RER is instead

$$E_{p_{ij}^*;\epsilon} = -\frac{2\eta^* \varphi_i}{\sigma\epsilon\tau + 2\eta^* \varphi_i} \ , \tag{8}$$

which implies, also in this case, $-1 < E_{p_{ij}^*;\epsilon} < 0$. Hence, we can derive a second testable prediction.

Proposition 2. *The (real) exchange rate pass-through is incomplete also for intermediaries exporters: if the domestic currency appreciates (depreciates), the final export price set by the intermediary firm will decrease (increase).*

Based on a simple comparison between (7) and (8), it is straightforward to show that

$$|E_{p_{ij}^*;\epsilon}| = \frac{2\eta^* \varphi_i}{\sigma\epsilon\tau + 2\eta^* \varphi_i} > \frac{\eta^* \varphi_i}{\sigma\epsilon\tau + \eta^* \varphi_i} = |E_{p_i^*;\epsilon}| \ .$$

[14] Given equation (6), Result 3 directly follows from Result 2: given $\mu_{ij} > \mu_i^*$ and $\mu_j^* > 1$, then it necessarily holds that $\mu_{ij}^* \equiv \mu_{ij}\mu_j^* > \mu_i^*$.

The above inequality holds as far as $2(\sigma\tau\epsilon + \eta^*\varphi_i) > \sigma\tau\epsilon + 2\varphi\eta^*$, a condition which is always verified under our restrictions on the model parameters.[15] A third testable prediction then follows.

Proposition 3. *Because of the combination of two price adjustment mechanisms, the price elasticity with respect to real exchange rate movements is always larger for goods traded through intermediaries, rather than for goods traded directly.*

As a theoretical speculation, it is worth noticing that, for goods that are exported via intermediaries, the result of incomplete pass-through originates from two different price adjustments. On one hand, in the event of exchange rate movements, the indirect exporter adjusts its markup μ_{ij} over the marginal cost of production when selling product i to intermediary j. On the other hand, j also adjusts its own margin μ_j^* over the procurement price.

To shed light on the relative contribution of these two changes on the overall price adjustment in the intermediary channel, we compute the elasticity to the RER of both the indirect exporter's and the intermediary's markups. In particular, the elasticity of the indirect exporter's markup is

$$E_{\mu_{ij};\epsilon} = -\frac{\eta^*\varphi_i}{(\sigma-1)\,\tau\epsilon + \eta^*\varphi_i} \ .$$

It can be easily proved that $0 < |E_{\mu_{ij};\epsilon}| < 1$; moreover, $|E_{\mu_{ij};\epsilon}|$ is increasing in φ_i, which means that the more productive firms will adjust their markup to a larger extent than the less productive firms, consistently with the findings of Berman et al. (2012).[16]

The corresponding elasticity of the intermediary's markup is instead

$$E_{\mu_j^*;\epsilon} = -\frac{(\sigma-1)\,\epsilon\tau\eta{*}\varphi_i}{\left[(\sigma-1)\,\epsilon\tau + \eta^*\varphi_i\right]\left[\sigma\epsilon\tau + 2\eta^*\varphi_i\right]} \ .$$

The restrictions on parameters ensure that, also in this case, $0 < |E_{\mu_j^*;\epsilon}| < 1$. At odds with the former case, however, $|E_{\mu_j^*;\epsilon}|$ is a bell shaped function of φ_i: it first increases with φ_i, then it reaches a peak at some value less than one, and eventually starts declining, approaching zero for $\varphi_i \to \infty$.

Given the two elasticities, we can easily prove that

$$|E_{\mu_{ij};\epsilon}| > |E_{\mu_j^*;\epsilon}| \ , \tag{9}$$

the fundamental condition for this inequality to hold (with all the parameters of the model that are positive) being $\sigma > 1$, in line with our assumptions. Inequality (9) implies that most of the overall change in the export prices along the intermediary export channel is due to the indirect exporter's response to the RER movement. In light of Result 2, the producer of good i has a larger margin than intermediary j for adjusting the price to the external shock, which implies that, in principle, most of the overall price adjustment is represented by a change in the indirect exporter's markup, namely μ_{ij}, rather than in the intermediary's markup, i.e. μ_j^*.

[15] Notice that, for both the modes of export, the extent of the price adjustment -i.e. the absolute value of the export price elasticity with respect to the RER- is always (i) increasing in firm productivity and in the level of local distribution costs; and (ii) decreasing in the real exchange rate, in the elasticity of substitution and in the level of iceberg costs.

[16] In particular, the elasticity is negative because $\sigma > 1$ and $\eta^*\varphi_i > 0$ necessarily imply $(\sigma-1)\,\epsilon\tau > 0$; notice also that as φ_i goes to infinity, $E_{\mu_{ij};\epsilon}$ approaches to -1.

We now turn our attention to the export value elasticity to (real) exchange rate movements. Consider fist the sales of a direct exporter i, namely $x_i^* \equiv p_i^* q_i^*$, where p_i^* is given by equation (2), whereas $q_i^* = A^* \cdot (\widetilde{p}_i^*)^{-\sigma} = A^* \cdot (\tau \varepsilon p_i^* + \eta^* w^*)^{-\sigma}$. The direct export sales elasticity to the RER, namely ϵ, can be proved to be

$$E_{x_i^*;\epsilon} = -\frac{\sigma\epsilon\tau}{\epsilon\tau + \eta^*\varphi_i} - \frac{\eta^*\varphi_i}{\sigma\epsilon\tau + \eta^*\varphi_i}\left[\frac{\sigma}{\sigma-1}\frac{w^*(\epsilon\tau + \eta^*\varphi_i)}{\varphi_i}\right]^{-\sigma} ,$$

which is clearly negative (i.e. real appreciation always reduces the direct exporters' sales abroad).

The export sales of intermediary j would be $x_{ij}^* \equiv p_{ij}^* q_{ij}^*$, with p_{ij}^* given by equation (6), while $q_{ij}^* = A^* \cdot (\widetilde{p}_{ij}^*)^{-\sigma} = A^* \cdot (\tau \varepsilon p_{ij}^* + \eta^* w^*)^{-\sigma}$. The intermediary export sales elasticity to the RER would be

$$E_{x_{ij}^*;\epsilon} = -\frac{\sigma\epsilon\tau}{\epsilon\tau + \eta^*\varphi_i} - \frac{2\eta^*\varphi_i}{\sigma\epsilon\tau + 2\eta^*\varphi_i}\left(\frac{\sigma}{\sigma-2}\frac{w^*[\epsilon\tau + \eta^*\varphi_i]}{\varphi_i}\right)^{-\sigma} ,$$

which, again, is certainly negative (i.e. real appreciation always reduces intermediaries' exports).

A simple comparison among the two above elasticities reveals that

$$|E_{x_i^*;\epsilon}| > |E_{x_{ij}^*;\epsilon}| \ , \tag{10}$$

which leads to the following proposition

Proposition 4. *As a result of the lower degree of exchange rate pass-through that characterizes the intermediary export channel, firm-level direct exports are more elastic to RER as compared to intermediaries' export sales.*

Notice that the theoretical result in Proposition 4 is consistent with the main finding of Bernard et al. (2015), that is, the higher is the incidence of indirect exports, the less export sales to a given destination are sensitive to (real) exchange rate movements.[17]

3.3 Productivity cut-offs and extensive margin adjustments to exchange rate movements

In section 3.2 we have shown that, in the event of exchange rate movements, different types of exporters adjust their export prices to a different extent. Hence, the shock is proved to have a heterogeneous impact on the intensive margin of trade, depending on whether intermediaries are involved into the exchange or not. In this Section, instead, we focus on the adjustment that takes place at the extensive margin.

This point relates to the mechanisms according to which firms select their mode of export. In this regard, our model generates a standard productivity sorting pattern: the most productive firms export directly; firms with intermediate levels of productivity resort on intermediaries, whereas the least productive firms only serve the domestic market. This is the same pattern that emerges in Akerman (Forthcoming), Ahn et al. (2011) and Felbermayr and Jung (2011) and empirically verified

[17] The condition for (10) to hold is that $\frac{2\eta^*\varphi_i}{\epsilon\tau} > \sigma\frac{2(\sigma-2)^\sigma - (\sigma-1)^\sigma}{(\sigma-1)^\sigma - (\sigma-2)^\sigma}$, which is always verified, since the left-hand side of this inequality is certainly positive, while the left-hand side is negative. Indeed, σ is positive by assumption, $(\sigma-1)^\sigma - (\sigma-2)^\sigma > 0$ for $\sigma > 1$ and $2\,(\sigma-2)^\sigma - (\sigma-1)^\sigma < 0$ for $\sigma > 1$.

also by Grazzi and Tomasi (2016), which can therefore be considered as robust to the introduction of local distribution costs. An extended proof for this result is reported in Appendix A3.[18]

Consider now the two export cut-offs that emerge in the presence of intermediaries. The first is the direct-export productivity cut-off, which corresponds to

$$\varphi_{X^{dir}} \equiv \frac{\tau\epsilon}{\left(\frac{\phi A^*}{\epsilon(1-\lambda)f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} \text{ , where } \phi \equiv \frac{(\sigma-1)^{\sigma-1} - (\sigma-2)^{\sigma-1}}{\sigma^\sigma \delta} \text{ .} \quad (11)$$

All manufacturing firms with productivity higher than $\varphi_{X^{dir}}$ will find optimal to export directly. The second is the indirect-export productivity cut-off, that is

$$\varphi_{X^{ind}} \equiv \frac{\tau\epsilon}{\left(\frac{\chi A^*}{\epsilon\lambda f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} \text{ , where } \chi \equiv \frac{(\sigma-2)^{\sigma-1}}{\sigma^\sigma \delta} \text{ .} \quad (12)$$

All manufacturing firms with productivity lower than $\varphi_{X^{ind}}$ will not sell their products abroad; those with productivity higher than $\varphi_{X^{ind}}$ will have instead positive profits from indirect export sales and will therefore reach the foreign markets thanks to an intermediary. Nevertheless, given $\varphi_{X^{dir}} > \varphi_{X^{ind}}$, the most productive firms, i.e. those with productivity higher than $\varphi_{X^{dir}}$, will always prefer to manage directly their exports to the foreign market, rather than going for the intermediary export channel.

As shown in Appendix A3, the condition to be imposed for the emergence of this pattern is that the fixed cost of accessing trade intermediation services is small enough as compared to the fixed cost of a direct entry into the foreign market.[19] If it were not the case, indirect exporters would not save enough on the fixed cost of exports to compensate for the implicit cost of double marginalization (which raises the export price, reducing the quantities sold abroad); exports though intermediaries would then be a feasible option only for those manufactures that are so much productive to remain competitive in spite of the additional markup imposed by the trade intermediary.

According to equations (11) and (12), both the export cut-off levels are a positive function of the RER, namely $\epsilon = \varepsilon w^*/w$ (with $w = 1$); an appreciation of the domestic currency thus implies an increase in the critical level of productivity for either direct or indirect exporting.

With some simple algebra, the elasticity of the direct-export cut-off to RER movements can be proved to be

$$E_{X^{dir};\epsilon} = 1 - \frac{\frac{1}{\sigma-1}\left(\frac{(w^*)^{-\sigma}\phi A^*}{\epsilon(1-\lambda)f_X}\right)^{\frac{1}{\sigma-1}}}{\left(\frac{(w^*)^{-\sigma}\phi A^*}{\epsilon(1-\lambda)f_X}\right)^{\frac{1}{\sigma-1}} - \eta^*} \text{ ,}$$

[18] Albeit it represents a well-established result in the literature on trade intermediaries, we report anyhow a proof of productivity sorting in the export mode selection, thereby highlighting how the conditions to be imposed for the emergence of this pattern within our model generalizes those to be imposed in the simpler settings of Akerman (Forthcoming) and Ahn et al. (2011).

[19] Indeed, in Appendix A3 we impose a restriction on the value of λ, which is the ratio between the fixed cost of contracting a trade intermediary, namely f_J, and the fixed cost of entry into the foreign market, namely f_X.

whereas the corresponding elasticity for the indirect-export cut-off is

$$E_{X^{ind};\epsilon} = 1 - \frac{\frac{1}{\sigma-1}\left(\frac{(w^*)^{-\sigma}\chi A^*}{\epsilon\lambda f_X}\right)^{\frac{1}{\sigma-1}}}{\left(\frac{(w^*)^{-\sigma}\chi A^*}{\epsilon\lambda f_X}\right)^{\frac{1}{\sigma-1}} - \eta^*},$$

with both the elasticities being positive by construction, provided that $\sigma > 2$.

The same circumstances under which the usual sorting pattern emerges, also ensure that

$$E_{X^{ind};\epsilon} > E_{X^{dir};\epsilon}, \tag{13}$$

that is, the indirect-export productivity cut-off is more elastic to RER movements than the direct-export cut-off. Hence, in the event of a real appreciation (depreciation), the cut-off level for indirect export shifts upward (downward) relatively more than the cut-off for direct export (see Appendix A4 for a formal proof).

With some loss of generality, if we introduce a specific assumption on the firm productivity distribution $G(\varphi)$, then the condition in (13) delivers a new testable prediction on the effects of a RER movement, particularly on the change in the number of varieties that are traded directly and through an intermediary. More specifically, consider the case of a uniform or a Pareto distribution, the latter being the most commonly used in the trade literature built on heterogeneous firms and monopolistic competition.[20] A new proposition then follows.

Proposition 5. *As far as φ_i is uniformly or Pareto distributed, then the measure of varieties that intermediaries drop in response to a real appreciation is larger, on aggregate, then the measure of varieties discarded from direct exporters.*

An appreciation of the domestic currency makes it more difficult to sell national products abroad, increasing the minimum level of productivity which is required for making exports a profitable activity. This is true for both the export modes, the direct and the indirect one. In the aftermath of the currency appreciation, the least productive among the indirect exporters will now locate below the indirect-entry cut-off level, thereby their variety will not be traded any longer. This identifies a first range of varieties, those that are dropped by the intermediary firms. At the same time, also manufacturers with productivity just above the direct export cut-off will not be able to export directly anymore, thus they will need to resort to intermediaries to profitably reach the foreign destination. This identifies a second set of varieties, namely those that will switch from being traded along the direct export channel, to being traded along the intermediary one.

If intermediaries were characterized by an optimal scope, as in the model of Akerman (Forthcoming), then the two sets of varieties would be quantitatively equivalent: in the event of currency

[20] Most of the authors typically follow Chaney (2008), who considers a Melitz's (2003) type of economy in which firm productivity is Pareto-distributed. Albeit its main advantage is making the model particularly tractable, the Pareto distribution has been found to provide a reasonable approximation to the observed distribution of firm size (e.g. Axtell (2001)). A recent work of Head et al. (2014) has challenged this point, showing that a log-normal distribution provides a substantially better fit to the firm's sales distributions, especially in the lower tail, where already Eaton et al. (2011) highlighted departures from a standard Pareto distribution (see also Mrázová et al. (2015)). However, most of the global trade originates in the upper tail of the distribution, since more productive firms are typically those engaged in export activity; for this reason, the Pareto assumption is still largely appealing in trade literature.

appreciations, intermediaries would get rid of their marginal varieties only to the extent necessary to create room in their export baskets for the varieties discarded from the direct export channel.[21] Nevertheless, if the density of firm productivity is monotonically (weakly) decreasing in the level of productivity φ, then the condition in (13) ensures that the first range of varieties necessarily exceeds the second one, at least for a quantitative point of view. Intermediaries will drop their marginal varieties to an extent which is larger than the measure of varieties that they are going to add to their export baskets, with a subsequent change in their scope. As a result, in our model not only the direct but also the indirect mode of export features an extensive margin of adjustment to external shocks, the validity of this prediction being directly testable on our data.[22]

4 Data and empirical evidence

4.1 Trade and firm-level data

In order to test the propositions put forth in the model, we use two data set collected by the Italian statistical office (ISTAT): Statistiche del Commercio Estero (COE), and Archivio Statistico Imprese Attive (ASIA).[23]

COE contains all cross-border transactions (both exports and imports) of Italian firms over the period 2000-07. For all export flows defined at the firm-product-destination level we observe both annual values and quantities expressed respectively in euros and in kilograms.[24] Products are defined as 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 the unit-values $Unit\ Value_{fcpt}$ of the exported varieties as the ratio of export values to export quantities, where the subscripts f, c, p and t respectively identify firms, HS6 product classes, destination countries and years.

Using the common firm ID, we link the firm-level export data to ISTAT's registry of active firms (ASIA) which provides the sectoral classification of business required to identify manufacturing and wholesale businesses. We employ the ATECO industrial classification, which is derived from NACE

[21] In the model of Akerman (Forthcoming), this result originates from the assumption that the fixed cost of the intermediary firm is monotonically and convexly increasing in the range of goods that have to be handled. This limits the economies of scope of the intermediaries and, together with productivity sorting in the export mode selection, introduces a mechanisms according to which intermediary firms react to RER movements by changing the composition of their export baskets, replacing their marginal products with the marginal products of the direct exporters, but without changing the number of goods that they ship to the foreign market.

[22] Notice that the result reported in Proposition 5 could also apply in the case of other distributions of firms' productivity, other than Pareto or uniform (such as log-normal or extreme value distributions), but only conditional on verifying that both the export cut-offs, namely $\varphi_{X^{dir}}$ and $\varphi_{X^{ind}}$, locate in the region of the domain of $G(\varphi)$ in which $g(\varphi) \equiv G'(\varphi)$ is decreasing in φ.

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

[24] ISTAT collects data on trade based on transactions. The European Union sets a common framework of rules but leaves some flexibility to member states. A detailed description of requirements for data collection on trade in Italy is provided by Bernard et al. (2015). Although only annual values which exceeds a threshold are reported in the 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).

Rev. 1.1, at five digits. More in detail, as in Bernard et al. (2015), we classify firms in sectors from 151 to 372 as manufacturers and firms in sectors from 501 to 519 (with the exclusion of 502 which concerns the activity of repair of motor vehicles) as wholesalers or intermediaries.[25] The combined data set that result from matching COE to ASIA is not a sample but includes all active firms and is our preferred dataset for testing the model.

In 2000 manufacturers were responsible for the larger share (85%) of Italian aggregate exports, intermediaries accounted for around 10%, retailers for below than 1% and other firms 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 10% export share of intermediaries was due to 26% of Italian exporters classified as wholesalers, whether the 85% export share of manufacturers was generated by 57% of Italian exporters recorded as manufacture exporters (Bernard et al., 2015). Intermediaries exporters are on average smaller than manufacturers that sell abroad but this difference largely disappears when considering exports per employee. Moreover, both exporting intermediaries and manufacturers sell several products to each destination but the former are active in a wider range of products compared to similarly-sized manufacturers. Detailed descriptive evidence on the characteristics of wholesalers and manufacturers exporters, also focusing on product and geographic diversity, is available in Bernard et al. (2011).

The transaction level data is then used to test the propositions put forth in the theoretical setting. Notice that in our data, most of the manufacturing firms that export directly tend to reach the foreign market with more than one product category. In this respect, the implicit assumption of our model is that manufacturing firms can potentially engage in producing many varieties of the final good, but all these varieties correspond to businesses that are independent from each other. Hence, we consider the product-specific component of the fixed cost of exporting as the relevant one, as compared to the other component, represented by a standard firm-level sunk cost.[26]

4.2 Empirical evidence on price and exports elasticities to exchange rate movements

In this section we test the validity of our model with respect to the firms' price and exports adjustment mechanisms following a change in the RER. We focus on Propositions 1 to 3 that relate the export price adjustment in the event of RER movements to the mode of export of the different products, and on Proposition 4, which considers a firm's export sales adjustment following RER movements. Do intermediary exporters have indeed different price and exports responses to exchange rates than manufacturing exporters?

[25] Throughout this paper, we use the two terms interchangeably.

[26] In principle, neither assuming a pure firm-specific or product-specific formulation for the fixed cost of export appears as fully satisfactory: under firm-specific costs, in fact, it would be hard to justify why multi-product firms tend to react to external shock (such as RER movements) by keeping exporting only their core products and dropping the marginal products in their portfolio, as documented in Chatterjee et al. (2013). To clarify this point, consider a toy model in which firm i exports to some given destination three different products, say a, b and c, in descending order of productivity. If the fixed cost of entry in the foreign market were product-specific, in the aftermath of a currency appreciation firm i might find convenient to keep exporting product a and b, and drop c. At odds, in case of firms-specific fixed costs, having sunk the cost for varieties a and b, firm i would have no reason to drop c, thereby giving up on positive profits (even if small) from the sale of c abroad.

To explore the sensitivity of the firm's export price response to annual movements of the exchange rate for a given country-product pair, we explore information on unit values of the exported products and we consider the following equation

$$\Delta \ln UnitValue_{fcpt} = \beta_0 + \beta_1 D^W_{ft} + \beta_2 \Delta \ln RER_{ct} + \beta_3 \Delta \ln RER_{ct} * D^W_{ft} + d_j + \nu_{fpct} , \quad (14)$$

where $\Delta \ln UnitValue_{fpct}$ is annual difference in the unit value of product p in country c by individual firm f between time t and $t+1$, whereas d_j indicates a set of fixed effects. We denote with D^W_{ft} the dummy variable which identifies f as an intermediary firm (W stands for wholesaler). The (log) real exchange rate is denoted as $\ln RER_{ct}$, and is here defined as the nominal Italian 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}).[27] An upward (downward) movement of the RER therefore represents an appreciation (depreciation) of the domestic currency. Real exchange rates are measured using data from the International Financial Statistics database (IMF, 2010). In the above equation, both the dependent variable and RER are defined as annual differences.

The extent to which exchange rate variations are transmitted into consumer prices can be computed as $ERPT = 1 - \beta_2$ where β_2 is the coefficient of RER_{ct} in regressions on $Unit\ Value_{fcpt}$. Accordingly, if exporters do not adjust their export prices in response to exchange rate variations then $\beta_2 = 0$ and the ERPT is perfect. On the contrary, the closer is β_2 to -1 the greater is the offsetting adjustment of export prices to neutralize ERPT into consumer prices. We expect a negative sign on both β_2 and β_3. While the first coefficient measures the pricing to market of manufacturing firms, the second captures the heterogeneity of pricing strategies with respect to the mode of exports. According to Proposition 3 of our model, intermediaries decrease more their export price following a depreciation.

To test the sensitivity of the firm's export values to annual movements of the exchange rate for a given country-product pair, we use the same reduced-form strategy

$$\Delta \ln X_{fcpt} = \beta_0 + \beta_1 D^W_{ft} + \beta_2 \Delta \ln RER_{ct} + \beta_3 \Delta \ln RER_{ct} * D^W_{ft} + d_j + \nu_{fpct} , \quad (15)$$

where X_{fpct} denotes the export value of product p in country c by individual firm f.

Following Proposition 4 of our model the coefficient on the interaction term, β_3, should be positive: the export value elasticity to real exchange rate changes should be lower for intermediary exporters.

Columns 1 and 2 of Table 1 report the results from regression model 14, while columns 3 and 4 show the estimates of equation 15. We cluster standard errors at the destination-year level in order to allow for correlation of the error terms across destination-year but the results are robust to alternative treatments of the error terms, such as clustering by destination. In columns 1 and 3 we show the estimated coefficient from a specification that includes year, country and product

[27] We use annual averages of the monthly official exchange rate, that can be either the rate determined by national authorities or the rate determined in the legally sanctioned exchange market. Using a wholesale price index to construct the RER reduces the number of countries in the sample, but does not affect the main results. See Table B1 in Appendix B for the results of regression 14 using the WPI.

Table 1: Firm's unit value and exports elasticities to exchange rate movements

	Annual Differences			
	ln UnitValue$_{fcpt}$		ln X$_{fcpt}$	
	(1)	(2)	(3)	(4)
D^W_{ft}	-0.002		-0.020***	
	(0.001)		(0.003)	
ln RER$_{ct}$	-0.034***	-0.031***	-0.316***	-0.376***
	(0.011)	(0.011)	(0.092)	(0.109)
$*D^W_{ft}$	-0.021*	-0.030**	0.069*	0.031**
	(0.011)	(0.013)	(0.039)	(0.015)
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Product FE	Yes	No	Yes	No
Firm-Product FE	No	Yes	No	Yes
Clustering Country-Year	Yes	Yes	Yes	Yes
Adj R-squared	0.003	-0.011	0.004	-0.010
Observations	4008339	4008339	4008339	4008339

Note: Table reports the results of regressions at the firm-product-country level, obtained by using data on export values, quantities and unit values between 2000 and 2007. The dependent variables and the real exchange rates (RER) are defined as annual differences. D^W_{ft} is a dummy for intermediaries; $*D^W_{ft}$ is the interaction term with real exchange rates in annual differences. 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.

fixed effects that control for time trends and shocks that affect all firms exporting the same HS6 product and serving the same destination. Columns 2 and 4 report the results from a specification including year, destination and firm-product fixed effects which takes into account also possible idiosyncratic firm-product attributes that may be correlated with the evolution of export value, prices or quantities.

Results of columns 1 and 2 represent a direct test of Proposition 1 to 3 of the theoretical framework we propose here. Unit values decrease both for manufacturing and intermediaries, which is coherent to what put fort in Proposition 1 and 2. The coefficient on RER, β_2, reports the average elasticity of export prices to RER variations for manufacturing firms. The exchange rate elasticity of export prices for these firms is estimated to be on a range between -0.031 and -0.034, which implies an exchange rate pass-through into the import prices of about 0.96.[28] The interaction term between exchange rates and a dummy for wholesaler D^W_{ft} reveals that price adjustment is significantly larger for intermediaries, as predicted by Proposition 3 of our model. According to column 1, the exchange rate elasticity of wholesalers' export prices is estimated to be of approximately -0.055, which implies an exchange rate pass-through into the import prices of about 0.95. When considering the firm-product fixed effects, column 2, the effect is slightly larger with an elasticity to RER movements of about -0.060.

[28] Using the same dataset Bernini and Tomasi (2015) find an exchange rate pass-through into the import prices of about 0.97. Using similar micro-level data for French exporters Berman et al. (2012) find an exchange rate pass-through to import prices abroad of around 0.88, while in Chatterjee et al. (2013) the producer price elasticity for Brazilian exporters is estimated to be of approximately 0.23 (77% of pass-through).

Table 2: Firm's unit value and exports elasticities to exchange rate movements: robustness checks

	Annual Differences			
	ln UnitValue$_{fcpt}$	ln UnitValue$_{fcpt}$	ln X$_{fcpt}$	ln X$_{fcpt}$
	(1)	(2)	(3)	(4)
ln RER$_{ct}$	-0.031**	-0.026**	-0.163***	-0.226*
	(0.017)	(0.016)	(0.035)	(0.107)
$*D^W_{ft}$	-0.034**	-0.020**	0.021**	0.023*
	(0.011)	(0.010)	(0.009)	(0.012)
$*\ln nce_{ft}$	0.001		-0.091***	
	(0.004)		(0.025)	
$*\ln npc_{fct}$		-0.009***		-0.036**
		(0.004)		(0.014)
$\ln nce_{ft}$	0.003*		-0.092***	
	(0.002)		(0.011)	
$\ln npc_{fct}$		0.003*		-0.058***
		(0.001)		(0.006)
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm-Product FE	Yes	Yes	Yes	Yes
Clustering Country-Year	Yes	Yes	Yes	Yes
Adj R-squared	0.034	0.033	-0.010	-0.005
Observations	4008339	3852915	4008339	3852915

Note: Table reports the results of regressions at the firm-product-country level, obtained by using data on export values, quantities and unit values between 2000 and 2007. The dependent variables and the real exchange rates (RER) are defined as annual differences. D^W_{ft} is a dummy for intermediaries; $\ln nce_{ft}$ is the (log) number of countries a firm is exporting to; $\ln npc_{fct}$ is the (log) number of product-countries a firm is exporting to $*D^W_{ft}$, $*\ln nce_{ft}$, $*\ln npc_{fct}$ are the interaction terms with real exchange rates in annual differences. 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.

As far as the value of exports (columns 3 and 4) to a given product-country combination is concerned, we observe - as expected - a negative coefficient on $lnRER_{ct}$: export values fall in response to currency appreciation. However, as predicted by Proposition 4, the coefficient on the interaction of wholesaler type and the real exchange rate is positive and significant in both columns, suggesting that exports through intermediaries are less elastic to RER as compared to direct export sales. Firms' exports fall less (8-21 percent) for intermediaries than for manufacturers when the Italian currency appreciates. This result is well in tune with Bernard et al. (2015), which report similar results at a more aggregate level.

4.2.1 Robustness checks

In this section we consider a set of exercises aimed at testing the robustness of our results to the inclusion of additional controls in the baseline specification. Because firm-product fixed effects provide a better control for firms' idiosyncratic attributes, they will be included in all the specifications that follow.

As a first robustness check we run equations 14 and 15 by including the (log) number of countries, $ln\ nce_{ft}$ to which a firms is exporting to and its interaction with RER in order to control for the

Table 3: Firm's unit value and exports elasticities to exchange rate movements: with TFP interacted

	Annual Differences			
	ln UnitValue$_{fcpt}$	ln UnitValue$_{fcpt}$	ln X$_{fcpt}$	ln X$_{fcpt}$
	(1)	(2)	(3)	(4)
ln RER$_{ct}$	-0.032**	0.138	-0.398***	-0.619***
	(0.014)	(0.088)	(0.121)	(0.176)
$*D^W_{ft}$	-0.063**	-0.060**	0.028*	0.026*
	(0.029)	(0.029)	(0.017)	(0.015)
$*\ln \widetilde{TFP}_{ft-1}$		-0.035**		0.046
		(0.013)		(0.033)
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm-Product FE	Yes	Yes	Yes	Yes
Clustering Country-Year	Yes	Yes	Yes	Yes
Adj R-squared	0.003	0.003	0.007	0.007
Observations	2081711	2081711	2081711	2081711

Note: Table reports results of regressions at the firm-product-country-level, using data on export values, quantities and unit values of exported products for the period 2000-2006. The dependent and independent variables are defined as annual differences. D^W_{ft} is a dummy for intermediaries; $*D^W_{ft}$ is the interacted dummy, and $*TFP_{ft}$ is the interaction term with real exchange rates in annual differences. 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.

possible shift of exports to other countries in response to real exchange rate appreciation. These regressions are reported in columns 1 and 3 of Table 2, for unit value and export value respectively. Moreover, since the sunk entry-costs can be at country-product level, we include the (log) number of country-product pairs ($ln\ npc_{fct}$) where the firm has positive exports, with the exclusion of the country under investigation, so that, even for the same firm, such variable might take different values across countries. Columns 2 and 4 of Table 2 report the results. The main results are robust across these specifications. As far as unit value is concerned, the coefficient on the interaction term remains negative and statistically significant suggesting that export price adjustment is higher (and ERPT is lower) for intermediaries.

Although the exchange rate movement can be safely considered as a shock which is exogenous to the firm, as shown for French firms in Berman et al. (2012), the firm-level adjustment might be related to some firms' characteristic such as productivity. In particular, one might argue that the different response in terms of unit values between direct exporters and intermediaries may be driven by the lack of specific controls for productivity differences across firms. As an additional robustness check we therefore add such control. In order to perform this check, we link our Italian trade data to firm-level characteristics, retrieved from Micro.3, a dataset containing information on 148,604 Italian firms (those with more than 20 employees; 71,437 of which classified as manufacturers) for the period 1989-2006 (see Grazzi et al., 2013, for further details on the dataset). Using this data, we measure exporters' productivity by means of the total factor productivity (TFP), as computed by applying the semi-parametric estimation technique of Levinsohn and Petrin (2003). In Table B2 in Appendix B we first verify that the results of Berman et al. (2012) also hold for Italian firms.

Table 4: Firm's export quantity elasticities to exchange rate movements

	Annual Differences					
	ln Quantity$_{fcpt}$					
	(1)	(2)	(3)	(4)	(5)	(6)
D^W_{ft}	-0.018***					
	(0.004)					
ln RER$_{ct}$	-0.282***	-0.344***	-0.131***	-0.200**	-0.365***	-0.756***
	(0.097)	(0.114)	(0.039)	(0.109)	(0.130)	(0.181)
$*D^W_{ft}$	0.090**	0.061**	0.051**	0.043**	0.091**	0.087*
	(0.041)	(0.030) (0.020)	(0.020)	(0.043)	(0.049)	
$*\ln nce_{ft}$			-0.092**			
			(0.042)			
$*\ln npc_{fct}$				-0.026*		
				(0.014)		
$*\ln \widetilde{TFP}_{ft-1}$						0.081**
						(0.038)
$\ln nce_{ft}$			-0.094**			
			(0.029)			
$\ln npc_{fct}$				-0.061***		
				(0.006)		
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	No	No	No	No	No
Firm-Product FE	No	Yes	Yes	Yes	Yes	Yes
Clustering Country-Year	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-squared	0.001	0.034	-0.006	-0.006	0.36	0.36
Observations	4008339	4008339	4008339	3852915	2081711	208171

Note: Table reports the results of regressions at the firm-product-country level, obtained by using data on export values, quantities and unit values between 2000 and 2007. The dependent variables and the real exchange rates (RER) are defined as annual differences. D^W_{ft} is a dummy for intermediaries; $*D^W_{ft}$ is the interaction term with real exchange rates in annual differences. 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.

We estimate now a slightly modified version of equations (14) and (15), augmented with the inclusion of the interacted TFP measure. Hence, the new equation to be estimated is

$$\begin{aligned} \Delta \ln Y_{fpct} &= \beta_0 + \beta_1 D^W_{ft} + \beta_2 \Delta \ln RER_{ct} + \beta_3 \Delta \ln RER_{ct} * D^W_{ft} + \\ &+ \beta_4 \Delta \ln RER_{ct} * \widetilde{TFP}_{ft-1} + d_j + \nu_{fpct} \ , \end{aligned} \tag{16}$$

where $\ln Y_{fpct}$ is the log of the dependent variable, which can be the unit value or total exports of a given product p in destination c by a firm f. We add to the baseline specification the interaction term $\Delta \ln RER_{ct} * \widetilde{TFP}_{ft-1}$.

Linking transaction level trade data with the firm-level information contained in Micro.3 significantly reduces the number of observations available. For this reason, in Table 3 we first replicate our baseline model to the restricted sample (columns 1 and 3, for unit value and exports respectively), thereby checking whether the results of the regression might be driven by the selection of relatively larger firms. The restricted sample in columns 1 and 3 confirm our findings, according to which, in the event of currency appreciations, intermediaries tend to reduce their unit values more than the manufacturing exporters; hence, the pass-through along the intermediary export channel is lower, and total exports fall less. As columns 2 and 4 of Table 3 show, including the TFP variable, interacted with the annual movement of the (log) RER, does not alter these results.

To complete the empirical analysis in Table 4 we report the results of the same regressions run for unit value and total exports using as dependent variable the difference of the (log) export quantity of product p in country c by individual firm f. We note that in general, the overall adjustment in exports for direct exporters is primarily due to reduction in the quantities (80%) rather than in unit value (20%) of the exported products. For intermediaries, the overall adjustment turns out to be smaller, essentially because of a much smaller quantity response. This is explained by the fact that intermediaries reduce their unit values more than direct exporters: the exchange rate pass-through is therefore lower for them, and the quantities sold abroad consequently fall by less.

4.3 Empirical evidence on the extensive margin

Our theoretical framework also formulates that, given how productivity is distributed among manufacturing firms, we should expect that following a RER appreciation, intermediaries drop more varieties than manufacturers (see Proposition 5 in Section 3.3).

In the following, in order to test this prediction, we focus on the dropping behavior of the two categories of firms and we regress the number of varieties dropped by wholesalers and direct exporters between years t and $t+1$, conditional on (real) exchange rate variations. We analyze the different dropping behavior of the various type of exporting firms by estimating a model at the product-country level, the model being

$$\ln \#Drop_{pct}^{W} = \beta_0 + \beta_1 D_t^W + \beta_2 \Delta \ln RER_{ct} + \beta_3 \Delta \ln RER_{ct} * D_t^W + \beta_4 X_t^W + d_j + \nu_{pct} \quad ,(17)$$

where $\#Drop_{cpt}^{W}$ is the (log) number of varieties of product p exported to country c in year t but not in year $t+1$ by the category W (either wholesalers or direct exporters). D_t^W is the dummy that identifies the intermediary category, while $\Delta\ln RER_{ct}$ is the change in the (log) real exchange rate of the Italian currency *vis-a-vis* the currency of country c, Finally, $\Delta \ln RER_{ct} * D_t^W$ is the variable of interest, that captures whether and to what extent the intermediary category is more likely to drop varieties than manufacturing exports, following a change in RER.

To control for attributes that might be associated with the difference between dropping behavior, we include a vector of controls, denoted as X_t^W. As shown by Bernard et al. (2011), there are significant differences between wholesaler and manufacturing exporters in terms of product and geographic diversity. Indeed, we include a proxy for the product diversification of the two category, $\ln NP_{ct}^W$, which is the (log) number of products exported within country c at time t, and a proxy for their geographic diversification, $\ln NC_{pt}^W$, which is the (log) number of countries served with product p at time t. We include in the regression product-country and year fixed effects that allows us to control also for the possibility that the intermediary category export products to country c with characteristics that make these varieties more likely to be dropped.

Table 5: Number of varieties dropped in the aftermath of exchange rate movements

	$\ln \#Drop^W_{pct}$			
	(1)	(2)	(3)	(4)
Δ ln RER$_{ct}$	0.004	-0.007	0.002	-0.023
	(0.004)	(0.004)	(0.004)	(0.020)
$*D^W_t$	0.042***	0.074***	0.039***	0.043***
	(0.007)	(0.007)	(0.007)	(0.008)
$*$ ln NC$^W_{pt}$				0.004
				(0.003)
D^W_t	-0.036***	0.505***	0.330***	0.330***
	(0.005)	(0.005)	(0.005)	(0.005)
ln NP$^W_{ct}$	0.463***	0.448***	0.326***	0.326***
	(0.004)	(0.003)	(0.003)	(0.003)
ln NC$^W_{pt}$		0.449***	0.330***	0.330***
		(0.003)	(0.002)	(0.002)
Deviation$^W_{pct}$			0.134***	0.134***
			(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes
Product-Country FE	Yes	Yes	Yes	Yes
Clustering Product-Country	Yes	Yes	Yes	Yes
Adj R-squared	0.656	0.688	0.725	0.725
Observations	1369279	1369279	1369279	1369279

Note: Table reports the results of regressions at product-country-category level, where category refers either to manufacturing and intermediary sector. The dependent variable $\ln \#Drop^W_{pct}$ is the number of varieties of product p exported to country c in year t but not in year $t+1$. D^W_t is a dummy for wholesaler sector; ln NP$^W_{ct}$ $\ln NC^W_{pt}$ is the number of products exported within country c and the number of countries served with product p, respectively; Deviation$^W_{pct}$ measure of the relevance of product p in the exports to destination c for each category W. All variables are computed at time t. $*D^W_t$ and $*\ln NC^W_{pt}$ are the interaction terms with real exchange rates in annual differences. 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.

Columns 1 and 2 of Table 5 report the results of the regression 17, controlling for the number of products exported by wholesalers (column 1) and for the number of countries served (column 2). In both cases the coefficient on the interaction term, $\Delta \ln RER_{ct} * D^W_t$, suggests the number of varieties dropped by intermediaries is higher than that of direct exporters in the aftermath of an exchange rate appreciation. In line with Proposition 5 of our model, the measure of varieties that intermediaries drop in response to a real appreciation is larger, on aggregate, then the measure of varieties discarded from direct exporters. Indeed, external shocks, such as changes in tariffs or exchange rates, have differential effects on intermediaries and manufacturers in terms of extensive margin.[29]

This differential persists even when we control, in column 3, for the relevance of product p in the exports to destination c for each category W, $Deviation^W_{pct}$. This is computed by taking the difference between the (log) exports of product p in c at time t for the category W, and the corresponding (log) average over all the products exported in c by the relative category. Finally,

[29]Even if not explicitly taken into account in our model, this result is also consistent with manufacturers having a greater commitment to their products than intermediary firms.

in column 4 we add the interaction term with the number of countries served with product p in order to control for the possible shift of exports to other countries in response to real exchange rate appreciation. The results are robust to this alternative specification.

n

5 Conclusion

This paper contributes to the growing literature on trade intermediaries by providing new facts at the micro-level, particularly on the different pricing behavior of direct exporters and intermediaries (and, on reflection, of indirect exporters) and therefore on their heterogeneous response to common external shocks, such as exchange rate movements. More specifically, we provide a first bulk of micro-foundations for the evidence available on aggregate exports, in particular for the findings of Bernard et al. (2015), according to which aggregate exports to destinations with high shares of intermediary exports are less responsive to changes in the RER than exports to markets served primarily by direct exporters.

With the support of the evidence stemming from Italian firm-level trade data, we show that goods traded via intermediaries are characterized by a lower degree of exchange rate pass-through than goods directly exported by their own producers, as a result of double marginalization in the presence of local distribution costs (the latter being the condition for heterogeneous markups and incomplete pass-through).

We achieve this result without departing away from two well-consolidated facts in trade literature. The first one is the productivity sorting pattern described by Akerman (Forthcoming), Ahn et al. (2011) and Felbermayr and Jung (2011), among others, which regulates the selection of the export mode of each firm. The second is represented instead by the finding of Berman et al. (2012), that is, the markup adjustment to RER movements is larger for high productivity firms. Both these facts are still valid in our framework: more productive firms export directly and adjust their markups in the event of external shocks to a larger extent that the less productive firms that export indirectly. However, because of the double adjustment of the indirect exporter's and the intermediary's markups, the overall price adjustment turns out to be larger for goods traded by intermediaries, rather than directly.

Since our data do not allow for a decomposition of export prices into their cost component and markups, a further and more general validation of our theory is postponed to some future research, when more disaggregated data on export unit values and unit production costs will be made available. This paper also explores how the direct and the intermediary export flows to a given destination react to RER movements along the extensive margin of adjustment, i.e. the measure of varieties traded along the two channels. Under specific assumptions on the firm productivity distribution, we derive a clear prediction on the effects of real appreciations and depreciations, that is, the measure of products traded through intermediaries tends to vary more than the measure of products exported directly by their producers.

Albeit we find evidence of this aggregate result, much still remains to be done in clarifying (i) how individual firm decide the products to be dropped or to be added to their export baskets in the event of RER movements or other exogenous shocks; and (ii) how these decisions are related to the firm status of direct or intermediary exporter. This would require a more sophisticated analysis, with a proper characterization of different elements such as the nature of local distribution costs and fixed costs of export in the presence of multi-product firms (specifying to what extent these costs are firm- or product-specific) and the mechanisms that govern the matching between indirect exporters and intermediaries (thereby going beyond the simplifying assumptions of random matching and symmetric intermediary firms).

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Appendix A: Mathematical Appendix

A1 - Productivity cut-offs in the absence of intermediaries

In this Appendix we show that, when the intermediary sector is ruled out, the critical cut-off level of productivity for entry in the domestic market is

$$\varphi_D = \frac{1}{\left(\frac{\psi A}{f_D}\right)^{\frac{1}{\sigma-1}}} \quad \text{, where } \psi \equiv \frac{(\sigma-1)^{\sigma-1}}{\sigma^\sigma \delta} \ .$$

Proof. This cut-off corresponds to that particular value of φ_i, such that

$$\pi_i = \frac{1}{\delta}\left(p_i q_i(p_i) - \frac{1}{\varphi_i} w_i q_i(p_i)\right) - f_D = 0 \ .$$

Given $w_i = 1$, it follows that $\left(\frac{\sigma}{\sigma-1}\frac{1}{\varphi_i} - \frac{1}{\varphi_i}\right) A\,(p_i)^{-\sigma} = \delta f_D$. With some manipulation, we get

$$A\varphi_i^{\sigma-1} = \underbrace{\delta\,(\sigma-1)^{1-\sigma}\,\sigma^\sigma}_{\equiv 1/\psi} f_D \ ,$$

which leads to the expression for φ_D reported in Section 2.2. □

The critical cut-off level of productivity for entry in the foreign market is instead

$$\varphi'_X = \frac{\tau\varepsilon}{\left(\frac{\psi A^*}{\varepsilon f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} \ .$$

Proof. This cut-off corresponds to that particular value of φ_i, such that

$$\pi_i^* = \frac{1}{\delta}\left(p_i^* \cdot q_i^*(\widetilde{p}_i^*) \cdot \tau - \frac{1}{\varphi_i} \cdot q_i^*(\widetilde{p}_i^*) \cdot \tau\right) - f_X = 0$$

Standard steps leads to $(\mu_i^* - 1)\frac{1}{\varphi_i} \cdot A^*(\widetilde{p}_i^*)^{-\sigma} \cdot \tau = \delta f_X$, which can be re-written as

$$\left[\underbrace{\frac{\sigma}{\sigma-1}\left(1 + \frac{\eta^*\varphi_i}{\sigma\tau\epsilon}\right)}_{\mu_i^*} - 1\right]\frac{1}{\varphi_i} \cdot A^* \left[\tau\varepsilon\underbrace{\frac{\sigma}{\sigma-1}\left(1 + \frac{\eta^*\varphi_i}{\sigma\tau\epsilon}\right)\frac{1}{\varphi_i}}_{p_i^*} + w^*\eta^*\right]^{-\sigma} \cdot \tau = \delta f_X \ .$$

From the above equation, we get $w^*\eta^* + \frac{\tau\varepsilon}{\varphi_i} = \left[\frac{\psi A^*}{\varepsilon f_X}\right]^{\frac{1}{\sigma-1}}$ and this, after some simple manipulation, delivers the expression for φ'_X reported above and in Section 2.2. □

Finally, we check that $\varphi'_X > \varphi_D$. If this inequality holds, then

$$\tau\left(\frac{\varepsilon^\sigma \psi f_X}{\psi f_D}\right)^{\frac{1}{\sigma-1}} > \left(\frac{A^*}{A}\right)^{\frac{1}{\sigma-1}}\left(1 - w^*\eta^*\left(\frac{\varepsilon f_X}{\psi A^*}\right)^{\frac{1}{\sigma-1}}\right) \ .$$

As in Akerman (Forthcoming), accounting also for free entry, which means that $E(\pi) = f_E$, yields that $A = A^*$. The above inequality then turns into

$$\tau \left(\frac{\varepsilon^{\sigma} f_X}{f_D} \right)^{\frac{1}{\sigma-1}} > 1 - w^* \eta^* \left(\frac{\varepsilon f_X}{\psi A^*} \right)^{\frac{1}{\sigma-1}} .$$

We can finally conclude that all the previous inequalities hold, conditional on

$$f_X > f_D \left[\tau \varepsilon^{\frac{\sigma}{\sigma-1}} + w^* \eta^* \left(\frac{\psi A^*}{\varepsilon f_D} \right)^{-\frac{1}{\sigma-1}} \right]^{1-\sigma} .$$

A2 - Comparison among markups

This Appendix provides formal proofs of the Results 1 and 2 reported in Section 3.1.

Proof. We split the proof of Result 1 in two halves. In this first one, we prove that μ_{ij} (i.e. the indirect exporter's markup, in case good i is traded through a generic intermediary j) is larger than μ_i (i.e. the Dixit-Stilglitz markup applied by firm i when selling its variety to national consumers). Given the expressions of the two markups, respectively from equations (5) and (1), in order for μ_{ij} to be larger than μ_i, we must verify that

$$\underbrace{\frac{(\sigma-1)^2}{\sigma(\sigma-2)}}_{>1} \left(1 + \underbrace{\frac{\eta * \varphi_i}{(\sigma-1)\,\epsilon\tau}}_{>0} \right) > 1 .$$

This inequality holds for any admissible value of $\sigma \in [2, +\infty)$, since $(\sigma-1)^2/[\sigma(\sigma-2)] > 1$ is always true for $\sigma > 2$; and $\eta^* \varphi_i/[(\sigma-1)\epsilon\tau] > 0$ is verified for any $\sigma > 1$. □

Proof. The second part of the proof of Result 1 entails a comparison between μ_{ij}, i. e. the indirect exporter's markup that applies when variety i is traded indirectly, and μ_i^*, which is the markup that firm i would apply in case of direct export, reported in equation (2). If $\mu_{ij} > \mu_i^*$, then

$$\frac{\sigma-1}{\sigma-2} \left(1 + \frac{\eta^* \varphi_i}{(\sigma-1)\,\epsilon\tau} \right) > \frac{\sigma}{\sigma-1} \left(1 + \frac{\eta^* \varphi_i}{\sigma\tau\epsilon} \right) ,$$

which is true provided that $\eta^* \varphi_i/(\tau\epsilon) > -1$. However, this condition is always satisfied, since $\varphi_i, \eta^*, \epsilon$ and τ are all positive real numbers. □

Proof. Finally, we prove that μ_{ij}, i.e. the indirect exporter's markup when variety i is traded through intermediary j is larger then μ_j^*, i.e. the intermediary j's markup charged on this product, according to equation (4). This corresponds to Result 2. The condition of our interest is

$$\frac{\sigma-1}{\sigma-2} \left(1 + \frac{\eta^* \varphi_i}{(\sigma-1)\,\epsilon\tau} \right) > \frac{\sigma\epsilon\tau + 2\eta^* \varphi_i}{(\sigma-1)\,\epsilon\tau + \eta^* \varphi_i} ,$$

and it is straightforward to show that this inequality is always verified, since the polynomial $(\eta^* \varphi_i)^2 + 2\epsilon\tau\eta^* \varphi_i + (\epsilon\tau)^2$ is larger than zero, given $\varphi_i, \eta^*, \epsilon$ and $\tau \in (0, +\infty)$. □

A3 - Export mode selection

In this Appendix we show how productivity sorting characterizes the selection of the mode of export of each firm. For producer i, the expected profit from direct export sales (discounted by the forced exit rate) is

$$\pi_i^* = \frac{1}{\delta}\left[p_i^* \cdot q_i^*(\widetilde{p}_i^*) \cdot \tau - \frac{1}{\varphi_i} \cdot q_i^*(\widetilde{p}_i^*) \cdot \tau\right] - f_X = \frac{(\sigma-1)^{\sigma-1}}{\sigma^\sigma \delta}\frac{A^*}{\varepsilon} \cdot \left(\frac{\tau\varepsilon}{\varphi_i} + w^*\eta^*\right)^{1-\sigma} - f_X \ ,$$

whereas the expected (discounted) profit from indirect export sales through intermediary j is

$$\pi_{ij} = \frac{1}{\delta}\left[p_{ij} \cdot q_{ij}^*(\widetilde{p}_{ij}^*) \cdot \tau - \frac{1}{\varphi_i} \cdot q_{ij}^*(\widetilde{p}_{ij}^*) \cdot \tau\right] - f_W = \frac{(\sigma-2)^{\sigma-1}}{\sigma^\sigma \delta}\frac{A^*}{\varepsilon} \cdot \left(\frac{\tau\varepsilon}{\varphi_i} + w^*\eta^*\right)^{1-\sigma} - \lambda f_X \ .$$

The minimum level of productivity for a direct entry into the foreign market can be proved to be

$$\varphi_{X^{dir}} \equiv \frac{\tau\varepsilon}{\left(\frac{\phi A^*}{\varepsilon f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} \ , \text{ where } \phi \equiv \frac{(\sigma-1)^{\sigma-1} - (\sigma-2)^{\sigma-1}}{\sigma^\sigma\delta} \ .$$

Proof. The choice of exporting directly, rather than indirectly, is motivated by the occurrence of the following condition: $\pi_i^* > \pi_{ij}$, which implies

$$\frac{(\sigma-1)^{\sigma-1}}{\sigma^\sigma \delta}\frac{A^*}{\varepsilon} \cdot \left(\frac{\tau\varepsilon}{\varphi_i} + w^*\eta^*\right)^{1-\sigma} - f_X > \frac{(\sigma-2)^{\sigma-1}}{\delta\sigma^\sigma}\frac{A^*}{\varepsilon} \cdot \left(\frac{\tau\varepsilon}{\varphi_i} + w^*\eta^*\right)^{1-\sigma} - \lambda f_X \ .$$

The inequality reduces as follows

$$\varphi_i > \frac{\tau\varepsilon}{\left(\frac{\phi A^*}{\varepsilon(1-\lambda) f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} \ ,$$

where ϕ is a constant term that depends only on σ and δ. The above condition identifies the cut-off level of our interest, which is the one reported in equation (11) in Section 3.3.[30] □

Given the profits associated with two export modes, the critical cut-off for indirect entry into the foreign market is instead

$$\varphi_{X^{ind}} = \frac{\tau\varepsilon}{\left(\frac{\chi A^*}{\varepsilon\lambda f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} \ , \text{ where } \chi \equiv \frac{(\sigma-2)^{\sigma-1}}{\sigma^\sigma\delta}$$

and $\lambda f_X = f_J$ is the fixed cost that each producer has to pay in order to gain access to the services of a trade intermediary, this cost representing a fraction λ of the fixed cost of (direct) entry in the foreign market, namely f_X.

[30] To draw a parallel with the simpler model of Akerman (Forthcoming), with no local distribution costs, in its setting the direct export cut-off turns out to be: $(\varphi_{X^{dir}})^{Ake} = \left[f_X/\left(\tau^{1-\sigma}\psi A^*\left(1-\left(\frac{\sigma-1}{\sigma}\right)^\sigma\right)\right)\right]^{\frac{1}{\sigma-1}} = \tau/\left[\overline{\phi}A^*/f_X\right]^{-\frac{1}{\sigma-1}}$, where $\overline{\phi} \equiv (1/\psi) \cdot \left[1-\left(\frac{\sigma-1}{\sigma}\right)^\sigma\right]^{-1} = \frac{\sigma^\sigma-(\sigma-1)^\sigma}{(\sigma-1)^{1-\sigma}\sigma^{2\sigma}\delta}$.

Proof. The choice of exporting indirectly, rather than servicing only the domestic market, is motivated by the occurrence of the condition $\pi_{ij} > 0$, which entails

$$\frac{(\sigma-2)^{\sigma-1}}{\delta\sigma^{\sigma}}\frac{A^*}{\varepsilon}\cdot\left(\frac{\tau\varepsilon}{\varphi_i}+w^*\eta^*\right)^{1-\sigma} > f_J = \lambda f_X$$

With some simple algebra, this condition reduces to the following restriction

$$\varphi_i > \frac{\tau\varepsilon}{\left(\frac{\chi A^*}{\varepsilon f_W}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*}\text{ , where } \chi \equiv \frac{(\sigma-2)^{\sigma-1}}{\sigma^{\sigma}\delta}\ .$$

This identifies the indirect export cut-off, as reported in equation (12) in Section 3.3.[31] □

If λ is small enough (i.e. the fixed cost associated with indirect export is small enough as compared to the fixed cost of direct entry into the foreign market), the model generates a standard productivity sorting pattern as regards the choice of the mode of export. The most productive firms, i.e. those with productivity $\varphi_i > \varphi_{X^{dir}}$, will export directly, as they are productive enough to take the fixed cost of exporting themselves, thereby avoiding their products to be subject to double marginalization. Firms with intermediate productivity levels, i.e. those with $\varphi_i \in (\varphi_{X^{ind}}, \varphi_{X^{dir}})$, will export through the intermediary sector. Finally, the least productive firms, i.e. those with productivity $\varphi_i \in (\varphi_D, \varphi_{X^{ind}})$, will do not engage in export activity and will only serve the domestic market. The last result, in particular, holds conditional on imposing the following restriction

$$\lambda f_X > \frac{\chi}{\psi} f_D\left[\tau\varepsilon^{\frac{\sigma}{\sigma-1}} + w^*\eta^*\left(\frac{\psi A^*}{\varepsilon f_D}\right)^{-\frac{1}{\sigma-1}}\right]^{1-\sigma}\ ,$$

where f_D is the fixed cost of entry in the domestic market, sunk by all firms with productivity larger than φ_D.

Proof. It is straightforward to prove that $\varphi_{X^{dir}} > \varphi_{X^{ind}}$ as long as we restrict λ to be lower than a given threshold, to be determined hereinafter. Given the expressions of the two cut-off levels, $\varphi_{X^{dir}} > \varphi_{X^{ind}}$ necessarily implies

$$\frac{\chi A^*}{\varepsilon\lambda f_X} > \frac{\phi A^*}{\varepsilon(1-\lambda) f_X}$$

which is always verified as far as $\lambda < \left(\frac{\sigma-2}{\sigma-1}\right)^{\sigma-1}$.

Under the above restriction, only the most productive among the firms able to export in the absence of an intermediary sector will actually prefer to export directly, rather than indirectly, once the intermediary sector has been introduced. The other firms will keep exporting, but they will find more convenient to do so by using intermediaries, rather than by managing directly the exchange.

[31] In Akerman (Forthcoming) the corresponding cutoff is pin down by accounting for the optimal scope of intermediaries when solving for the equilibrium, since manufacturing firms access to the services provided by trade intermediaries without incurring a fixed cost ($\lambda = 0$), but intermediaries incur in a cost when adding new varieties to their export basket.

Furthermore, if $\varphi_{X^{ind}} > \varphi_D$ holds, then we have

$$\frac{\tau\varepsilon}{\left(\frac{\chi A^*}{\varepsilon\lambda f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} > \frac{1}{\left(\frac{\psi A^*}{f_X}\right)^{\frac{1}{\sigma-1}}} .$$

As in Appendix A, free entry implies that $A = A^*$. The inequality then turns into

$$f_X > \frac{\chi}{\lambda\psi} f_D \left[\tau\varepsilon^{\frac{\sigma}{\sigma-1}} + w^*\eta^* \left(\frac{\psi A^*}{\varepsilon f_D}\right)^{-\frac{1}{\sigma-1}}\right]^{1-\sigma} ,$$

which is the counterpart, for the model with intermediaries, of the condition (3), namely

$$f_X > f_D \left[\tau\varepsilon^{\frac{\sigma}{\sigma-1}} + w^*\eta^* \left(\frac{\psi A^*}{\varepsilon f_D}\right)^{-\frac{1}{\sigma-1}}\right]^{1-\sigma} ,$$

that must be imposed in the model without intermediaries to ensure that manufacturing firms cannot be exporters without being able to serve first their own domestic market. □

Provided that λ is small enough, our model then predicts that the export cut-off in the absence of intermediaries, namely φ'_X, is (i) lower then the direct-export cutoff in the presence of an intermediary sector, i.e. $\varphi_{X^{dir}}$; and (ii) larger than the indirect-export cutoff, namely $\varphi_{X^{ind}}$. This means that, when introducing trade intermediaries, the basket of goods traded along the indirect export channel will include both:

- goods produced by manufacturers that would be able to export by their own (even in the absence of an intermediation sector), but find more profitable to use intermediaries, when the latter are available;
- goods produced by firms that, because of their lower marginal productivity, would not be able export if not assisted, and therefore manage to reach the overseas markets only thanks to the presence of intermediation sector.

Proof. It is straightforward to prove that $\varphi_{X^{dir}} > \varphi'_X$ conditional on λ being sufficiently small. In fact, $\varphi_{X^{dir}} > \varphi'_X$ necessarily implies

$$\frac{\tau\varepsilon}{\left(\frac{\phi A^*}{\varepsilon(1-\lambda) f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} > \frac{\tau\varepsilon}{\left(\frac{\psi A^*}{\varepsilon f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} ,$$

which is always verified as far as $(1-\lambda)\psi > \phi$, a condition that can be reduced to $\lambda < \left(\frac{\sigma-2}{\sigma-1}\right)^{\sigma-1}$.

Under this restriction, we can also prove that

$$\frac{\tau\varepsilon}{\left(\frac{\chi A^*}{\varepsilon\lambda f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} < \frac{\tau\varepsilon}{\left(\frac{A^*}{\varepsilon\psi f_X}\right)^{\frac{1}{\sigma-1}} - w^*\eta^*} ,$$

which means $\varphi_{X^{ind}} < \varphi'_X$. Indeed, the above condition is satisfied for $\psi\lambda < \chi$, which is always true, again, if $\lambda < [(\sigma-2)/(\sigma-1)]^{\sigma-1}$. □

Notice that, under the above restriction on λ (which leads to the emergence of the sorting pattern in the manner of Akerman (Forthcoming) and Ahn et al. (2011), among others) the condition that must be imposed to prevent firms from selecting in the export market without also selecting in the domestic market is more severe in the model with intermediaries, than in the model without.

In the setting with the intermediation sector, $\varphi_{X^{dir}} > \varphi_D$ necessarily implies

$$f_X > \frac{\chi}{\psi\lambda} f_D \left[\tau\varepsilon^{\frac{\sigma}{\sigma-1}} + w^*\eta^* \left(\frac{\psi A^*}{\varepsilon f_D} \right)^{-\frac{1}{\sigma-1}} \right]^{1-\sigma} \equiv F_X \ ,$$

while, in the model without intermediaries, the fact that $\varphi'_X > \varphi_D$ implies

$$f_X > f_D \left[\tau\varepsilon^{\frac{\sigma}{\sigma-1}} + w^*\eta^* \left(\frac{\psi A^*}{\varepsilon f_D} \right)^{-\frac{1}{\sigma-1}} \right]^{1-\sigma} \equiv F'_X \ .$$

It can be proved that $F_X > F'_X$ as long as $\lambda < \chi/\psi$ or, equivalently, $\lambda < [(\sigma-2)/(\sigma-1)]^{\sigma-1}$, in line with the restriction imposed to ensure that $\varphi_{X^{ind}} < \varphi'_X < \varphi_{X^{dir}}$.

A4 - Comparison of the export cut-off elasticities

This Appendix provides a proof for condition (13), which states that, if $\lambda < [(\sigma-2)/(\sigma-1)]^{\sigma-1}$, then the indirect-export productivity cut-off is more elastic to the RER than the direct-export cut-off.

Proof. The inequality reported in (13) can be expressed as

$$\underbrace{1 - \frac{\frac{1}{\sigma-1}\left(\frac{(w^*)^{-\sigma}\chi A^*}{\lambda\epsilon f_X}\right)^{\frac{1}{\sigma-1}}}{\left(\frac{(w^*)^{-\sigma}\chi A^*}{\lambda\epsilon f_X}\right)^{\frac{1}{\sigma-1}} - \eta^*}}_{=E_{X^{ind};\epsilon}} > \underbrace{1 - \frac{\frac{1}{\sigma-1}\left(\frac{(w^*)^{-\sigma}\phi A^*}{\epsilon(1-\lambda) f_X}\right)^{\frac{1}{\sigma-1}}}{\left(\frac{(w^*)^{-\sigma}\phi A^*}{\epsilon(1-\lambda) f_X}\right)^{\frac{1}{\sigma-1}} - \eta^*}}_{=E_{X^{dir};\epsilon}} \ ,$$

where both the cut-off elasticities are written as a function of the RER, i.e. $\epsilon = \varepsilon w^*/w$ (with $w = 1$), instead of the nominal exchange rate ε. The above condition can be reduced to

$$\eta^* \left[1 - \left(\frac{\phi\lambda}{\chi(1-\lambda)} \right)^{\frac{1}{\sigma-1}} \right] > 0 \ ,$$

and then to $\left(\frac{\phi\lambda}{\chi(1-\lambda)}\right)^{\frac{1}{\sigma-1}} < 1$, given $\eta^* > 0$.

Since $1/(\sigma-1) > 0$ is certainly a positive number (given $\sigma > 2$), we can conclude that inequality (13) holds as far as

$$\underbrace{\frac{(\sigma-1)^{\sigma-1} - (\sigma-2)^{\sigma-1}}{\sigma^\sigma\delta}}_{\equiv\phi} \cdot \lambda < \underbrace{\frac{(\sigma-2)^{\sigma-1}}{\sigma^\sigma\delta}}_{\equiv\chi} \cdot (1-\lambda) \ ,$$

which leads us to the usual fundamental condition, that is $\lambda < \left(\frac{\sigma-2}{\sigma-1}\right)^{\sigma-1}$. □

Appendix B: Empirical Appendix

Table B1: Exchange rates and firm's export values, quantities and unit values by product and country over time, by different type of firms, Extra-EU: using Wholesaler Price Index

	Annual Differences		
	ln X_{fcpt}	ln UnitValue_{fcpt}	ln Quantity_{fcpt}
	(1)	(2)	(3)
ln RER_{ct}	-0.352***	-0.039***	-0.313**
	(0.135)	(0.012)	(0.138)
$*D_{ft}^{W}$	0.037**	-0.035**	0.072**
	(0.15)	(0.017)	(0.35)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm-Product FE	Yes	Yes	Yes
Clustering Country-Year	Yes	Yes	Yes
Adj R-squared	-0.011	0.033	-0.012
Observations	3655626	3655626	3655626

Note: Table reports the results of regressions at the firm-product-country level, obtained by using data on export values, quantities and unit values between 2000 and 2007. The dependent variables and the real exchange rates (RER) are defined as annual differences. D_{ft}^{W} is a dummy for intermediaries; $*D_{ft}^{W}$ is the interaction term with real exchange rates in annual differences. 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.

Table B2: Firms' productivity and Exchange Rate Changes

Sample	Single Prod	Main Prod (by value)	Main Prod (by destin.)	Single Prod	Main Prod (by value)	Main Prod (by destin.)
	ln UnitValue_{fcpt}	ln UnitValue_{fcpt}	ln UnitValue_{fcpt}	ln Export_{fcpt}	ln Export_{fcpt}	ln Export_{fcpt}
$\widetilde{TFP}_{t-1}$	0.027***	0.030***	0.031***	0.053***	0.072***	0.066***
	(0.007)	(0.004)	(0.005)	(0.018)	(0.012)	(0.011)
ln RER	-0.015	-0.043***	-0.034**	-0.408***	-0.522***	-0.454***
	(0.010)	(0.013)	(0.015)	(0.098)	(0.117)	(0.114)
$\widetilde{TFP}_{t-1}$ * ln RER	-0.005**	-0.003	-0.003*	0.004*	0.002	0.005**
	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.002)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster Country-Year	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-squared	0.951	0.959	0.938	0.724	0.753	0.716
Observations	308748	662220	776367	308748	662220	776367

Note: Table reports results of regressions at the firm-product-country level, using cross-border Italian data on export values, quantities and unit values of exported products for the period 2000-2006. We merged the ISTAT trade data 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). Source: Our elaboration on Italian micro-data.

In this Appendix we verify that the results of Berman et al. (2012) holds also for the case of Italian firms. To accomplish this task, we focus on manufacturing firms only and we exploit the same methodology as in Berman et al. (2012) to deal with the existence of multi-product firms. Hence, we consider three samples. The first (*Single Product*) contains single product-and-destination specific observations, i.e. observations referred to firms that export only one product to a given destination. The second (*Main Product by value*) keeps only the top product (in terms of export value) exported by the firm worldwide. Finally, the last (*Main Product by destination*) considers again the top product only, but here the latter is defined as the variety exported to the largest number of destinations.

The estimated equation is

$$\ln Y_{fct} = \beta_0 + \beta_1 \widetilde{TFP}_{ft-1} + \beta_2 \ln RER_{ct} + \beta_3 \widetilde{TFP}_{ft-1} * \ln RER_{ct} + d_j + \nu_{fct} \ , \tag{18}$$

where Y_{fct} is, alternatively, the firm-level unit value or the export value of the single or main product (depending on the sample used), whereas $\widetilde{TFP}_{ft-1}$ denotes the productivity of the firm f in year $t-1$, normalized by the average industry productivity computed in that year. The results are reported in Table B2 and are coherent with the findings of Berman et al. (2012): more productive firms tend to increase more their export prices in response to currency depreciations. As a result, their export sales display a smaller increase when compared to firms with lower TFP.