Monograph:

Navas, A., Serti, F. and Tomasi, C. (2013) Intermediate inputs and the export gravity equation. Research Report. Department of Economics, University of Sheffield ISSN 1749-8368

2013014

The University Of Sheffield.

Department Of Economics.

Sheffield Economic Research Paper Series.

Intermediate Inputs and the Export Gravity Equation

Antonio Navas
Francesco Serti
Chiara Tomasi

ISSN 1749-8368

SERP no. 2013014
October 2013

www.sheffield.ac.uk/economics

Intermediate inputs and the export gravity equation*

Antonio Navas[a], Francesco Serti[b], and Chiara Tomasi[c]

[a]Department of Economics, The University of Sheffield
[b]Departamento de Fundamentos del Analisis Economico, Universidad de Alicante
[c]University of Trento, Italy, and LEM, Scuola Superiore Sant'Anna, Italy

October 16, 2013

Abstract

This paper introduces imports in intermediate inputs into a standard heterogeneous firms model of trade with asymmetric countries. The model highlights how imports from a specific country affects a firm's decision to export to that country (the extensive margin), as well as its export value (the intensive margin). The model shows that the effect of both distance and market size on the export margins is magnified when imports in intermediates are accounted for. Indeed, to the extent that exporting firms also use foreign intermediate inputs, the impact of traditional gravity forces on exports also depends on import activities. Exploiting data on product-destination level transactions of a large panel of Italian firms, the paper provides empirical evidence in support of the predictions of the model. Controlling for firm-level time-varying unobserved heterogeneity and for the potential endogeneity of firm-level import decisions, the empirical analyses confirm that the estimated elasticities of exports to distance and market size depend on firms' importing activities.

JEL codes: F12, F14

Keywords: Imports, Exports, Firm heterogeneity, Gravity equation.

*The present work has been possible thanks to a research agreement between the Italian Statistical Office (ISTAT) and the Scuola Superiore Sant'Anna. Chiara Tomasi gratefully acknowledges financial support from the Marie Curie Program Grant COFUND Provincia Autonoma di Trento. Francesco Serti gratefully acknowledges financial support from The Spanish Ministry of Economics and Competition (ECO2012- 34928).

1 Introduction

A growing empirical and theoretical literature has emphasised the importance of firm heterogeneity in trade. The burgeoning micro-econometric studies on international trade have mostly focused on exports, while imports have been relatively neglected. Even less attention has been given to firms engaged in a combination of both imports and exports. This is quite surprising given the increasing international fragmentation of production, implying that more and more firms are active in both imports and exports of intermediates and final goods (Hummels et al.; 2001). Only very recently new research on firm heterogeneity and trade has started combining information on both the import and export sides. The available studies show that the majority of exporters are also importers and vice versa. These firms, which have been labeled as two-way traders, account for the bulk of a country's total trade (Bernard et al.; 2007; Mayer and Ottaviano; 2008; Muuls and Pisu; 2009). Furthermore, a few studies have addressed the key role that imports have in enhancing manufacturing exports. The results suggest that imports positively affect a firm's probability to become an exporter, as well as its export value and scope (Kasahara and Lapham; 2013; Bas and Strauss-Kahn; 2010).

We contribute to this new strand of literature by investigating previously unexplored effects of the connection between an individual firm's import and export outcomes. Precisely, the paper studies the consequent influence that the complementarity between the two trade activities has on the export gravity equation, at the firm level. The basic form of the gravity equation relates exports to the economic size and the geographical distance of the destination market, with the latter used as a proxy for transportation costs. The recent trade models with heterogeneous firms show that the gravity forces affect exports via both the extensive and intensive margins of trade (Melitz; 2003; Chaney; 2008; Helpman et al.; 2008). Accordingly, higher market size or lower distance increase the probability that a firm exports to a particular destination as well as its export value to that market.[1] However, whether a firm is importing or not may be crucial to evaluate the overall impact that market size and distance have on its export patterns.

This paper derives and estimates the export gravity equation for both the extensive and intensive margins of trade among asymmetric countries in the presence of imports in intermediate inputs. Our theoretical framework follows Chaney (2008) which derives the gravity equation for final good exports in a model of trade with firm heterogeneity. As in Chaney (2008) countries are asymmetric and differ in terms of size, labour costs, trade and institutional barriers. In addition, our model introduces an intermediate input sector. To produce, firms in the final good sector use labor and a continuum of intermediate inputs from different locations. The technology is similar to early endogenous growth models (Romer; 1990; Rivera-Batiz and Romer; 1991), which use a Cobb Douglas specification in which there is love of variety in intermediate inputs.

Two main implications emerge from our setting. First, the exports of final goods are more reactive to distance in the presence of imports in intermediate inputs. A decline in transportation costs (i.e. in distance) has, in fact, a comparatively larger impact on a firm's probability of exporting and on its export value. This is because, in addition to the standard direct effect found in the gravity model, a reduction in transportation costs also decreases the cost of imported inputs, thus allowing firms to offer their exports at lower prices and to increase their revenues in the exporting markets. Second, following a similar reasoning the presence of intermediate imports amplifies the effect of the foreign market size. The intuition is that the bigger the foreign country, the larger the mass

[1] As suggested in Crozet and Koenig (2010), the definition employed in this paper for the intensive margin of export reflects that used in Chaney (2008), that is the value shipped by the marginal exporter, which differs from the average shipment per exporter, used in most empirical analyses (Eaton et al.; 2004; Bernard et al.; 2007; Mayer and Ottaviano; 2008).

of imported inputs and the lower the marginal cost of production. Importing from bigger markets determines larger efficiency gains and thereby increases a firm's export performance. Thus, foreign market size exerts a positive effect on exports also indirectly through an efficiency increase induced by imports of intermediate inputs.

Our model is also able to reproduce some stylized facts which have emerged from the recent empirical literature. New research show that there is a positive correlation between imports and a firm's productivity. More generally, importers display similar characteristics to those observed for exporters (Bernard et al.; 2007). The evidence points to the presence of fixed costs not only of exporting, but also of importing and to a process of self-selection in both export and import markets (Kasahara and Lapham; 2013; Castellani et al.; 2010). Also, many theoretical and empirical studies have recognised that imports of intermediate and capital goods can raise productivity via several channels: learning, variety and quality effects.[2] In line with these findings our theoretical framework predicts that the relatively more productive firms self select into importing and that only a subset of the most productive firms undertake both trade activities. Moreover, the model shows that importing increases a firm's productivity, through a better reallocation of resources across new intermediate inputs.

We test the main predictions of our model by exploiting an original Italian database obtained by merging a firm-level dataset, including standard balance sheet information, with a transaction-level dataset, recording custom information on exports and imports for each product and destination. The key advantage of our data is that we know, for each firm in the panel, whether a firm exports or imports, how much it trades, and where it exports to or imports from. Moreover, by exploiting the product information we can distinguish whether a firm's imports are intermediate inputs. Firm-level trade data are complemented by country characteristics including proxies for market size, distance, variable and fixed trade costs.

All the empirical results support the theoretical predictions of the model showing that, both on the extensive and the intensive margins, the estimated elasticities of exports to distance and GDP depend on firms' importing activities.

Within the vast empirical literature on firm heterogeneity in international trade, this article directly relates to the emerging literature on the interdependence between importing and exporting activities. A leading recent theory is provided by Kasahara and Lapham (2013) who develop a symmetric country model on the import-productivity-export nexus. In their theoretical framework the use of foreign intermediates increases a firm's productivity but, because of the existence of fixed costs of importing, only the most productive firms are able to source from abroad. In turn, productivity gains from importing allows some importers to start exporting. In a similar framework, Nocco (2012) studies the consequences for average productivity and welfare of trade liberalisation in a model of trade with vertical linkages,obtaining that the results clearly depend on the share of intermediate inputs in the total production of the final good. Unlike these papers, we extend the Melitz (2003) model to incorporate trade in intermediates in an asymmetric country environment. The latter allows us to derive the gravity equation and to include cross country determinants of export and import activities across firms, which is the focus of the paper. The causal link from intermediate inputs to final good exports is also tested in Bas and Strauss-Kahn (2010). Using French firm level data the study shows that a larger variety of imported inputs, increases firms' productivity and firms with high productivity levels export more varieties. The importance of imported intermediates for exports is also implied by Feng et al. (2012), who find that Chinese

[2]For a theoretical background of the productivity gains induced by intermediate inputs see Markusen (1989); Grossman and Helpman (1991); Acharya and Keller (2009) among others. Micro-level empirical studies providing evidence on the positive relationship between import and firm productivity include Kasahara and Rodrigue (2008) for Chile, Halpern et al. (2011) for Hungary, Amiti and Konings (2007) for Indonesia.

firms that increased the expenditure and the varieties of imported inputs enlarged the value and the scope of their exports.

Our paper is also strongly connected to the literature on the gravity equation. Applied for the first time by Tinbergen (1962), the equation shows that trade between two countries is proportional to their respective sizes, measured by their GDP, and inversely proportional to the geographic distance between them. The heterogeneous-firm model brings to the gravity model a need to consider the effects of trade barriers both on the value of exports by current exporters and on the entry of exporters. In his model Chaney (2008) extends the work of Melitz (2003) to show that there is both an intensive and an extensive margin of adjustment of trade flows to trade barriers. In a similar manner, Helpman et al. (2008) derive a gravity equation and develop an estimation procedure to obtain the effects of trade barriers and policies on the two margins. Empirical analyses that use firm-country level data confirm several of the theoretical predictions. Eaton et al. (2011, 2004) for France and Bernard et al. (2007) for the US find that the number of exporting firms is sharply decreasing in the distance to the destination country and increasing in importer income. Crozet and Koenig (2010) use French data to estimate the structural parameters of Chaney's model and show by how much the foreign sales of a given set of firms and by how much the number of firms respond to changes in trade costs. By estimating an export firm-level gravity equation, other empirical studies offer evidence that both firm-level productivity and market-specific trade costs affect individual export decision and export sales to a particular destination (Lawless and Whelan; 2008; Smeets et al.; 2010).

None of the cited studies, however, consider the role played by imports in the export firm level gravity equation. Indeed, while it has been already established that market size and distance are crucial in shaping exports patterns, it is an open question whether and how importing plays a role in the gravity mechanisms. This paper provides a micro-foundation for the export gravity equation with imports in intermediate inputs.

The remained of the paper is organized as follows. Section 2 presents a trade model with heterogeneous firms, featuring imports in intermediate inputs to derive the export gravity equation, both at firm and industry level. Section 3 introduces the strategy in the empirical analysis and describes the data for the empirical study. Section 4 presents the estimation results and Section 5 concludes.

2 The model

The aim of this section is to motivate our empirical analysis by introducing a partial equilibrium model to study the effects of imports in intermediate inputs in the export gravity equation at the firm level. The model is based on Chaney (2008), which extends Melitz (2003) to incorporate trade between asymmetric countries. To the latter framework we add an intermediate input sector and we allow for trade in both intermediate inputs and final goods.

2.1 Preferences

Consider N potential asymmetric countries, indexed by n, each of them populated by a continuum of individuals of measure L_n who derive utility from the consumption of the $H+1$ final goods existing in the economy according to the following functional form

$$U = \prod_{h=0}^{H} (Q_{hn})^{\mu_h}, \qquad \sum_{h=0}^{H} \mu_h = 1,$$

where Q_{hn} represents consumption of final good h in the generic country n. Sector 0 produces an homogeneous good. Each of the rest of the H different sectors produces a continuum of varieties ω in the set Ω_h. Preferences across different varieties of the same final good are described by the CES utility function

$$Q_{hn} = \left(\int_{\omega \epsilon \Omega_h} (q_{hn}(\omega))^{\frac{\sigma_h - 1}{\sigma_h}} d\omega \right)^{\frac{\sigma_h}{\sigma_h - 1}} , \quad \sigma_h > 1$$

where the parameter σ_h controls for the elasticity of substitution across varieties within the sector h. Solving for the consumer's maximization problem we obtain the demand function for each variety within each sector

$$q_{hn}(\omega) = \frac{\mu_h R_n}{P_{hn}} \left(\frac{p_{hn}(\omega)}{P_{hn}} \right)^{-\sigma_h}$$

where R_n, P_{hn} represents respectively income and the standard CES aggregate price index for country n.[3]

2.2 Production

Production of the homogeneous good uses labor as an input. The technology is linear, described by the following functional form

$$q_{0n} = \varepsilon_n l_{0n}.$$

Assuming that this good is produced under perfect competition and taking this good as the numeraire, profit maximization will imply that $w_n = \varepsilon_n$. Each firm produces a unique differentiated variety. To produce, each firm f in the final good sector h needs to incur in per period fixed costs of operation f_h (in units of the numeraire). In contrast to Chaney (2008) we assume that firms use intermediate inputs and labor to produce. More precisely, each firm produces using the following Cobb-Douglas technology

$$q_{hn}^f = \varphi_h^f \left(l_{hn}^f \right)^{1-\alpha_h} \left(m_{hn}^f \right)^{\alpha_h} \tag{1}$$

where l_h^f denotes labor dedicated to production, $m_{hn}^f = \left(\int_{\nu \epsilon \Lambda} \left(m_{hn}^f(\nu) \right)^{\frac{\phi_h - 1}{\phi_h}} d\nu \right)^{\frac{\phi_h}{\phi_h - 1}}$ is the intermediate composite input used in sector h where $m_{hn}^f(\nu)$ is firm f's demand of the intermediate input variety ν produced in country n, and φ_h^f denotes firms' productivity. The parameter $\phi_h > 1$ controls for the degree of substitutability across intermediate inputs within a sector. The parameter α_h measures the importance of intermediate inputs in the production of each final good. We assume that the elasticity of substitution across intermediate inputs is a technological parameter and therefore it is common across all countries though it may differ across sectors. Following Romer (1990) and Rivera-Batiz and Romer (1991), we have assumed that there is love of variety in the set of intermediates and each firm within each country offers a unique variety either in the final

[3] $P_{hn} = \left(\int_{\omega \epsilon \Omega_h} (p_{hn}(\omega))^{1-\sigma_h} d\omega \right)^{\frac{1}{1-\sigma_h}}.$

good sector or in the intermediate input sector. The former will be crucial to obtain the result according to which that importing intermediate inputs has a positive impact on a firm's total factor productivity.

As it is common to this literature, we assume that the firms' productivity is stochastic. More precisely, we assume that φ_h^f follows a Pareto distribution with cumulative density function given by

$$\Pr(\varphi_h^f < \varphi) = 1 - \varphi^{-\gamma_h} \tag{2}$$

with γ_h controlling for the productivity dispersion within sectors. Following the broad literature on trade and firm heterogeneity we assume $\gamma_h > \sigma_h - 1$ and $\gamma_h > 2$. At the moment of entry each firm takes a draw from this common productivity distribution. This determines the productivity of the firm that for simplicity we assume that is constant over time.

In the intermediate input sector, each firm within each country is producing a unique variety. To produce it, the firm uses a simple linear technology where labor is the unique production factor

$$m(\nu) = l_m. \tag{3}$$

We assume, as in Chaney (2008), that the mass of entrants is proportional to the income of the economy (i.e. $w_n L_n$). In this setup, however, we need to make an extra assumption about how the prospective entrants are distributed among the $H+1$ differentiated sectors. We posit that an exogenous percentage of those entrants β_{hn} enters in the final good sector h and a proportion $\beta_{mn} = (1 - \sum_{h=1}^{H} \beta_{hn})$ enters in the intermediate sector. Therefore, our modeling strategy allows two different stages of production characterized by two different sets of tradable goods, final goods and intermediate inputs. However, for the sake of simplicity, the country level determinants of the allocation of resources across the two production stages are left unmodeled.

To complete the definition of the model we assume that all existing firms in the world belong to a mutual fund and each individual in each country owns w_n shares of this mutual fund. In this model entry is exogenous, and since firms earn positive profits in each of the final good sectors and the intermediate input sector, we should assume a way to redistribute positive profits across consumers. Since income distribution does not affect the aggregate variables in this model all our results will be robust to any alternative way of redistributing profits across individuals.

2.3 Trade

In our world there exists trade in both final goods and intermediate inputs. Moreover, both activities bear fixed and variable costs. More precisely, a firm in country k, which wants to export to country j, must pay a fixed cost f_{hxkj} (in units of the numeraire) and variable costs of the iceberg type τ_{hxkj}. We follow Anderson and van Wincoop (2004) in assuming that τ_{hxkj}, the variable export costs in sector h, are a loglinear function of D_{kj}, the distance between countries, and Δ_{hxkj}, other variable costs which are not related to distance (i.e. export tariffs). Export variable trade barriers are given by the following functional form

$$\tau_{hxkj} = \Delta_{hxkj} \left(D_{kj}\right)^{\delta_h}, \tag{4}$$

where $\Delta_{hxkj} > 1$ if $k \neq j$.[4]

[4]If one unit of the good is shipped from country k to country j, only a fraction $1/\tau_{kj}$ reaches country j. $\tau_{kj} > 1$ for any $k \neq j$. We assume as well that $\tau_{kk} = 1$ and the following triangular inequality: $\tau_{kn} \leq \tau_{kj} \times \tau_{jn}$ for any (n, k, j).

Firms have also the option to import intermediates from abroad by incurring a fixed cost of f_{hik} in units of the numeraire. Exporting intermediates is also subject to variable costs of the iceberg type τ_{hmjk}. We assume that variable costs related to distance are the same for final good exporters and intermediate exporters, but we allow for differences in the other variable costs

$$\tau_{hmjk} = \Delta_{hmjk} \left(D_{kj}\right)^{\delta_h} . \tag{5}$$

The inclusion of fixed costs in both activities implies that not all firms are going to find it profitable either to export final goods or to import intermediates. Consistent with the above stylized facts, we are going to show that only those firms that overcome a threshold productivity level will find it profitable to engage in foreign activities and only a subset of these ones, which will be the most productive ones, will find profitable to engage in both activities.

2.4 The firm-level export gravity equation

Since the model is deterministic, depending on the parameters' configuration we can have different types of equilibria. In this paper, we focus on equilibria where the firms engaged in international trade are either both exporters of final goods and importers of intermediate products or just only importers.[5]

Each intermediate input producer is a monopolist of its own variety. This implies that the price the intermediate producer charges will be given by $p_{hmk} = \rho_{hm}\tau_{hmjk}w_j$ where $\tau_{hmjj} = 1$ and $\rho_{hm} = \frac{\phi_h}{\phi_h - 1}$ is the firm's mark-up.[6] The intermediate input producer charges a higher price to the foreign market because it is more costly to serve the foreign market.

In the final good sectors, the firm profit maximization problem can be described in two steps. In the first step, the cost minimization problem, firms choose the optimal combination of inputs for a given production quantity, while in the second step they choose the price (and therefore indirectly the quantity sold) they will charge to consumers for their differentiated product. Solving the first step we obtain that the variable cost of production associated to a firm in country k is given by the following expression [7]

$$c_{hk}\left(\varphi^f\right) = \frac{\left(w_k\right)^{1-\alpha_h}\left(P_{hmk}\right)^{\alpha_h}}{\Gamma_h}\frac{q^f_{hk}}{\varphi^f} = \frac{\left(\rho_{hm}\right)^{\alpha_h} w_k}{\Gamma_h\left(\chi_{hk}\right)^d\left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}}}\frac{q^f_{hk}}{\varphi^f} \tag{6}$$

which is a linear function of the quantity, $\chi_{hk} = \left[\sum_{j=1}^{N}\left(\left(\frac{w_j}{w_k}\right)\tau_{hmjk}\right)^{1-\phi_h}\frac{\tilde{L}_j}{\tilde{L}_k}\right]^{\frac{\alpha_h}{\phi_h - 1}}$, d is a dummy variable taking the value 1 if the firm imports intermediates, Γ_h is a technological constant, and $\tilde{L}_k = \beta_{mk}w_kL_k$.[8] Notice that $\chi_{hk} > 1$,and consequently, importers, *ceteris paribus,* enjoy lower marginal costs of production.

In the second step of the profit maximization problem, as usual in the Dixit Stiglitz monopolistic competition framework, the price set by firms is a constant mark-up over marginal costs. Therefore,

[5]The empirical analysis on Italian data reveals that the export productivity premia is higher than the import productivity premia suggesting that the productivity threshold required for exporting is greater than that one for importing (results are available upon request). This is consistent with the equilibrium we focus in our theoretical model.

[6]Note that the mark-up ρ_{hm} is the same for foreign intermediate producer and domestic intermediate producers.

[7]Details about how to derive this analytical result can be found in the appendix.

[8]$\Gamma_h = \alpha_h^{\alpha_h}(1-\alpha_h)^{1-\alpha_h}$.

the price on market j of a final good produced in country k by a firm with productivity φ^f is

$$p_{hxkj}(\varphi^f) = \frac{\sigma_h}{\sigma_h - 1} \frac{(\rho_{hm})^{\alpha_h}}{\Gamma_h (\chi_{hk})^d \left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}}} \frac{\tau_{hxkj} w_k}{\varphi^f}. \tag{7}$$

Substituting (7) in the demand function we obtain the quantity sold in country j by a final good producer of country k, which is

$$q_{hxkj}(\varphi^f) = \frac{\mu_h R_j}{(P_{hj})^{1-\sigma_h}} \left(\frac{\tau_{hxkj} \rho_h (\rho_{hm})^{\alpha_h} w_k}{\Gamma_h \chi_{hk} \left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}} \varphi^f} \right)^{-\sigma_h}, \tag{8}$$

where $\rho_h = \frac{\sigma_h}{\sigma_h - 1}$ is the mark-up of final goods producers belonging to sector h; notice that we have denoted with subscript j the demand variables referring to country j.

The variable profits from selling to country j for a firm producing in sector h, in country k is given by

$$r_{hxkj}(\varphi^f) = (\tau_{hxkj})^{1-\sigma_h} \frac{\mu_h R_j}{\sigma_h (P_{hj})^{1-\sigma_h}} \left(\frac{\rho_h (\rho_{hm})^{\alpha} w_k}{\Gamma_h \chi_{hk} \left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}} \varphi^f} \right)^{1-\sigma_h}. \tag{9}$$

A firm of country k will export to country j when $r_{hxkj}(\varphi^f) \geq f_{hxkj}$. Hence, the productivity of the marginal firm which is indifferent between exporting and not exporting to country j is given by the following cutoff

$$\varphi^*_{hxkj} = \tau_{hxkj} \left(\frac{\sigma_h}{\mu_h}\right)^{\frac{1}{\sigma_h - 1}} \left(\frac{1}{R_j}\right)^{\frac{1}{\sigma_h - 1}} \rho_h (w_k) (P_{hj})^{-1} (f_{hxkj})^{\frac{1}{\sigma_h - 1}} \underbrace{\frac{(\rho_{hm})^{\alpha} \left(\tilde{L}_k\right)^{\frac{\alpha}{1-\phi_h}}}{\chi_{hk} \Gamma_h}}_{Interm.Inputs}. \tag{10}$$

This expression is identical to the one derived in a model without intermediate inputs except for the last term. This equation determines the probability of exporting to a specific destination j. In a further section we discuss the main variables influencing this probability.

A firm in k is willing to import intermediates from the rest of the world if the gains in revenue from importing intermediates overcome the fixed cost of importing f_{hik}. We focus on equilibria where the marginal importing firm is not an exporter. To obtain the productivity cutoff associated with importing we first consider the revenue that an importing firm has in the domestic market, which is given by [9]

$$r_{hik}(\varphi^f) = \frac{\mu_h R_k}{\sigma_h (P_{hk})^{1-\sigma_h}} \left(\frac{\psi_h w_k}{\chi_{hk} \left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}} \varphi^f} \right)^{1-\sigma_h} \tag{11}$$

where for simplicity we denote $\psi_h = \frac{\rho_h (\rho_{hm})^{\alpha_h}}{\Gamma_h}$. A firm in k which is not an importer obtains the following domestic revenue

$$r_{hk}\left(\varphi^f\right) = \frac{\mu_h R_k}{\sigma_h (P_{hk})^{1-\sigma_h}} \left(\frac{\psi_h w_k}{\left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}} \varphi^f} \right)^{1-\sigma_h}. \tag{12}$$

[9] Note that r_{hik} is the revenue of a firm importing intermediate inputs and producing final goods only for the domestic market k. Thus, r_{hk} is the revenue of a firm that is neither an importer nor exporter.

Note that $r_{hik}(\varphi^f) = (\chi_{hk})^{\sigma_h - 1} r_{hk}(\varphi^f)$. A firm in k will be importing intermediates from abroad if $r_{hik}(\varphi^f) - r_{hk}(\varphi^f) \geq f_{hik}$. The marginal firm, the one that is indifferent between importing and not importing, satisfies the following condition

$$\left((\chi_{hk})^{\sigma_h-1} - 1\right) \frac{\mu_h R_k}{\sigma_h (P_{hk})^{1-\sigma_h}} \left(\frac{\psi_h (w_k)}{\left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}}} \right)^{1-\sigma_h} (\varphi^*_{hik})^{\sigma_h - 1} = f_{hik}.$$

The threshold productivity level associated with importing intermediates from abroad (for a firm that is only importing) is given by

$$\begin{aligned} \varphi^*_{hik} = & \frac{1}{\left((\chi_{hk})^{\sigma_h-1} - 1\right)^{\frac{1}{\sigma_h - 1}}} \left(\frac{\sigma_h}{\mu_h}\right)^{\frac{1}{\sigma_h-1}} \left(\frac{1}{R_k}\right)^{\frac{1}{\sigma_h-1}} \psi_h w_k (P_{hk})^{-1} \\ & \cdot (f_{hik})^{\frac{1}{\sigma_h-1}} \left(\tilde{L}_k\right)^{\frac{\alpha_h}{1-\phi_h}}. \end{aligned} \tag{13}$$

In this case the lower are the variable trade costs (the larger χ_{hk}) the lower is the import threshold productivity level. Indeed, as variable trade costs are reduced, foreign intermediate inputs become cheaper, and, as a consequence, more firms are able to bear the fixed costs of importing. Clearly, larger fixed costs of importing goods are associated with a more stringent productivity threshold, or less firms importing. Finally, the larger is the home market, the larger is the mass of importing firms. This is due to two different mechanisms. On the one hand, a larger home market, R_k, implies a larger demand of final goods and, as a consequence, a larger demand of intermediate inputs. On the other hand, firms in larger markets have access to a larger set of intermediate inputs and, therefore, have a lower marginal cost. As the gains from importing intermediates from abroad are inversely proportional to the marginal cost of production, firms' profits from importing intermediates are larger in larger markets.

Finally, the survival productivity threshold is described by the following equation

$$\varphi^*_{hk} = \left(\frac{\sigma_h}{\mu_h}\right)^{\frac{1}{\sigma_h-1}} \left(\frac{1}{R_k}\right)^{\frac{1}{\sigma_h-1}} (\psi_h w_k) (P_{hk})^{-1} (f_h)^{\frac{1}{\sigma_h-1}} \left(\tilde{L}_k\right)^{\frac{\alpha_h}{1-\phi_h}}. \tag{14}$$

Given the basic ingredients of the model - preferences, technologies and the optimal strategies of firms - we need now to derive the equilibrium aggregate price index for each economy so to obtain the gravity equation for exports of final goods. Initially we have considered the aggregate price indexes P_{hj} as given, disregarding the fact that they adjust depending on country characteristics.

The economy j aggregate price index P_{hj} can be easily obtained considering that

$$P_{hj}^{1-\sigma_h} = \underbrace{\beta_{hj} w_j L_j \int_{\varphi^*_{hj}}^{\infty} (p_{hj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi}_{\text{Domestic firms}} + \underbrace{\sum_{n \neq j}^{N} \beta_{hn} w_n L_n \int_{\varphi^*_{hxnj}}^{\infty} (p_{hxnj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi}_{\text{Foreign exporters}}.$$

In contrast to models in which firms are not allowed to import, we need to distinguish between domestic importers and non-importers, as they price differently

$$\int_{\varphi^*_{hj}}^{\infty} \left(p_{hj}\left(\varphi\right)\right)^{1-\sigma_h} g\left(\varphi\right) d\varphi = \int_{\varphi^*_{hj}}^{\varphi^*_{hij}} \left(p_{hj}\left(\varphi\right)\right)^{1-\sigma_h} g\left(\varphi\right) d\varphi + \int_{\varphi^*_{hij}}^{\infty} \left(p_{hij}\left(\varphi\right)\right)^{1-\sigma_h} g\left(\varphi\right) d\varphi$$

where $p_{hj}\left(\varphi\right)$ denotes the price that domestic firms which do not import charge in the domestic market and $p_{hij}\left(\varphi\right)$ is the price that domestic firms that import charge in the domestic market. Notice that $p_{hj}\left(\varphi\right) = \chi_{hj}\, p_{hij}\left(\varphi\right)$ and therefore non importing firms charge higher prices. Substituting the expression for optimal pricing for each firm in each market and rearranging terms we obtain

$$P_{hj} = \lambda_{2h} \left(Y_j\right)^{\frac{1}{\gamma_h} - \frac{1}{\sigma_h - 1}} \theta_{hj} \tag{15}$$

where

$$\left(\theta_{hj}\right)^{-\gamma_h} = \left[\sum_{n=1}^{N} \underbrace{\frac{Y_n}{Y} \left(w_n \tau_{hxnj}\right)^{-\gamma_h} \left(f_{hxnj}\right)^{\left(\frac{\sigma_h - \gamma_h - 1}{\sigma_h}\right)(1-\xi)}}_{Chaney's} \beta_{hn} \left(\tilde{L}_n\right)^{\frac{\alpha_h \gamma_h}{\phi_h - 1}} \psi_h^{-\gamma_h} \left(\chi_{hn}^{\gamma_h}\right)^{(1-\xi)} \left(\Phi_h\right)^{\xi}\right]$$

$$\lambda_{2h}^{\gamma_h} = \left(\frac{\gamma_h - (\sigma_h - 1)}{\gamma_h}\right) \left(\frac{\sigma_h}{\mu_h}\right)^{\frac{\sigma_h - \gamma_h - 1}{1 - \sigma_h}} \left(\frac{1+\pi}{Y}\right)$$

and

$$\Phi_h = \left(f_h\right)^{\left(\frac{\sigma_h - \gamma_h - 1}{\sigma_h - 1}\right)} + \left(\left(\chi_{hn}\right)^{\sigma_h - 1} - 1\right)^{\frac{\gamma_h}{\sigma_h - 1}} \left(f_{hin}\right)^{\left(\frac{\sigma_h - \gamma_h - 1}{\sigma_h - 1}\right)}.$$

The variable ξ is a dummy taking the value of 1 if $n = j$ and 0 otherwise.[10] θ_{hj} is an aggregate index of j's remoteness from the rest of the world. With respect to Chaney (2008), this "multilateral resistence variable" also takes into account that, in this case, the price of final goods depends also on the cost of intermediate inputs. The larger the access of country j to intermediate inputs sources, the lower will be the probability of exporting to country j.

In what follows we assume that our country is a small open economy. This implies that any change in the domestic market does not have any relevant impact on the measure θ'_{hj}, the multilateral resistance term. This simplifies significantly the calculations. With the definition of the price index in hand, we are able to derive the general equilibrium value of the export productivity cutoffs and of firm-level exports.

Plugging (15) in (10) and using the fact that $R_j = Y_j$, we obtain the equilibrium value of the productivity threshold for exports. Then the probability that a firm in country k exports to country j is given by

$$\Pr(\varphi \geq \varphi^*_{hxkj}) = \left(\varphi^*_{hxkj}\right)^{-\gamma_h} = \left(\lambda'_{4h}\right)^{-\gamma_h} \underbrace{\left(\frac{Y_j}{Y}\right) \left(\frac{w_k \tau_{hxkj}}{\theta'_{hj}}\right)^{-\gamma_h} \left(f_{hxkj}\right)^{\frac{-\gamma_h}{\sigma_h - 1}}}_{Chaney's} \underbrace{\left(\tilde{\chi}_{hk}\right)^{\gamma_h}}_{new\ elements} \tag{16}$$

[10]Details on the calculations are provided in the appendix.

where λ'_{4h} is a constant[11] and $\tilde{\chi}_{hk} = \chi_{hk}\left(\frac{\beta_{mk}Y_k}{Y}\right)^{\frac{\alpha_h}{\phi_h-1}}$ [12]. This is the gravity equation at the firm level for the extensive margin of trade. It relates the standard elements found in a gravity equation to the probability that a firm in k exports to country j (and therefore the mass of firms in k exporting to country j). Foreign market size contributes positively to the mass of firms exporting to country j. Barriers to exports (both fixed and variable costs) reduce the probability of exporting. The multilateral resistance term affects positively the mass of firms exporting, that is, the larger are trade barriers of a trade partner with the rest of the world, the larger is the mass of country k firms exporting to such destination. The novelties with respect to a model without intermediate inputs are related to the last element of equation (16). The inverse of this element represents the cost of the basket of intermediate inputs that the firm is using. The smaller the cost is the larger is the probability that a firm exports to country j.

To see what are the main determinants of the value of the exports to country j for a firm with productivity $\varphi^f \geq \varphi^*_{xkj}$, it is useful to express firms' revenue from the export market as

$$\begin{aligned} r_{hxkj}(\varphi^f) &= \left(\frac{\varphi^f}{\varphi^*_{hxkj}}\right)^{\sigma_h-1} r_{hxkj}(\varphi^*_{hxkj}) \\ &= (\lambda'_{3h}) \underbrace{\left(\frac{Y_j}{Y}\right)^{\frac{\sigma_h-1}{\gamma_h}} \left(\frac{\theta'_{hj}}{w_k \tau_{hxkj}}\right)^{\sigma_h-1}}_{Chaney's} \underbrace{(\tilde{\chi}_{hk})^{\sigma_h-1}}_{new\ element} \left(\varphi^f\right)^{\sigma_h-1} \end{aligned} \tag{17}$$

where λ'_{3h} is a constant.[13] This is the gravity equation for the intensive margin of trade. The individual export value increases with destination market size and country $j's$ remoteness from the rest of the world and decreases with variable trade costs.

The next section describes in detail what are the main predictions of this model. Some of the results predicted by the model are already familiar in the empirical literature, while some of them are entirely new. The empirical part focuses on testing these new results.

2.5 The predictions of the model

This section presents the main predictions of the model. The very first set of results focuses on the impact that importing intermediates has on a firms' TFP. These results have been recently the focus of the attention of a broad set of empirical papers.

[11] $\lambda'_{4h} = \left(\frac{\gamma_h}{\gamma_h-(\sigma_h-1)}\right)^{\frac{1}{\gamma_h}} \left(\frac{\sigma_h}{\mu_h}\right)^{\frac{1}{\gamma_h}} (1+\pi)^{\frac{-1}{\gamma_h}} \left(\frac{1+\pi}{Y}\right)^{\frac{\alpha_h}{\phi_h-1}}$.

Notice that this constant is similar to the corresponding one derived in Chaney's paper. There are however two main differences: First the last term that is purely due to the existence of intermediate inputs (since the market size has an extra effect), to transform this measure of market size in country's k GDP we need to multiply by that constant. The second one will correspond to the aggregate profits, whose expression will be different in this paper. Apart from the profits in the final good sector that will change we need to take into account as well the profits in the intermediate good sector.

[12] More precisely $\tilde{\chi}_{hk} = \chi_{hk}\left(\frac{\beta_{hk}Y_k}{Y}\right)^{\frac{\alpha_h}{\phi_h-1}} = \left[\sum_{j=1}^{N}\left(\frac{w_j}{w_k}\tau_{hmjk}\right)^{1-\phi_h}\left(\frac{\beta_{mj}}{\beta_{mk}}\right)\frac{Y_j}{Y_k}\frac{\beta_{mk}Y_k}{Y}\right]^{\frac{\alpha_h}{\phi_h-1}} = \left[\sum_{j=1}^{N}\left(\frac{w_j}{w_k}\tau_{hmkj}\right)^{1-\phi_h}\beta_{hj}\frac{Y_j}{Y}\right]^{\frac{\alpha_h}{\phi_h-1}}$

[13] Following Chaney (2008) notation $\lambda'_{3h} = \sigma\left(\lambda'_{4h}\right)^{1-\sigma}$.

Proposition 1 *Importing intermediate inputs has a positive effect on a firm's productivity.(TFP)*
Proof. *See appendix* ■

This result is a consequence of the love of variety assumption. The technology, similar to Romer (1990), presents decreasing returns to scale in the use of each intermediate input and increasing returns to scale in the mass of varieties used. A firm importing intermediates from abroad is able to escape from the decreasing returns to scale associated with each of the intermediate inputs currently used by the firm by splitting its intermediate input requirements across more varieties. The ability of the firm to do so clearly depends on the mass of imported intermediate inputs available, as well as on the price of each intermediate input. Since both variables vary across destinations, the model also predicts heterogeneous gains across source countries.

The statement of Proposition 1 is consistent with the empirical findings of Kasahara and Rodrigue (2008); Halpern et al. (2011); Bas and Strauss-Kahn (2010), which observe a positive link between importing intermediates and productivity.

Corollary 1.1 *The productivity benefits from importing intermediate inputs decrease with variable trade costs, increase with the foreign country size and, under certain conditions, with the income per capita (i.e. the wage) of the source country.*
Proof. *See appendix* ■

The larger the size of the source country, the larger the mass of intermediate inputs available. As a consequence a firm can split its intermediate input requirements across more varieties, having a stronger impact on productivity. The variable trade costs affect negatively the cost of intermediate inputs from abroad. The latter limits the ability of a firm to spread its intermediate input requirements across varieties coming from that destination. Concerning the income per capita of the source country (i.e. the wage[14]), there are two opposite effects. On the one hand, intermediates coming from rich countries are more expensive. This limits the scope of a firm to take advantage from the access to a larger range of varieties in a similar way as transportation costs do, with a negative impact on a firm's TFP. On the other hand, richer countries produce more varieties. It can be shown that the second effect dominates the first one provided that $\phi_h < 2$, or in other terms, the intermediate inputs are not substitutable enough.

The second set of results focuses on the role played by intermediates imports in the gravity equation, both in terms of the extensive and intensive margins of exports. We will start by considering the implications for the extensive margin of trade. The introduction of imported intermediate inputs in the basic Melitz/Chaney model has two main consequences with respect to the export productivity cutoff expressed by equation (16).

Proposition 2 *The effect of distance on the probability of exporting to a specific country is magnified by the presence of trade in intermediate inputs. The elasticity with respect to distance is given by*

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(D_{kj})} = -\delta_h\gamma_h\left(1 + \alpha_h s_{hmjk}\right).$$

Proof. See appendix ■

[14]We are aware that the income per capita of the economy is given by $y_j = \frac{Y_j}{L_j} = w_j(1+\pi)$ which is not exactly the wage. However, notice that the only source of variation in income per capita across countries is the wage.

The inclusion of trade in intermediates in the analysis changes the effects of distance on the probability that a firm in country k exports to country j. To the extent that export and import variable costs have common determinants [15], a decrease in transportation costs has a comparatively larger impact on the mass of exporting firms. This is the consequence of the fact that a reduction in distance affects both the price of exports to country j and the cost of intermediate inputs coming from country j.

The first effect is standard in the literature. A reduction in the costs of serving country j allows firms to charge lower prices, increasing the value of sales to that country. The expected increase in foreign sales makes exporting more attractive to firms. The latter increases the probability of selling to that country. The second effect is inherent to this framework. A reduction in transportation costs between k and j decreases the cost of importing intermediates from market j. This allows a firm to charge lower prices in country j too, increasing its export sales. This latter effect is shaped by two parameters: the share of imported intermediate inputs from country j - s_{hmkj} - and the importance of intermediate inputs in the production of the final good - α_h.

Proposition 3 *The elasticity of the probability of exporting to a specific destination with respect to market size (domestic and foreign) is given by*

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(Y_l)} = \xi + \frac{\alpha_h \gamma_h}{\phi_h - 1} s_{hmlk} \quad l = k, j.$$

Proof. See appendix ■

In this case it is convenient to discuss separately the effect of both the foreign and the domestic market size. An increase in foreign market size has a positive effect on the probability of exporting due to both a direct and an indirect effect. Foreign market size enters directly in equation (16) through Y_j. The larger the income level of country j, the larger the expenditure on final goods and the market potential of domestic exporters. This reduces the productivity level necessary to cover the fixed costs of exporting to that destination. The positive effect of the country size is magnified by the fact that the foreign market is also a source of intermediate inputs. The larger is the foreign market, the larger is the mass of imported intermediate inputs and the lower is the marginal cost of production. Consequently, firms importing from a large market will be able to charge lower prices, increasing the probability of becoming an exporter to a particular destination.

Novel to this framework, domestic market size also affects the probability of exporting. More populated and more productive economies provide a greater number of varieties of intermediate inputs. Since the marginal costs of production decrease with the amount of intermediate inputs used by the firm, marginal costs of production decrease with the size of the domestic market. The latter gives a competitive advantage to domestic firms in foreign markets.[16]

Similar implications are derived when we consider the intensive margin of exports. Also in this case, intermediate imported inputs magnify the effects of the traditional gravity forces on the value of exports.

Proposition 4 *The effect of distance on a firm's exports to a specific destination is amplified. The elasticity of a firm's exports to distance is given by*

[15] Indeed, the model assumes that costs are related to distance in the same way.

[16] Unfortunately, we are not able to test this prediction since we have information only for one domestic market, that is Italy.

$$\frac{d\ln r_{hxkj}(\varphi^f)}{d\ln(D_{kj})} = -\delta_h(\sigma_h - 1)(1 + \alpha_h s_{hmjk}).$$

Proof. See appendix ■

Proposition 5 *The effect of market size on a firm's exports to a specific destination is amplified. The elasticity of a firm's exports to market size is given by*

$$\frac{d\ln r_{hxkl}(\varphi^f)}{d\ln(Y_l)} = \left(\frac{\sigma_h - 1}{\gamma_h}\right)\xi + \frac{\alpha_h(\sigma_h - 1)}{\phi_h - 1} s_{hmlk},\ l = k, j$$

where the home country size plays also an important role.[17]

Proof. See appendix ■

The mechanisms behind the amplification effect in the intensive margin are the same as in the extensive margin. A decrease in transportation costs reduces the cost of importing intermediates. This allows exporting firms to reduce the price charged for their exports and consequently to increase the sales in each market, domestic and foreign. Foreign and domestic market size positively affect the value of exports since these are connected with the mass of intermediate inputs available for the firm. The larger the foreign and the domestic market, the larger is the range of intermediate inputs available for the firm. The latter allows the firm to reduce the price charged for their exports and to increase the value of sales in each market.

In this section we have derived the main predictions of the model. We have shown that including intermediate inputs in the analysis modifies the standard predictions of the effects of distance and market size either on the probability that a firm exports to a particular destination or on the value of exports to that particular destination. The model strongly suggests controlling for measures related to firm intermediate importing activities in order to estimate accurately the effects that traditional gravity forces have on firms' exporting behaviour. In the next sections, we test these empirical implications using a rich firm-country level Italian dataset.

3 Empirical specification, Data and Facts

We now turn to present the empirical specification adopted to test some of the main predictions of the model. We then describe the firm level dataset used in the analyses and then discuss the country-level variables employed in the regressions. Finally, we discuss some trends and facts regarding firms' behaviour in international markets.

[17] In a model without trade in intermediates the elasticities will be equal to:

$\frac{d\ln r_{hxkj}(\varphi^f)}{d\ln(D_{kj})} = -\delta_h(\sigma_h - 1)$

$\frac{d\ln r_{hxkl}(\varphi^f)}{d\ln(Y_l)} = \left(\frac{\sigma_h - 1}{\gamma_h}\right)\xi,\ l = k, j$

$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(D_{kj})} = -\delta_h\gamma_h$

$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(Y_l)} = \xi$

3.1 Empirical specification

Having described the theoretical structure of the model and its testable predictions, we now adapt it for the empirical estimations. Equations (16) and (17) describe how the country's extensive margin of trade (the decision to export or not) and the intensive margin of trade (the export value decision) are related to firm and country characteristics. Equation (16) of our model predicts that the country-by-country entry decision (*Entry*) depends on firm productivity (φ), foreign market size (Y), the multilateral resistance term (θ), variable trade costs (D and Δ), fixed trade costs (f) and the new element $\tilde{\chi}$. According to equation (17), all these elements, except the fixed trade costs, enter also in the individual export value decision. Indeed, these costs, once paid, do not influence an exporter's revenues. These two equations together with Propositions 2-5 form the underpinning of our estimations.

We start by specifying a model for the export entry decision. The empirical model for the probability of entry is given by

$$\begin{aligned} Entry_{fjt} = \alpha_o + b_1\varphi_{ft-1} + \alpha_2 D_j + \alpha_3 Y_{jt} + \alpha_4 \Delta_{jt} + \alpha_5 f_j + \alpha_6 \theta_{jt} + \\ + \alpha_7 M_{fjt} + \alpha_8 M_{fjt} * D_j + \alpha_9 M_{fjt} * Y_{jt} + d_i + \epsilon_{fjt} \end{aligned} \tag{18}$$

where the dependent variable, $Entry_{fjt}$, is a dummy variable that takes value one if a firm f starts exporting to country j at time t and zero otherwise. The focus on the group of starters allows us to disregard the role of the lagged export status on the probability of exporting to country j at time t. Indeed, the international trade literature has strongly emphasized that previous trading status significantly affects the current probability of trading (Roberts and Tybout; 1997; Bernard and Jensen; 2004). Analogously, past participation in a specific market increases the probability that a firm will enter the same market (Lawless and Whelan; 2008).

The empirical specification includes a measure of the firm's productivity (φ_{ft-1}) and all the country-level variables included in equation (16) (Y_{jt}, θ_{jt}, D_j, Δ_{jt}, f_j). We use the lagged value of φ to reduce the possibility that the estimated coefficient is not contaminated by possible feedback effects of export decision on firm productivity. We expect α_1 to be positive in accordance with our model and, more generally, with the standard literature on the relationship between productivity and exports. The model also predicts that the probability of serving the foreign market j should increase with the size of the country ($\alpha_3 > 0$) and the level of remoteness ($\alpha_6 > 0$) and decrease with the level of variable costs ($\alpha_2 < 0$; $\alpha_4 < 0$) and fixed costs ($\alpha_5 < 0$).

In the empirical framework we also include a proxy for the import share of the firm M_{fjt}. Note that in the current version of the model, the intermediate input cost index does not vary at the firm level. This is the consequence of the fact that all firms import from all sources and firm's intermediate inputs are also proportional to the productivity parameter $\left(\varphi^f\right)^{\sigma_h - 1}$. However, in reality we observe that firms do not import from all sources and that the share of imports from a particular country varies across firms within the same sector. This implies that we can not control for the intermediate input mechanism just by adding sector fixed effects since this channel will vary also at the firm level. Thus, in the empirical model we include the firm level variable M_{fjt} indicating a firm's share of imported intermediate inputs from country j at time t. We expect a positive impact of imports on the probability of exporting, i.e. $\alpha_7 > 0$. We then interact the two gravity forces with our firm-level measure of imports ($M_{fjt} * D_j$ and $M_{fjt} * Y_{jt}$). From our framework (Propositions 2 and 3), we expect the effect of distance and foreign market size on the probability of entry to be stronger for those firms that import intermediate inputs from country j; i.e. we expect $\alpha_8 < 0$ and $\alpha_9 > 0$, respectively.

Our model also includes a set of fixed effect d_i. By exploiting the three-dimensional nature (firms, destinations, time) of our dataset, we take time-invariant as well as time-varying firm-level unobserved heterogeneity into account.

The second step of our empirical analysis consists of estimating the determinants of a firm's exports across countries. The econometric model, which can be thought of as a micro-gravity equation, takes the following form

$$\begin{aligned}\ln Exports_{fjt} = \beta_o + \beta_1\varphi_{ft-1} + \beta_2 D_j + \beta_3 Y_{jt} + \beta_4\Delta_{jt} + \beta_5\theta_{jt} + \\ + \beta_6 M_{fjt} + \beta_7 M_{fjt} * D_j + \beta_8 M_{fjt} * Y_{jt} + d_i + \epsilon_{fjt}\end{aligned} \tag{19}$$

where the dependent variable is the (log) total exports of firm f in country j at time t. As in the previous equation, we include firm productivity, country determinants, and a proxy for the firm's importing activity. Following equation (17), we exclude the trade fixed costs variable (f). According to Propositions 4 and 5, the effect of distance and foreign market size on a firm's export value to country j is amplified when imports are taken into account. We thus include in the empirical model the interaction terms $M_{fjt} * D_j$ and $M_{fjt} * Y_{jt}$.

3.2 Firm level data

The empirical analysis combines three sources of data collected by the Italian Statistical Office (ISTAT): the Italian Foreign Trade Statistics (COE), the Italian Register of Active Firms (ASIA) and a firm level accounting dataset (Micro 3).[18].

The COE dataset is the official source for the trade flows of Italy and it reports all cross-border transactions performed by Italian firms for the period 1998-2003. The database includes the value of the transactions, on a yearly basis, of the firm as disaggregated by countries of destination for exports and markets of origin for imports.[19] The total value of a firm-country transaction, recorded in euros, is broken down into five broad categories of goods, Main Industrial Groupings (MIGs), identified by EUROSTAT as energy, intermediate, capital, consumer durables and consumer non-durables.[20] This is a unique feature of our dataset which allows distinguishing imported intermediate inputs from other types of imports.[21]

Using the unique identification code of the firm, we are able to link the trade data to ISTAT's archive of active firms, ASIA. The ASIA register covers the population of Italian firms active in the same time span, irrespective of their trade status. It reports annual figures on number of employees, sector of main activity and information about the geographical location of the firms (municipality of principal activity of legal address). The ASIA-COE dataset obtained by merging the two sources is not a sample but rather includes all active firms.

Data on firm level characteristics come from Micro.3, which is a dataset based on the census of Italian firms conducted yearly by ISTAT containing information on firms with more than 20 employees covering all sectors of the economy for the period 1989-2007.[22] Starting in 1998 the

[18] 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.

[19] ISTAT collects data on exports 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 exports and imports in Italy is provided in Appendix A4.

[20] EUROSTAT's end-use categories (Main Industrial Groupings, MIGs), based on the Nace Rev. 2 classification, are defined by the Commission regulation (EC) n.656/2007 of 14 June 2007.

[21] Hereafter, when using the word "import" we refer to import of intermediates inputs unless otherwise specified.

[22] The database has been built as a result of collaboration between ISTAT and a group of LEM researchers from the Scuola Superiore Sant'Anna, Pisa.

Table 1: COVERAGE OF OUR DATASET

Year	Active Firms	Traders	Exports (billion)	Intermediate Imports (billion)	Imports (billion)
	(1)	(2)	(3)	(4)	(5)
			Panel A - ASIA-COE		
1998	570,548	119,979	190.0	50.0	106.2
1999	564,366	118,588	189.7	49.6	110.1
2000	565,396	122,098	211.6	59.2	131.5
2001	560,657	121,651	221.6	57.5	132.4
2002	552,940	122,538	216.0	53.8	120.8
2003	541,835	123,610	211.3	53.3	120.5
			Panel B - Our dataset		
1998	30,570	25,745	159.5	41.5	90.1
1999	30,592	25,668	161.9	42.5	95.6
2000	30,402	25,495	177.6	50.4	113.3
2001	30,011	25,338	184.4	47.0	111.5
2002	29,882	25,256	178.5	44.8	100.7
2003	28,920	24,583	171.0	43.8	98.7

Note: Table reports the number of manufacturing firms in ASIA-COE and after the merge with Micro3. Panel A - ASIA-COE, Panel B, Our dataset.

census of the whole population of firms only concerns companies with more than 100 employees, while in the range of employment 20-99, ISTAT directly monitors only a "rotating sample" which varies every five years. In order to complete the coverage of firms in that range Micro.3 resorts, from 1998 onward, to data from the financial statement that limited liability firms have to disclose, in accordance to Italian law.[23] The database contains information on a number of variables appearing in a firm's balance sheet. For the purpose of this paper we utilise: number of employees, turnover, value added, capital, labour cost, intermediate inputs costs and capital assets. Capital is proxied by tangible fixed assets at book value (net of depreciation). Nominal variables are in million euros and are deflated using 2-digit industry-level production prices indices provided by ISTAT.

After merging these three databases, we work with an unbalanced panel of about 46,819 manufacturing firms over the sample period. Table 1 presents the number of firms active in the manufacturing sector for the ASIA-COE dataset (Panel A) and for our database (Panel B), obtained after the merge with Micro 3. We cover only 5% of the population of active Italian manufacturing firms (column 1) and about 21% of all manufacturers engaged in international transactions, either by means of exports, imports, or a combination of the two (column 2). Yet, despite relatively few in terms of number, the firms in our dataset account for the great bulk of overall Italian exports and imports, as shown in columns 3-5 of Table 1. Since the paper focuses on the role of intermediate inputs on firms' export margins, column 4 reports the total Italian imports in intermediate inputs defined according to the MIG classification. As a comparison, in column 5 we report also the imports of all products. Given that our interest is in the complementarity between export and import activities, we can consider the representativeness of our database with respect to the whole Italian trade flows to be quite satisfactory. Indeed, our database covers on average 82% of total Italian exports (column 3), 83% of total imports in intermediate inputs (column 4), and about 84% of imports in all goods (column 5).

[23]Limited liability companies (societa' di capitali) have to provide a copy of their financial statement to the Register of Firms at the local Chamber of Commerce.

Table 2: Variables

Variables	Proxies	Type of variable	Source
	Firm-level variables		
φ_{ft}	TFP_{ft}	Continuous	ASIA-COE-Micro.3
M_{fjt}	$Imported\ Inputs\ Share_{fjt}$	Continuous	ASIA-COE-Micro.3
$Entry_{fjt}$	$Starters_{fjt}$	Dummy	ASIA-COE-Micro.3
	Country-level variables		
Y_{jy}	Gdp_{jy}	Continuous	World Bank
D_j	$Distance_j$	Continuous	CEPII
θ_{jt}	$Remoteness_{jt}$	Continuous	World Bank
f_j	$MarketCosts_j$	Continuous	World Bank
Δ_j	$Trade\ Opening_{jt}$	Continuous	Fraser Institute

Note: Table reports the variables used in the empirical analyses.

Starting from our database we can derive the firm-level variables used to estimate the empirical models described in Section 3.1. The top panel of Table 2 lists the firm-level variables used in the empirical analyses. To measure a firm's productivity we use the variable TFP_{ft}, which is computed as the residual of a two input (capital and labour) Cobb-Douglas production function estimated using the semi-parametric method proposed by Levinsohn and Petrin (2003). The empirical models include a variable M_{fjt} to proxy a firm's share of imported intermediate inputs from country j and its interactions with the two gravity forces. The variable M_{fjt} is computed as the fraction of imported inputs from country j over the total amount of intermediate inputs of firm f, that is $Imported\ Inputs\ Share_{fjt}$. This allows accounting for the relative importance of imports in the total intermediate inputs of firm f.

In order to estimate equation (18) we need to single out the firms that enter into a specific export market during the period of observation. Following previous empirical studies, we define as export $Starter_{fjt}$ a firm that starts to export to j in t and has not exported to that destination in the previous three years. The rationale behind this definition of trade starters stems from the empirical literature dealing with sunk costs and export market participation. Roberts and Tybout (1997) estimate that on average, in their sample of Colombian firms, after a three year absence the re-entry costs are not different from those faced by a new exporter. Due to the time span of six years, we can create three cohorts of export starters, respectively from 2001 to 2003. In total we obtain 101,064 firms that enter into a specific foreign market at a certain point in time. The number of starters is 30,415, 36,387, and 34,262, respectively for 2001, 2002 and 2003.[24] As a reference group we select for each firm which is an export starter in some countries, the observations for all the other destinations in which the firm has never exported.[25]

3.3 Country-level data

In addition to firm-level data, we complement the analysis with information on country characteristics. We consider the two standard gravity-type variables, GDP_{jt} and $Distance_j$ to proxy for market size (Y_{jt}) and transportation costs (D_j), respectively. Data on GDP are taken from

[24]Table A1 in Appendix A5 reports the number of exporter starters by country.

[25]In the reference group we do not include firms that are not export starters in any markets because for these firms the dependent variable ($Starters_{fjt}$) takes always the value zero. Indeed, inclusion of firm-fixed effects perfectly predicts the behaviour of these firms.

the World Bank's World Development Indicators database. Information on geographical distance comes from CEPII. Distances are calculated following the great circle formula, which uses latitudes and longitudes of the most important city (in terms of population) or of the official capital (Mayer and Zignago; 2005).

We augment the gravity model by including additional variables that might be expected to affect the costs of trading internationally. As indicated in Section 3.1 and predicted by equation (16) of our model, the probability of starting to export depends on variable trade costs not related to distance (Δ_j), market specific fixed costs (f_j) and a multilateral resistance term (θ_{jt}). At the same time equation (17) suggests that a firm's export sales to a specific destination can be modelled in a parallel fashion to the model for export participation, though in this case market-specific fixed costs are not included.

For additional trade costs (Δ_j), we use a measure of average country-level import tariffs taken from the Fraser Institute ($Trade\ Opening_{jt}$).[26] The market specific fixed costs (f_j) can be related to the establishment of a foreign distribution network, difficulties in enforcing contractual agreements, or the uncertainty of dealing with foreign bureaucracies. Following Bernard et al. (2011), to generate a proxy for these costs we use information from three measures from the World Bank Doing Business dataset: number of documents for importing, cost of importing and time to import (Djankov et al.; 2010). Given the high level of correlation between these variables, we use the primary factor ($Market\ Costs_j$) derived from principal component analysis as that factor accounts for most of the variance contained in the original indicators. Finally, to proxy the multilateral resistance terms (θ_{jt}) we employ the variable $Remoteness_{jt}$ which captures the extent to which a country is separated from other potential trade partners.[27] The idea is that a remote country has high shipping costs, high import prices, and thus a high aggregate price index. As in Manova and Zhang (2012) the variable remoteness is computed for each country as the inverse of the distance weighted sum of the market sizes of all trading partners.[28]

The bottom panel of Table 2 lists the country level characteristics used to proxy the variables in our empirical models. After selecting the destinations for which we have the information needed to carry out our analysis, we end up with a dataset including 109 countries.[29]

3.4 Descriptive statistics and trends

Before moving to the econometric analyses it is useful to start with few summary statistics pointing in the direction of the linkage between importing and exporting activities.

We begin by exploring the export and import patterns of Italian manufacturing firms. Figure A1 in the appendix shows the distribution of Italian exports and imports across countries in 2003. From the figure, it turns out that although there is variation in the level of trade among countries,

[26] This variable is a simple average of three sub-components: revenue from trade taxes, the mean tariff rate and the standard deviation of tariffs. Each sub-component is a standardized measure ranging from 0 to 10 which is increasing in the freedom to trade internationally. For further details see J.Gwartney, R.Lawson and J.Hall, 2012, Economic Freedom of the World - 2012 Annual Report, Fraser Institute.

[27] We are aware of the fact that the remoteness proxy bears little resemblance to its theoretical counterpart and that a structural approach would be more adequate. However, in the empirical analyses our main interest lies in the elasticity of exports with respect to distance and market size. All the other country variables are simply included as controls.

[28] Precisely, $Remoteness_j = \sum_n GDP_n * distance_{nj}$, where GDP_n is the GDP of the origin country and $distance_{nj}$ is the distance between n and j, and the summation is over all countries in the world n. An alternative measure of remoteness used in Baldwin and Harrigan (2011) is given by $Remoteness_j = \sum_n (GDP_n/distance_{nj})^{-1}$. Our results are robust to the use of this other measure.

[29] The complete list of countries is reported in Table A1 in Appendix A5. Basic statistics for the different market characteristics are reported in Table A2 in Appendix A5.

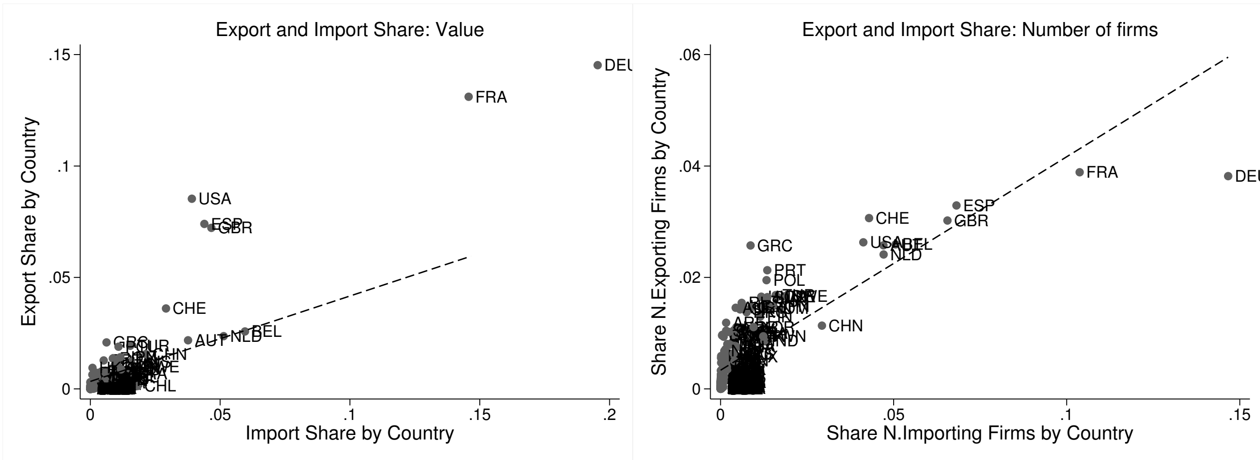

Figure 1: Export and Import share by country: value and number of firms. The figure reports the export and import share by country (ISO codes) in terms of value (left panel) and number of firms (right panel) for 2003. Table A1 reports the assigned official ISO code for each country.

the majority of flows are with European countries, followed by other developed markets (USA, Japan, Canada, Australia) and emerging markets (China, Brazil, Russia, Mexico, India). More importantly, the figure points toward complementarity between exporting and importing activities across countries as the areas where the majority of exports are directed to correspond to the countries where the gross of imports come from. The linkage between the two trade activities is reflected also by Figure 1 which shows the correlation between the country's export share and the country's import share in terms of value (left panel) and number of firms (right panel). This figure demonstrates that there is a strong positive correlation between the fraction of exports and imports at country level. To ascertain whether this correlation is related to gravity forces is the aim of our empirical analyses.

4 Results

In the next few sections, we will formally assess the fit of the model developed in Section 2 by estimating the equation for export participation (equation (18)) and that for export sales (equation (19)). We will test the predictions on the relative importance that imports have in influencing the impact of the gravity forces on the two margins of exports.

4.1 The extensive and intensive margins of exports

We start our empirical investigation by considering the probability of entry into a specific export market, that is the extensive margin. Table 3 reports the estimation results of equation (18).

Following Bernard and Jensen (2004) to estimate our binary choice framework with unobserved heterogeneity, we employ a linear probability model so that firm (columns 1-3) or firm-time (columns 4-6) fixed effects are accounted for in the regressions. Although this estimation strategy suffers from the problem of predicted probabilities outside the 0-1 range, it allows us to control for any unobserved time constant or time varying firm characteristics that influence the decisions regarding entry into foreign markets. As stressed before, the focus on the sample of starters allows us to ignore the role of the firm's previous export experience that may significantly affect the current probability

Table 3: Firms' exports extensive margin by country: the role of imports

	(1)	(2)	(3)	(4)	(5)	(6)
			$Starter_{fjt}$			
$\ln TFP_{f,t-1}$	0.0014***	0.0014***	0.0014***			
	(0.0003)	(0.0002)	(0.0002)			
$\ln Gdp_{jt}$	0.0062***	0.0062***	0.0062***	0.0062***	0.0062***	0.0062***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
$\ln Distance_j$	-0.0094***	-0.0093***	-0.0093***	-0.0093***	-0.0093***	-0.0093***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
$\ln Remoteness_{jt}$	0.0057	0.0057	0.0057	0.0056	0.0056	0.0056
	(0.0042)	(0.0042)	(0.0042)	(0.0042)	(0.0042)	(0.0042)
$MarketCosts_j$	-0.0014**	-0.0014**	-0.0014**	-0.0014**	-0.0014**	-0.0014**
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
$Trade\ Opening_{jt}$	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
$Imported\ Inputs\ Share_{fjt}$		0.2196***	0.1704		0.2162***	0.1696
		(0.0271)	(0.5193)		(0.0269)	(0.5230)
$* \ln Gdp_{jt}$			0.0282*			0.0280*
			(0.0155)			(0.0156)
$* \ln Distance_{jt}$			-0.0885***			-0.0882***
			(0.0268)			(0.0269)
Year FE	Yes	Yes	Yes			
Firm FE	Yes	Yes	Yes			
Firm-Year FE				Yes	Yes	Yes
Adj. R^2	0.034	0.038	0.038	0.052	0.052	0.052
N.Observations	7,055,819	7,055,819	7,055,819	7,055,819	7,055,819	7,055,819

Note: The table reports regressions using data on 1998-2003. The dependent variable used is reported at the top of the columns. All the regressions include a constant term. Regressions are run on the same observations in all specifications. Robust standard errors clustered at country level are reported in parenthesis below the coefficients. Asterisks denote significance levels (***:p<1%; **: p<5%; *: p<10%).

of exporting.[30] We cluster standard errors at the country level in order to allow for correlation of the error terms across firms for a given destination.[31]

We start in column 1 of Table 3 by reporting the results of a model without considering the import status of a firm and controlling for firm and year fixed effects. The results provide a clear picture. The productivity variable has the expected positive and significant sign: a positive firm-level productivity shock at time t increases the likelihood of starting to export to a specific country at time $t+1$. Specifically, a 10 percent increase in firm productivity is associated with an increase of about 0.014 percentage points in the probability of exporting. The magnitude of this effect is sizeable (i.e., 1%) if compared with the probability of starting to export observed in our sample, which is 0.014. As for the two gravity variables, we find that the probability of entry into a specific market increases with market size but decreases with distance. A 10 percent rise in the destination country's GDP is associated with an increase of 0.062 percentage points in the probability of starting to export to that country. A 10 percent increase in distance decreases the

[30] As a robustness check, we perform a validation exercise where we explore results under a different definition of export starters. The variable *Entry* takes value 1 if a firm starts to export to j in t and has not exported to that destination in the previous two years. The results are robust to this alternative definition and are available upon request.

[31] Our results are robust to alternative treatments of the error terms, such as clustering by firm or firm and country. Table A3 in Appendix A5 reports the results of both the extensive and intensive margins of exports by clustering at firm and country level.

likelihood of a positive export decision by approximately 0.094 percentage points.

The coefficient for market size suggests that, holding all other independent variables constant, a 10% increase in the GDP of a country raises the probability of entry into that market by about 4.4%. To gauge the economic significance of this correlation, consider the difference in the probability of starting to export to countries which are respectively at the 25^{th} and 75^{th} percentiles of the GDP distribution. Increasing, for instance, the GDP of Estonia to the level of that in Finland would increase the probability of exporting to Estonia by about 2 percentage points.

On average, the ceteris paribus effect of a 10% increase in distance is a decrease in the probability of entry of around 6.7%. Consider the difference in the probability of exporting to France (with a distance of about 1000km) and to the US (with a distance of about 7000km). Holding all the other country characteristics constant, the distance between Italy and US makes the probability of starting to export to US about 2 percentage points lower than the probability of starting to export to a closer country such as France.

Concerning the other country properties, as expected the probability of entry decreases with market costs. The negative and significant coefficient of $Market\ Costs$ suggests the existence of country-specific fixed export costs: the lower these costs are, the higher the probability is of reaching a market. Easy and accessible markets are likely to be served by a large number of firms, whereas less accessible countries with higher fixed export costs are more difficult to export to. The coefficients for $Remoteness$ and $Trade\ Opening$ have the expected sign but they are not statistically significant. Since remoteness makes a destination market less competitive, *ceteris paribus*, it is relatively easier for a firm to serve a trade partner that is geographically isolated from most other nations. The probability of starting to export to a country should indeed increase with both the remoteness of the destination and its level of freedom to trade.

In column 2 we add the variable for the firm import intensity - $Imported\ Inputs\ Share_{fjt}$. Our findings indicate that this variable enters with a positive and significant coefficient, confirming the hypothesis that an increase in the imported input intensity from a specific market is associated with a rise in the probability of entry in that market. The coefficient for the import variable implies that an increase of 1 percentage point in the import intensity is associated with an increase in the likelihood of a positive export decision of approximately 0.0022 points, which is 15% of the observed probability. The inclusion of this term does not change the sign or magnitude of the other coefficients.

Finally, in column 3 we add the interactions between a firm's imported inputs share and the two gravity variables, still controlling for firm and year fixed effects. According to the results and in line with the Predictions 2 and 3 of our model, the coefficient for the interaction with GDP is positive and significant whereas that for the interaction with distance is negative and significant. Thus, the effect of the two gravity forces on the probability of starting to export to country j depends on a firm's intermediate import intensity from that market. In particular, compared to a firm that sources its intermediate inputs only in the domestic market, the average importing firm, that is a firm with an average import share of 2 percent per foreign market, is more sensitive to distance and GDP by about 20 percent and 10 percent, respectively.

While in our initial specification we include firm and year fixed effects, it might be that there is also firm-level time-varying unobserved heterogeneity that is correlated with both the export decision and the import intensity. Indeed, in addition to firms' productivity that we control for, other firm-level supply shocks, such as changes in size, managerial ability or firms' workforce composition, may affect firms' decision to export. Thus, in columns 4-6 of Table 3 we replicate the previous regressions by including firm-year fixed effects. All the results confirm the evidence from the specification with firm fixed effects. The two coefficients of interest on the interaction terms are robust and stable when we control for firm-level time-varying unobserved heterogeneity.

Table 4: Firms' exports intensive margin by country: the role of imports

	(1)	(2)	(3)	(4)	(5)	(6)
			$\ln Exports_{fjt}$			
$\ln TFP_{ft-1}$	0.104***	0.103***	0.1043**			
	(0.009)	(0.009)	(0.009)			
$\ln Gdp_{jt}$	0.481***	0.473***	0.473***	0.485***	0.478***	0.477***
	(0.037)	(0.036)	(0.036)	(0.038)	(0.037)	(0.037)
$\ln Distance_{j}$	-0.568***	-0.557***	-0.554***	-0.571***	-0.560***	-0.556***
	(0.084)	(0.082)	(0.082)	(0.087)	(0.085)	(0.084)
$\ln Remoteness_{jt}$	0.727***	0.714***	0.707***	0.733***	0.720***	0.713***
	(0.254)	(0.251)	(0.250)	(0.259)	(0.256)	(0.255)
$Trade\ Opening_{jt}$	0.042*	0.041*	0.041*	0.045*	0.044*	0.044*
	(0.022)	(0.022)	(0.022)	(0.025)	(0.025)	(0.025)
$Imported\ Inputs\ Share_{fjt}$		5.398***	21.325**		5.469***	21.886**
		(0.367)	(9.411)		(0.376)	(9.458)
$* \ln Gdp_{jt}$			0.003			-0.008
			(0.322)			(0.321)
$* \ln Distance_{jt}$			-2.224***			-2.389***
			(0.564)			(0.576)
Year FE	Yes	Yes	Yes			
Firm FE	Yes	Yes	Yes			
Firm-Year FE				Yes	Yes	Yes
Adj. R^2	0.315	0.317	0.318	0.307	0.310	0.310
N.Observations	1,448,432	1,448,432	1,448,432	1,448,432	1,448,432	1,448,432

Note: Table reports regression using data on 1998-2003. The dependent variable used is reported at the top of the columns. All the regressions include a constant term. Regressions are run on the same observations in all specifications. Robust standard errors clustered at country level are reported in parenthesis below the coefficients. Asterisks denote significance levels (***:p<1%; **: p<5%; *: p<10%).

Having established the determinants of a firm's export participation across countries, we next explore whether firm and country differences are relevant for determining how much a firm sells across different markets, that is the intensive margin of exports. Thus, we estimate a firm-level gravity equation for exports as expressed by equation (19).[32] The results are reported in Table 4. As for the export entry equation, we run the regression controlling for time-invariant factors (columns 1-3) and then taking into account firm-level time-varying unobserved heterogeneity (columns 4-6).

Column 1 displays the results without controlling for the firms' intermediate import share. The estimated parameters display the expected signs. As standard in the literature, we confirm that more productive firms not only are more likely to enter foreign markets but they also export more to each country. The coefficient on (log) TFP_{ft-1} suggests that a 10% increase in a firm's productivity increases its exports by approximatively 1%. For *Gdp* and *Distance*, these figures are 4.8% and -5.7%, respectively. These effects are very similar to those observed for the extensive margin. Finally, besides showing the expected positive signs, now the estimated effects of *Remoteness* and *Trade Opening* turn out to be also statistically significant (even if the latter only at a 10

The results in column 2 including the control for the firms' intermediate import share are qualitatively similar of those reported in column 1. The findings are in accordance with a firm's productivity level positively affecting the export value decision. Indeed, more productive firms are more likely to export more to any country. Concerning country characteristics, the impacts of size,

[32] In the intensive margin equation the dependent variable (export value) is measured in logs. It follows that the coefficient estimates of productivity, market size, distance and remoteness can be interpreted as partial elasticities.

distance and remoteness on the intensive margin are quantitatively similar to what was observed in column 1. The *Trade Opening* variable remains barely statistically significant. Moreover, the higher a firm's intermediate import share from a country, the higher its exports to that country. The coefficient on the import variable implies that a change of 1 percentage point in the intermediate import share generates a 5% effect in the export value.[33]

Column 3 adds the interactions between firm intermediate input imports and the two gravity variables. In accordance with proposition 4, we estimate that, for the average importing firm, the export elasticity to distance is approximately 8 percent larger with respect to a firm that sources its intermediate inputs only in the domestic market.[34] However, we do not find evidence of a significant impact of imports on a firm's exports elasticity to GDP.

As in the extensive margin, in columns 4-6 we run all the three specifications including firm-year fixed effects. The main results are robust to this alternative econometric specification.

4.2 Endogeneity

One of the main problems in estimating equations (18) and (19) concerns the potential endogeneity of firm-level import decisions due to omitted variables or reverse causality. The introduction of firm and firm-year fixed effects ensures that our results are not driven by time constant unobserved heterogeneity which is correlated with the imported inputs decisions. However, the within estimator does not deal with simultaneity issues between export and import decisions or omitted variable bias. In particular, imports and exports could be jointly affected by common unobservable factors at the firm-destination level.

To deal with endogeneity we proceed in two ways. As a first step, we re-estimate the equations for the extensive and the intensive margins of exports using a lagged measure of imported inputs. Table 5 shows the results. In columns 1-2 and 5-6 we estimate, respectively, the extensive and the intensive margins of exports including the imported input share variable at time $t-1$. Regressions include firm-year fixed effects.[35]

The main message with respect to the previous tables does not change. An increase in the import intensity with a one period lag has a positive effect on both the probability of starting to export to country j (column 1) and on the value of exports to j (column 5). The magnitude of the coefficients on lagged import share (at both export margins) is slightly smaller than when considering the current value of import share, suggesting that import decisions have a decreasing influence on exports decisions.[36] The regressions with the interaction terms (columns 2 and 6) confirm the previous findings. On the extensive margins the results are qualitatively similar: compared to a firm that sources its intermediate inputs only in the domestic market, the average importing firm is more sensitive to distance and GDP by about 12 percent. On the intensive margins, the results are quantitatively unchanged.

[33] Note that the $Imported\ Inputs\ Share_{fjt}$ variable is not measured in logs and hence its coefficient estimate should not be interpreted as an elasticity.

[34] In all the samples used in the specifications presented in Tables 3 and 4 importing firms have an average share of imported intermediate inputs around 2 percent.

[35] The results with firm and year fixed effects (available upon request) are consistent with those reported here.

[36] As an additional robustness check we use a lag of two periods. The results confirm the positive impact of lagged import share on export decisions and the signs of the interaction terms.

Table 5: Firms' exports intensive and extensive margins by country: controlling for endogeneity

	(1)	(2)	(3)	(4)	(5)	(6))	(7)	(8)
	Lagged	Lagged	IV/GMM	IV/GMM	Lagged	Lagged	IV/GMM	IV/GMM
	$Starter_{fjt}$				$\ln Exports_{fjt}$			
$\ln Gdp_{jt}$	0.0062***	0.0062***	0.0112***	0.0112***	0.477***	0.477***	0.472***	0.471***
	(0.0005)	(0.0005)	(0.0001)	(0.0001)	(0.037)	(0.037)	(0.003)	(0.003)
$\ln Distance_j$	-0.0093***	-0.0093***	-0.0168***	-0.0168***	-0.550***	-0.556***	-0.572***	-0.568***
	(0.0014)	(0.0014)	(0.0003)	(0.0003)	(0.084)	(0.084)	(0.006)	(0.006)
$\ln Remoteness_{jt}$	0.0056	0.0056	0.0103***	0.0104***	0.721***	0.714***	0.574***	0.569***
	(0.0042)	(0.0042)	(0.0008)	(0.0008)	(0.255)	(0.255)	(0.022)	(0.022)
$MarketCosts_j$	-0.0014**	-0.0014**	-0.0027***	-0.0027***				
	(0.0007)	(0.0007)	(0.0001)	(0.0001)				
$Trade\ Opening_{jt}$	0.0005	0.0005	0.0021***	0.0021***	0.042*	0.041	0.043***	0.042***
	(0.0004)	(0.0004)	(0.0001)	(0.0001)	(0.026)	(0.026)	(0.003)	(0.003)
$Imported\ Inputs\ Share_{fjt-1}$	0.1716***	0.6141			5.270***	17.720**		
	(0.0234)	(0.4361)			(0.352)	(9.114)		
$* \ln Gdp_{jt}$		0.0380***				0.154		
		(0.0139)				(0.301)		
$* \ln Distance_{jt}$		-0.0573**				-2.315***		
		(0.0204)				(0.538)		
$Imported\ Inputs\ Share_{fjt}$			-0.482***	-0.3843			6.563***	8.279
			(0.058)	(0.9277)			(0.269)	(5.566)
$* \ln Gdp_{jt}$				0.0649**				0.628***
				(0.0319)				(0.197)
$* \ln Distance_{jt}$				-0.2343****				-2.639***
				(0.0544)				(0.381)
Firm-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.052	0.052			0.310	0.310		
N.Observations	7,055,811	7,055,811	2,516,377	2,516,377	1,448,383	1,448,383	513,288	513,288
Underidentification test			353.76	246.744			931.604	308.158
(Kleibergen-Paap statistic)								
Weak identification test			844.20	135.861			2837.850	234.800
(Kleibergen-Paap statistic)								
Hansen J statistic			1.749	1.575			1.269	2.549
(Overidentification test of all IVs)								

Note: The Table reports regressions using data on 1998-2003. The dependent variable used is reported at the top of each column. All the regressions include a constant term. Robust standard errors clustered at country level are reported in parenthesis below the coefficients. Asterisks denote significance levels (***:p<1%; **: p<5%; *: p<10%).

Although the strategy of using the lagged value is likely to reduce influence of simultaneity, endogeneity issues are still likely to be present. Indeed, it could be the case that a firm's export and import decisions are hit by common unobservable country-specific shocks which take more than one year to fade away. Thus, as a second step we combine the use of firm-year fixed effects with an instrumental variable approach. This approach allows us to correct for causality/simultaneity issues by treating the import measure as an endogenous variable.

Specifically, we estimate equations (18) and (19) by instrumenting $Imported\ Inputs\ Share_{fjt}$ with its lagged values. In addition to the relevance of the instrument, the other basic assumption is that $cov(M_{demeaned_{fjt-z}}, \epsilon_{demeaned_{fjt}}) = 0$ for $z >= l$. In other words, we assume that some degree of temporal persistency in the import decision at the firm-destination level contributes to the validity of our instrument, while we assume that unobserved shocks affecting simultaneously importing and exporting fade away as time passes by. We implement the two-step efficient generalized method of moments (GMM) estimator and we test our basic assumptions by considering the Kleibergen-Paap statistics (to detect possible problems of underidentification and weak identification) and the Hansen's J statistic (and the related C statistic, also called the "GMM distance" statistic, which allows a test of a subset of the orthogonality conditions).

Both sets of tests validate our choice of instruments for $l = 3, 4$. Moreover, the Kleibergen-Paap test statistics suggest that the excluded instruments are relevant and not weak. For $l = 1, 2$, the Hansen's J statistic rejects the exogeneity of the instruments.

We then turn to the results of the GMM specifications. Columns 4 and 5 of Table 5 show the estimates for the exports extensive margin, with and without the interaction terms. It is instructive to compare the IV/GMM results with the OLS estimates with firm-year fixed effects of Table 3. When instrumenting, the magnitude of the effects tends to be greater and the positive effect of $Trade\ Opening$ becomes statistically significant. However, the estimated coefficients on the interaction terms increase proportionally more than those of the main effects. This suggests that when endogeneity is not properly taken into account our baseline results underestimate the importance of the interaction terms. According to the IV/GMM results, compared to a firm that does not import, the average importing firm is more sensitive to distance and GDP by about 28% and 12%, respectively. Columns 7 and 8 of Table 5 report the estimates for the exports intensive margins. The coefficient on the interaction term between $Imported\ Inputs\ Share_{fjt}$ and Gdp, which becomes statistically significant, is the main difference with respect to the previous OLS estimates. Indeed, now we find that for the average importing firm the export elasticity to GDP is about 3% larger with respect to a firm that does not import. For $Distance$ this figure remains practically unaltered at 9%. The results of the empirical analysis are consistent with the predictions (2, 3, 4 and 5) of our model. Indeed, they suggest that the effect of gravity forces on export propensity and intensity is amplified by the importing activities of a firm and that, from a quantitative point of view, the size of this magnification effect is economically relevant.[37]

5 Conclusions

This paper introduces intermediate inputs into a standard Melitz (2003)/Chaney (2008) model of trade with firm heterogeneity and asymmetric countries to investigate how imports in intermediate inputs affect the firm-level export margins. In line with the growing evidence on the import-productivity-export nexus (Kasahara and Lapham; 2013; Bas and Strauss-Kahn; 2010), the

[37] As an additional robustness check we run a specification, using both the OLS and the IV approach, where the variable import share is interacted with all the country characteristics and with the TFP. The results, available upon request, confirm the previuos findings.

model builds on the idea that importing intermediate inputs improves a firm's export performance. Additionally, it provides a micro-foundation for the export gravity equation in the presence of imports in intermediate inputs. The model shows that the effect of traditional gravity forces on exports depends on a firm's importing activities. Indeed, the elasticity of exports to GDP and distance increases in the import intensity of the firm. Moreover, this mechanism operates both at the extensive and the intensive margins of exports.

The predictions of the model, which take the form of export gravity equations for the volume of exports and the probability to export, are tested using a large and unique panel data set of Italian manufacturing firms over the 1998-2003 period. We find that imported intermediate inputs intensity, measured by the importance of the intermediate inputs sourced from a country in the production process of the firm, amplifies the effects of distance and GDP on a firm's export performance. The estimated size of this magnification effect is economically relevant. The results are robust to controlling for firm-level time-varying unobserved heterogeneity and for the potential endogeneity of firms' import decisions.

The evidence suggests that, looking through the lenses of the gravity equation, firms' importing activities are an important determinant of the distribution of exports across different markets. The paper also outlines the role of sectoral linkages for export performance by suggesting that changes in trade barriers in the intermediate input sector may have important consequences for export performance in the final goods sector. It also provides very interesting predictions regarding the effects of domestic market size on export performance. The latter is a potentially interesting area for future research.

Appendix

Appendix A1: The profit maximization problem of the final good firms

As commented on Section 2, a firm's maximization problem is solved in two steps. First, a firm chooses the optimal allocation of production factors to minimize the costs of production for a given quantity produced. In a second step, a firm chooses the price charged for its final good variety in each market taking into account the optimal cost function derived in the previous step.

A firm will choose the optimal combination of inputs by minimizing the cost of production. This exercise can be done in two steps as well. In the first step, a firm selects the optimal allocation of intermediate inputs for a given firm demand of the intermediate composite good m^f_{hk}. Then the firm chooses the optimal combination of labor and the intermediate composite good, for a given production quantity q^f_{hk}. Therefore, a firms firstly solves

$$Min \int\limits_{\nu\epsilon\Lambda} p_{hmk}(\nu) m^f_{hk}(\nu)\, d\nu$$

$$s.t. \left(\int\limits_{\nu\epsilon\Lambda} \left(m^f_{hk}(\nu) \right)^{\frac{\phi_h - 1}{\phi_h}} d\nu \right)^{\frac{\phi_h}{\phi_h - 1}} = m^f_{hk}$$

This leads to the standard demand function for each intermediate input

$$m^f_{hk}(\nu) = \frac{m^f_{hk}}{P_{hmk}} \left(\frac{p_{hmk}(\nu)}{P_{hmk}} \right)^{-\phi_h} \tag{20}$$

where the aggregate price index for the intermediate composite good is given by

$$P_{hmk} = \left(\int\limits_{\nu\epsilon\Lambda} \left(p_{hmk}(\nu) \right)^{1-\phi_h} d\nu \right)^{\frac{1}{1-\phi_h}}. \tag{21}$$

We assume that the mass of varieties available is different across countries. Since each intermediate producer is a monopolist, then each firm will charge $p_{hmk}(\nu) = \frac{\phi_h \tau_{hmjk} w_j}{\phi_h - 1}$ where $\tau_{mhjj} = 1$.

Applying symmetry across all intermediate inputs belonging to the same country, we can express the aggregate price index for the intermediate composite good in country k and sector h as

$$P_{hmk} = \left(\sum_{j=1}^{N} \left(w_j \tau_{hmjk} \right)^{1-\phi_h} \tilde{L}_j \right)^{\frac{1}{1-\phi_h}} \frac{\phi_h}{\phi_h - 1} \tag{22}$$

where $\tilde{L}_j = \beta_{mj} w_j L_j$. Then the firm chooses the optimal combination of labor and the intermediate composite good

$$Min\ w_k l^f_{hk} + P_{hmk} m^f_{hk}$$

$$s.t. q^f_{hk} = \varphi^f \left(m^f_{hk} \right)^{\alpha_h} \left(l^f_{hk} \right)^{1-\alpha_h}$$

The conditional demand for each input of a firm with productivity φ^f is given by

$$l_{hk}^f = \frac{1}{\varphi^f}\left(\frac{P_{hmk}}{w_k}\frac{1-\alpha_h}{\alpha_h}\right)^{\alpha_h} q_{hk}^f \tag{23}$$

$$m_{hk}^f = \frac{1}{\varphi^f}\left(\frac{w_k}{P_{hmk}}\frac{\alpha_h}{1-\alpha_h}\right)^{1-\alpha_h} q_{hk}^f. \tag{24}$$

Substituting (23) and (24) in the objetive function we obtain the variable cost function for a firm with productivity φ^f in country k and sector h

$$c_{hk}\left(\varphi^f\right) = \frac{(w_k)^{1-\alpha_h}(P_{hmk})^{\alpha_h}}{\Gamma_h}\frac{q_{hk}^f}{\varphi^f} = \frac{(\rho_{hm})^{\alpha_h} w_k}{\Gamma_h (\chi_{hk})^d \left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h-1}}}\frac{q_{hk}^f}{\varphi^f} \tag{25}$$

where $d = 1$ if the firm imports intermediates (and 0 otherwise) and $\Gamma_h = \alpha_h^{\alpha_h}(1-\alpha_h)^{1-\alpha_h}$. We denote with $\rho_{hm} = \frac{\phi_h}{\phi_h-1}$ the mark-up of the intermediate producers.

Appendix A2: Computing P_{hj}

The economy j aggregate price index P_{hj} can be easily obtained considering that

$$P_{hj}^{1-\sigma_h} = \underbrace{\beta_{hj} w_j L_j \int_{\varphi_{hj}^*}^{\infty} (p_{hj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi}_{\text{Domestic firms}} + \underbrace{\sum_{n\neq j}^{N} \beta_{hn} w_n L_n \int_{\varphi_{hxnj}^*}^{\infty} (p_{hxnj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi}_{\text{foreign exporters}}.$$

In contrast to models in which firms are not allowed to import, we need to distinguish between domestic importers and non-importers, as they price differently

$$\int_{\varphi_{hj}^*}^{\infty} (p_{hj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi = \int_{\varphi_{hj}^*}^{\varphi_{hij}^*} (p_{hj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi + \int_{\varphi_{hij}^*}^{\infty} (p_{hij}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi.$$

In the following steps we compute each of these integrals. Substituting the expressions for $p_{hj}(\varphi), p_{hij}(\varphi)$ we have that

$$\int_{\varphi_{hj}^*}^{\infty} (p_{hj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi = \left(w_j \left(\tilde{L}_j\right)^{\frac{\alpha_h}{1-\phi_h}} \psi_j \right)^{1-\sigma_h} \cdot \underbrace{\left(\int_{\varphi_{hj}^*}^{\varphi_{hij}^*} \varphi^{\sigma_h - 1} g(\varphi)\, d\varphi + (\chi_{hk})^{\sigma_h - 1} \int_{\varphi_{hij}^*}^{\infty} \varphi^{\sigma_h - 1} g(\varphi)\, d\varphi. \right)}_{A}.$$

Taking derivatives in equation (2) we obtain the density function $g(\varphi) = \gamma_h (\varphi)^{-(\gamma_h + 1)}$. Substituting in the latter expression and solving for the integrals we have that

$$A = \frac{\gamma_h}{\gamma_h - (\sigma_h - 1)} \left[\left(\varphi_{hj}^*\right)^{\sigma_h - \gamma_h - 1} + \left(\varphi_{hij}^*\right)^{\sigma_h - \gamma_h - 1} \left((\chi_{hk})^{\sigma_h - 1} - 1 \right) \right].$$

Using the fact that $\left(\frac{\varphi_{hij}^*}{\varphi_{hj}^*}\right) = \left(\frac{f_{hik}}{\left((\chi_{hk})^{\sigma_h - 1} - 1\right) f_h} \right)^{\frac{1}{\sigma_h - 1}}$ and rearranging terms yields

$$\int_{\varphi_{hj}^*}^{\infty} (p_{hj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi = \left(w_j \left(\tilde{L}_j\right)^{\frac{\alpha_h}{1-\phi_h}} \psi_j \right)^{1-\sigma_h} \frac{\gamma_h}{\gamma_h - (\sigma_h - 1)} \cdot \left[\frac{(f_h)^{\frac{\sigma_h - \gamma_h - 1}{\sigma_h - 1}} + \left((\chi_{hk})^{\sigma_h - 1} - 1 \right)^{\frac{\gamma_h}{\sigma_h - 1}} (f_{hik})^{\frac{\sigma_h - \gamma_h - 1}{\sigma_h - 1}}}{(f_h)^{\frac{\sigma_h - \gamma_h - 1}{\sigma_h - 1}}} \right] \left(\varphi_{hj}^*\right)^{\sigma_h - \gamma_h - 1}.$$

Substituting the expression for φ_{hj}^* obtained from equation (14), and rearranging terms:

$$\int_{\varphi^*_{hj}}^{\infty} (p_{hj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi = \left(w_j \left(\tilde{L}_j\right)^{\frac{\alpha_h}{1-\phi_h}} \psi_j \right)^{1-\sigma_h} \frac{\gamma_h}{\gamma_h - (\sigma_h - 1)}$$

$$\cdot \left[(f_h)^{\frac{\sigma_h-\gamma_h-1}{\sigma_h-1}} + \left((\chi_{hk})^{\sigma_h-1} - 1 \right)^{\frac{\gamma_h}{\sigma_h-1}} (f_{hik})\, \frac{\sigma_h-\gamma_h-1}{\sigma_h-1} \right]$$

$$\cdot \left(\frac{\sigma_h}{\mu_h}\right)^{\frac{\sigma_h-\gamma_h-1}{\sigma_h-1}} \left(\frac{1}{R_k}\right)^{\frac{\sigma_h-\gamma_h-1}{\sigma_h-1}} \left(\psi_h w_j P_{hj}^{-1}\right)^{\sigma_h-\gamma_h-1} \left(\tilde{L}_k\right)^{\frac{\alpha_h(\sigma_h-\gamma_h-1)}{1-\phi_h}}$$

Now we compute the foreign exporters part. Substituting for the optimal prices and rearranging terms we have that

$$\sum_{n\neq j}^{N} \beta_{hn} w_n L_n \int_{\varphi^*_{hxnj}}^{\infty} (p_{hxnj}(\varphi))^{1-\sigma_h} g(\varphi)\, d\varphi = \sum_{n\neq j}^{N} \beta_{hn} w_n L_n \left(\frac{\psi_h \tau_{hxnj} w_n}{\left(\chi_{hn}\left(\tilde{L}_n\right)\right)^{\frac{\alpha_h}{\phi_h-1}}} \right)^{1-\sigma_h}$$

$$\cdot \int_{\varphi^*_{hxnj}}^{\infty} (\varphi)^{1-\sigma_h} g(\varphi)\, d\varphi.$$

Solving for the integral we have that

$$\sum_{n\neq j}^{N} \beta_{hn} w_n L_n \left(\frac{\psi_h \tau_{hxnj} w_n}{\left(\chi_{hn}\left(\tilde{L}_n\right)\right)^{\frac{\alpha_h}{\phi_h-1}}} \right)^{1-\sigma_h} \left(\frac{\gamma_h}{\gamma_h - (\sigma_h - 1)} \right) \left(\varphi^*_{hxnj}\right)^{\sigma_h-\gamma_h-1}$$

and substituting the expression for the productivity cutoff and rearranging terms yields

$$\sum_{n\neq j}^{N} \beta_{hn} w_n L_n \left(\frac{\psi_h \tau_{hxnj} w_n}{\left(\chi_{hn}\left(\tilde{L}_n\right)\right)^{\frac{\alpha_h}{\phi_h-1}}} \right)^{1-\sigma_h} \left(\frac{\gamma_h}{\gamma_h - (\sigma_h - 1)} \right) \left(\tau_{hxnj} \left(\frac{\sigma_h}{\mu_h}\right)^{\frac{1}{\sigma_h-1}} \left(\frac{1}{R_j}\right)^{\frac{1}{\sigma_h-1}} \psi_h (w_n) (P_{hj})^{-1} (f_{hxnj})^{\frac{\sigma_h-\gamma}{\sigma_h-}} \right.$$

Putting both integrals together, and rearranging terms:

$$P_j^{-\gamma_h} = \left(\frac{\gamma_h}{\gamma_h - (\sigma_h - 1)} \right) \left(\frac{\sigma_h}{\mu_h}\right)^{\frac{\sigma_h-\gamma_h-1}{\sigma_h-1}} \left(\frac{1}{R_j}\right)^{\frac{\sigma_h-\gamma_h-1}{\sigma_h-1}}$$

$$\cdot \sum_{n=1}^{N} \beta_{hn} w_n L_n \left(\tilde{L}_n\right)^{\frac{\alpha_h\gamma_h}{\phi_h-1}} \psi_h^{-\gamma_h} (w_n \tau_{hxnj})^{-\gamma_h} \left(\chi_{hn}^{\gamma_h}\right)^{(1-\xi)} (\Phi_h)^{\xi} (f_{hxnj})^{\left(\frac{\sigma_h-\gamma_h-1}{\sigma_h}\right)(1-\xi)}$$

where $\Phi_h = (f_h)^{\left(\frac{\sigma_h-\gamma_h-1}{\sigma_h-1}\right)} + \left((\chi_{hn})^{\sigma_h-1} - 1\right)^{\frac{\gamma_h}{\sigma_h-1}} (f_{hin})^{\left(\frac{\sigma_h-\gamma_h-1}{\sigma_h-1}\right)}$ and ξ is a dummy variable taking the value of 1 if $n = j$ and 0 otherwise. Defining $\lambda_{2h}^{\gamma_h} = \left(\frac{\gamma_h-(\sigma_h-1)}{\gamma_h}\right)\left(\frac{\sigma_h}{\mu_h}\right)^{\frac{\sigma_h-\gamma_h-1}{1-\sigma_h}}\left(\frac{1+\pi}{Y}\right)$ and taking into account that $R_j = w_j L_j (1+\pi) = Y_j$, and rearranging terms, P_{hj} can be expressed as

$$P_{hj} = \lambda_{2h} \left(Y_j\right)^{\frac{1}{\gamma_h} - \frac{1}{\sigma_h - 1}} \theta_{hj}$$

$$\left(\theta_{hj}\right)^{-\gamma_h} = \left[\sum_{n=1}^{N} \frac{Y_n}{Y} \left(w_n \tau_{hxnj}\right)^{-\gamma_h} \left(f_{hxnj}\right)^{\left(\frac{\sigma_h - \gamma_h - 1}{\sigma_h}\right)(1-\xi)} \beta_{hn} \left(\tilde{L}_n\right)^{\frac{\alpha_h \gamma_h}{\phi_h - 1}} \psi_h^{-\gamma_h} \left(\chi_{hn}^{\gamma_h}\right)^{(1-\xi)} \left(\Phi_h\right)^{\xi}\right].$$

Appendix A3: Proof of the propositions

Proposition 1. *Imports of intermediate inputs have a positive effect on firms' productivity.*

Proof. To prove that we closely follow Sala i Martin (2004) (ch.6).

Consider the case of a domestic firm which is not importing intermediate inputs. All domestic intermediate inputs are identical. Let denote by m_{kk} the amount of each intermediate input that the firm is using. The total volume of intermediate inputs used by the firm ($\tilde{m}_{hn}^{f}$) is given by

$$\tilde{m}_{hn}^{f} = \int\limits_{v\epsilon\Lambda} \frac{p_{hmk}(\nu)\, m_{hk}^{f}(\nu)\, dv}{p_{hmk}} = \tilde{L}_k m_{kk}$$

where we use the price of a domestic intermediate input (p_{hmk}) to obtain the quantities of intermediate input used by the firm. Notice that output per firm can be expressed as

$$q_{hn}^{f} = \varphi_h^f \left(l_{hn}^f\right)^{1-\alpha_h} \left(m_{hn}^f\right)^{\alpha_h}.$$

The CES intermediate input aggregator can be expressed as

$$m_{hn}^{f} = \left(\int\limits_{\nu\epsilon\Lambda} \left(m_{hn}^{f}(\nu)\right)^{\frac{\phi_{h-1}}{\phi_h}} d\nu\right)^{\frac{\phi_h}{\phi_h - 1}} = \left(\tilde{L}_k\right)^{\frac{\phi_h}{\phi_h - 1}} m_{kk}.$$

Substituting the latter in the production function we have that

$$q_{hn}^{f} = \varphi_h^f \left(l_{hn}^f\right)^{1-\alpha_h} \left(\left(\beta_k \tilde{L}_K\right)^{\frac{\phi_h}{\phi_h - 1}} m_{kk}.\right)^{\alpha_h} = \varphi_h^f \left(l_{hn}^f\right)^{1-\alpha_h} \left(\tilde{m}_{hn}^f.\right)^{\alpha_h} \left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}}.$$

If we compute the TFP for this firm we have that

$$TFP = \frac{q_{hn}^{f}}{\left(l_{hn}^f\right)^{1-\alpha_h} \left(\tilde{m}_{hn}^f.\right)^{\alpha_h}} = \varphi_h^f \left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}}$$

where the term in parenthesis represents the positive effect that having access to a broader set of intermediate input varieties has on TFP or in another terms, *the variety effect.*

For the case of a firm which import intermediates we have a similar expression. In this case the CES aggregator is given by

$$m_{hn}^{f} = \left(\int\limits_{\nu\epsilon\Lambda} \left(m_{hn}^{f}(\nu)\right)^{\frac{\phi_{h-1}}{\phi_h}} d\nu\right)^{\frac{\phi_h}{\phi_h - 1}} = \left[\sum_{j=1}^{N} \left(\left(\frac{w_j}{w_k}\right) \tau_{hmjk}\right)^{1-\phi_h} \frac{\tilde{L}_j}{\tilde{L}_k}\right]^{\frac{\phi_h}{\phi_h - 1}} \left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h - 1}}.$$

Notice that

$$\tilde{m}_{hn}^{f} = \int\limits_{v\epsilon\Lambda} \frac{p_{hmk}(\nu)\, m_{hk}^{f}(\nu)\, dv}{p_{hmk}} = \left[\sum_{j=1}^{N} \left(\left(\frac{w_j}{w_k}\right) \tau_{hmjk}\right)^{1-\phi_h} \tilde{L}_j\right].$$

Substituting in the production function and rearranging terms we have that the TFP of a firm that imports intermediate inputs is given by

$$TFP = \frac{q^f_{hn}}{\left(l^f_{hn}\right)^{1-\alpha_h}\left(\tilde{m}^f_{hn\cdot}\right)^{\alpha_h}} = \varphi^f_h\left[\sum_{j=1}^{N}\left(\left(\frac{w_j}{w_k}\right)\tau_{hmjk}\right)^{1-\phi_h}\frac{\tilde{L}_j}{\tilde{L}_k}\right]^{\frac{\alpha_h}{\phi_h-1}}\left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h-1}} = \varphi^f_h\left(\chi_{hk}\right)\left(\tilde{L}_k\right)^{\frac{\alpha_h}{\phi_h-1}}.$$

We know that $\chi_{hk} > 1$ so that the TFP of a firm importing intermediates is clearly larger than the one of a firm which only relies on domestic intermediate inputs. ■

Corollary 1.1. *The productivity benefits from importing intermediate inputs decrease with variable trade costs, increase with the foreign country size and, under certain condition, with the income per capita (i.e. the wage) of the source country.*

Proof. From the expression for χ_{hk} taking partial derivatives, it is easy to see that

$$\frac{d\ln\left(\chi_{hk}\right)}{d\ln\left(\tau_{hmjk}\right)} < 0, \frac{d\ln\left(\chi_{hk}\right)}{d\ln\left(\ L_j\right)} > 0.$$

The third result is a little bit more cumbersome since in principle wages have an ambiguous effect on the productivity of the firm. Higher wages in the source country implies that intermediate inputs coming from that country are more expensive, (we denote this as the cost channel). This effect will have a negative impact on TFP since it limits the ability of the firm to spread its input requirements across more varieties. However, a richer country also produces more varieties, which implies that the firm can spread its input requirements across more varieties (we denote this as the technological channel). The latter will have a positive impact on TFP. Taking logs and derivatives in the expression for χ_{hk}:

$$\ln\left(\chi_{hk}\right) = \ln(constant) + \frac{\alpha_h}{\phi_h - 1}\ln\left(\sum_{j=1}^{N}\left(w_j\tau_{hmjk}\right)^{1-\phi_h}\tilde{L}_j\right)$$

$$\frac{d\ln\left(\chi_{hk}\right)}{d\ln\left(w_j\right)} = \frac{1}{\sum\limits_{j=1}^{N}\left(w_j\tau_{hmjk}\right)^{1-\phi_h}\tilde{L}_j}\left[\underbrace{\left(1-\phi_h\right)\left(w_j\right)^{-\phi_h}\left(\tau_{hmjk}\right)^{1-\phi_h}\tilde{L}_j}_{\text{cost channel}} + \underbrace{\beta_{mj}L_j\left(w_j\tau_{hmjk}\right)^{1-\phi_h}}_{\text{supply channel}}\right]w_j.$$

Rearranging terms

$$\frac{d\ln\left(\chi_{hk}\right)}{d\ln\left(w_j\right)} = \frac{\left[\left(2-\phi_h\right)\left(w_j\tau_{hmjk}\right)^{1-\phi_h}\tilde{L}_j\right]}{\sum\limits_{j=1}^{N}\left(w_j\tau_{hmjk}\right)^{1-\phi_h}\tilde{L}_j}$$

The latter is bigger than zero if

$$\phi_h < 2.$$

■

Proposition 2. *The effect of distance on the probability of exporting to a specific country is magnified by the presence of trade in intermediate inputs. The elasticiy with respect to distance is given by*

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(D_{kj})} = -\delta_h\gamma_h\left(1+\alpha_h s_{hmjk}\right).$$

Proof. From (16), we can write that

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(D_{kj})} = -\gamma_h\frac{d\ln(\tau_{hxkj})}{d\ln(D_{kj})} + \gamma_h\frac{d\ln(\tilde{\chi}_{hk})}{d\ln(\tau_{hmjk})}\frac{d\ln(\tau_{hmjk})}{d\ln(D_{kj})}.$$

Notice that $\frac{d\ln(\tau_{hxkj})}{d\ln(D_{kj})} = \frac{d\ln(\tau_{hmjk})}{d\ln(D_{kj})} = \delta_h$. It follows that

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(D_{kj})} = -\delta_h\gamma_h\left(1-\frac{d\ln(\tilde{\chi}_{hk})}{d\ln(\tau_{hmjk})}\right) = -\delta_h\gamma_h\left(1-\frac{\alpha_h}{\phi_h-1}\frac{(1-\phi_h)\left(\frac{w_j}{w_k}\tau_{hmjk}\right)^{1-\phi_h}\frac{\beta_{mj}Y_j}{Y}}{\sum_{j=1}^{N}\left(\frac{w_j}{w_k}\tau_{hmjk}\right)^{1-\phi_h}\frac{\beta_{mj}Y_j}{Y}}\right).$$

Rearranging terms

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(D_{kj})} = -\delta_h\gamma_h\left(1-\frac{d\ln(\tilde{\chi}_{hk})}{d\ln(\tau_{hmjk})}\right) = -\delta_h\gamma_h\left(1+\alpha_h\left(\frac{(w_j\tau_{hmjk})^{1-\phi_h}\beta_{mj}Y_j}{\sum_{j=1}^{N}(w_j\tau_{hmjk})^{1-\phi_h}\beta_{mj}Y_j}\right)\right).$$

Applying symmetry to all varieties across the same destination we have that

$$s_{hmjk} = \frac{p_{hmjk}m_{hjk}\tilde{L}_j}{\sum_{l=1}^{N}p_{hmlk}m_{hlk}\tilde{L}_l}.$$

Using 20 we can express the volume of intermediates of a particular destination as a function of the domestic volume of intermediates. More precisely

$$m_{hjk} = \left(\frac{w_j}{w_k}\tau_{hmjk}\right)^{-\phi_h} m_{hkk}.$$

Substituting the expression for prices we have that

$$s_{hmkl} = \frac{p_{hmkl}m^f_{hkl}\tilde{L}_l}{\sum_{j=1}^{N}p_{hmjk}m^f_{hjk}\tilde{L}_j} = \frac{(w_l\tau_{hmlk})^{1-\phi_h}\tilde{L}_l m_{hkk}}{\sum_{j=1}^{N}(w_j\tau_{hmjk})^{1-\phi_h}\tilde{L}_j m_{hkk}} = \frac{(w_l\tau_{hmlk})^{1-\phi_h}_{hkl}\beta_{ml}Y_l}{\sum_{j=1}^{N}(w_j\tau_{hmjk})^{1-\phi_h}\beta_{mj}Y_j}$$

when the latter comes from multiplying by $(1+\pi)$ both the numerator and the denominator. Therefore,

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(D_{kj})} = -\delta_h\gamma_h\left(1-\frac{d\ln(\tilde{\chi}_{hk})}{d\ln(\tau_{hmjk})}\right) = -\delta_h\gamma_h\left(1+\alpha_h s_{hmjk}\right).$$

■

Proposition 3. *The elasticity of the probability of exporting to a specific destination with respect to market size (domestic and foreign) is given by*

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(Y_l)} = \xi + \frac{\alpha_h\gamma_h}{\phi_h - 1}s_{hmlk} \quad l = k, j.$$

Proof. From (16), we have that

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(Y_l)} = \xi + \gamma_h \frac{d\ln\tilde{\chi}_{hk}}{d\ln(Y_l)}.$$

Notice that

$$\frac{d\ln(\tilde{\chi}_{hk})}{d\ln(Y_l)} = \frac{\alpha_h}{\phi_h - 1}\left(\frac{(w_j\tau_{hmjk})^{1-\phi_h}\beta_{ml}Y_l}{\sum_{j=1}^{N}(w_j\tau_{hmjk})^{1-\phi_h}\beta_{mj}Y_j}\right).$$

Therefore,

$$\frac{d\ln(\Pr(\varphi \geq \varphi^*_{hxkj}))}{d\ln(Y_l)} = \xi + \frac{\alpha_h\gamma_h}{\phi_h - 1}s_{hmjk}$$

■

Proposition 4. The effect of distance on a firm's exports to a specific destination is amplified. The elasticity of a firm exports to distance is given by

$$\frac{d\ln(r_{hxkj}(\varphi^f))}{d\ln(D_{kj})} = -\delta_h(\sigma_h - 1)(1 + \alpha_h s_{hmjk}).$$

Proof. Taking logs and derivatives in equation (17) we have that

$$\frac{d\ln(r_{hxkj}(\varphi^f))}{d\ln(D_{kj})} = -(\sigma_h - 1)\left(\frac{d\ln(\tau_{hxkj})}{d\ln(D_{kj})} - \frac{d\ln(\tilde{\chi}_{hk})}{d\ln(\tau_{hmjk})}\frac{d\ln(\tau_{hmjk})}{d\ln(D_{kj})}\right).$$

Notice that $\frac{d\ln(\tau_{hxkj})}{d\ln(D_{kj})} = \frac{d\ln(\tau_{hmjk})}{d\ln(D_{kj})} = \delta_h$. Notice also that $\frac{d\ln(\tilde{\chi}_{hk})}{d\ln(\tau_{hmjk})} = -\alpha_h s_{hmkj}$.
Substituting both in the first derivative we have that:
$\frac{d\ln(r_{hxkj}(\varphi^f))}{d\ln(D_{kj})} = -\delta_h(\sigma_h - 1)(1 + \alpha_h s_{hmjk})$. ■

Proposition 5. *The effect of market size on a firm's exports to a specific destination is amplified. The elasticity of a firm exports to market size is given by*

$$\frac{d\ln(r_{hxkl}(\varphi^f))}{d\ln(Y_l)} = \left(\frac{\sigma_h - 1}{\gamma_h}\right)\xi + (\sigma_h - 1)\frac{d\ln(\tilde{\chi}_{hk})}{d\ln(Y_l)}.$$

Proof. where the latter is given by

$$\frac{d\ln(\tilde{\chi}_{hk})}{d\ln(Y_l)} = \frac{\alpha_h}{\phi_h - 1}s_{hmlk}$$

As we have shown in the proof of proposition 3. Plugging both expressions in the first derivative we have that

$$\frac{d\ln(r_{hxkl}(\varphi^{f}))}{d\ln\left(Y_{l}\right)} = \left(\frac{\sigma_{h}-1}{\gamma_{h}}\right)\xi + \frac{\alpha_{h}\left(\sigma_{h}-1\right)}{\phi_{h}-1}s_{hmlk}, l = k, j$$

■

Appendix A4: Custom data

In compliance with the common framework defined by the European Union (EU), there are different requirements in order for a transaction to be recorded, depending on whether the importing country is an EU or NON-EU country, and on the value of the transaction.

As far as outside EU transactions are concerned, there is a good deal of homogeneity among member states as well as over time. In the Italian system the information is derived from the Single Administrative Document (SAD) which is compiled by operators for each individual transaction. Since the adoption of the Euro, Italy sets the threshold at 620 euro (or 1000 Kg), so that all transactions bigger than 620 euro (or 1000 Kg) are recorded. For all of these recorded extra-EU transactions, the COE data report complete information, that is, also information about the product quantity and value.

Transactions within the EU are collected according to a different systems (Intrastat), where the thresholds on the annual value of transactions qualifying for a complete record are less homogeneous across EU member states, with direct consequences on the type of information reported in the data. In 2003 (the last year covered in the analysis), there are two cut-offs. If a firm has more than 200,000 euro of exports (based on previous year report), then the firm must fill the Intrastat document monthly. This implies that complete information about product is also available. Instead, if previous year export value falls in between 40,000 and 200,000 euro, the quarterly Intrastat file has to be filled, implying that only the amount of export is recorded, while information on the product is not. Firms with previous year exports below 40,000 euro are not required to report any information on trade flows. According to ISTAT, about one-third of the operators submitted monthly declarations, though covering about 98% of trade flows (http://www.coeweb.istat.it/default.htm). Thus, firms which do not appear in COE are either of this type (i.e. marginal exporters) or do not export at all.

Appendix A5: Additional results

Table A1: List of countries

Country	Starters	Country	Starters	Country	Starters
Albania (ALB)	1195	Greece (GRC)	1428	Nigeria (NGA)	1001
Algeria (DZA)	1040	Guatemala (GTM)	546	Norway (NOR)	1597
Argentina (ARG)	800	Guyana (GUY)	81	Oman (OMN)	618
Australia (AUS)	1532	Haiti (HTI)	72	Pakistan (PAK)	787
Austria (AUT)	1452	Honduras (HND)	281	Panama (PAN)	593
Bahamas (BHS)	116	Hong Kong (HKG)	1721	Paraguay (PRY)	180
Bahrain (BHR)	838	Hungary (HUN)	2128	Peru (PER)	955
Bangladesh (BGD)	363	Iceland (ISL)	652	Philippines (PHL)	927
Belize (BLZ)	40	India (IND)	1660	Poland (POL)	2284
Benin (BEN)	182	Indonesia (IDN)	1248	Portugal (PRT)	1364
Bolivia (BOL)	238	Iran (IRN)	1293	Romania (ROM)	2593
Botswana (BWA)	33	Ireland (IRL)	437	Russia (RUS)	2399
Brazil (BRA)	1369	Israel (ISR)	1412	Rwanda (RWA)	40
Bulgaria (BGR)	1920	Jamaica (JAM)	154	Senegal (SEN)	482
Burundi (BDI)	54	Japan (JPN)	1826	Sierra Leone (SLE)	126
Cameroon (CMR)	384	Jordan (JOR)	1080	Singapore (SGP)	1593
Canada (CAN)	1874	Kenya (KEN)	497	Slovenia (SVN)	1903
Chad (TCD)	49	Kuwait (KWT)	1127	South Africa (ZAF)	1338
Chile (CHL)	1111	Latvia (LVA)	1290	Spain (ESP)	1588
China (CHN)	2307	Lithuania (LTU)	1658	Sri Lanka (LKA)	534
Colombia (COL)	1066	Luxembourg (LUX)	671	Sweden (SWE)	1347
Costa Rica (CRI)	719	Macedonia (MKD)	255	Switzerland (CHE)	1838
Croatia (HRV)	2090	Madagascar (MDG)	268	Syria (SYR)	937
Cyprus (CYP)	1273	Malawi (MWI)	49	Tanzania (TZA)	258
Denmark (DNK)	1240	Malaysia (MYS)	1316	Thailand (THA)	1408
Ecuador (ECU)	744	Mali (MLI)	139	Togo (TGO)	153
Egypt (EGY)	1197	Mauritius (MUS)	501	Tunisia (TNU)	1549
El Salvador (SLV)	415	Mexico (MEX)	1935	Turkey (TUR)	1641
Estonia (EST)	1126	Morocco (MAR)	1345	Uganda (UGA)	162
Fiji (FJI)	81	Mozambique (MOZ)	76	Ukraine (UKR)	1706
Finland (FIN)	1195	Namibia (NAM)	80	United Kingdom (GBR)	1516
France (FRA)	1268	Nepal (NPL)	73	United States (USA)	1957
Gabon (GAB)	225	Netherlands (NLD)	1409	Uruguay (URY)	558
Georgia (GEO)	156	New Zealand (NZL)	1126	Venezuela (VEN)	1151
Germania (DEU)	1235	Nicaragua (NIC)	159	Vietnam (VNM)	293
Ghana (GHA)	446	Niger (NER)	110	Zambia (ZMB)	80
				Zimbabwe (ZWE)	132
Total			101,064		

Note: The Table reports the list of 109 countries used in the empirical analysis. ISO codes for the names of countries are reported in parenthesis

Table A2: Country variables: summary statistics

	Mean	SD	Min	25th Pct	75th Pct	Max
$\ln Distance_j$	8.29	0.92	6.19	7.58	9.07	9.83
$\ln GDP_{jt}$	24.11	2.05	20.40	22.51	25.54	29.98
$Trade\ Opening_{jt}$	7.19	1.67	2.26	6.08	8.48	9.94
$MarketCosts_j$	-0.168	0.91	-1.57	-0.82	0.19	3.48
$\ln Remoteness_{jt}$	40.08	0.25	39.70	39.83	40.26	40.67

Note: Table reports the summary statistics for the country variables used in the empirical analysis. Statistics are computed on 109 countries.

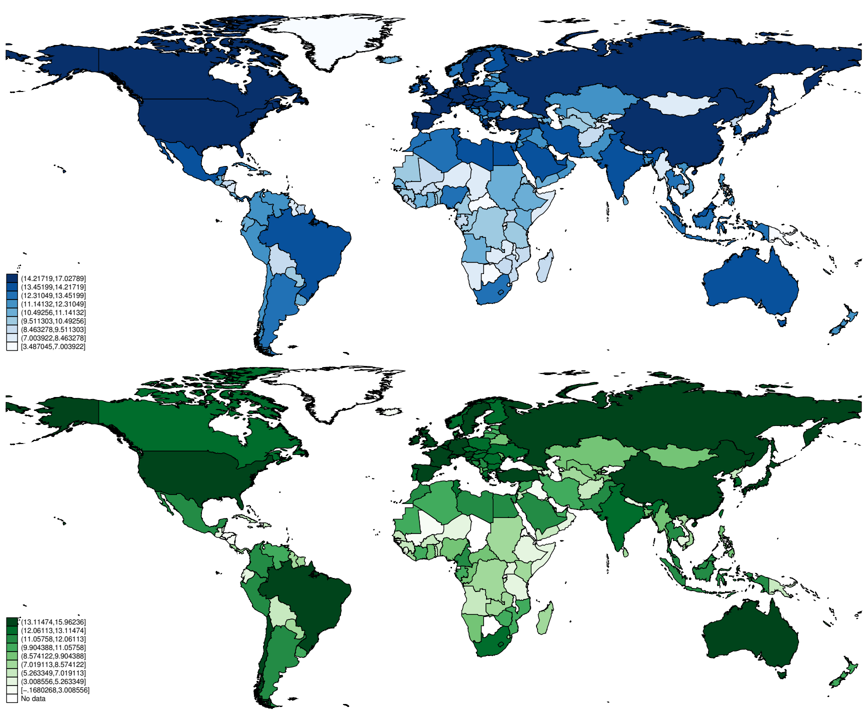

Figure A1: Italian Exports and Imports across countries. Figure reports total Italian exports (top panel) and imports (bottom panel) across countries for 2003.

Table A3: Firms' exports extensive and intensive margin by country: country and firm clustering

	(1)	(2)	(3)	(4)	(5)	(6)
		$Starter_{fjt}$			$\ln Exports_{fjt}$	
$\ln Gdp_{jt}$	0.006***	0.006***	0.006***	0.485***	0.477***	0.477***
	(0.000)	(0.000)	(0.000)	(0.037)	(0.036)	(0.036)
$\ln Distance_j$	-0.009***	-0.009***	-0.009***	-0.571***	-0.560***	-0.556***
	(0.001)	(0.001)	(0.001)	(0.083)	(0.081)	(0.081)
$\ln Remoteness_{jt}$	0.006	0.006	0.006	0.733***	0.720***	0.713***
	(0.004)	(0.004)	(0.004)	(0.249)	(0.246)	(0.245)
$MarketCosts_j$	-0.001**	-0.001**	-0.001**			
	(0.001)	(0.001)	(0.001)			
$Trade\ Opening_{jt}$	0.001	0.001	0.001	0.043*	0.044*	0.044*
	(0.000)	(0.000)	(0.000)	(0.026)	(0.026)	(0.026)
$Imported\ Inputs\ Share_{fjt}$		0.216***	0.170		5.469***	22.886**
		(0.027)	(0.518)		(0.372)	(9.243)
$* \ln Gdp_{jt}$			0.028*			-2.389***
			(0.016)			(0.561)
$* \ln Distance_{jt}$			-0.088***			-0.008
			(0.027)			(0.314)
Firm-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N.Observations	7,055,819	7,055,819	7,055,819	1,448,432	1,448,432	1,448,432

Note: The Table reports regressions using data on 1998-2003. The dependent variable used is reported at the top of the columns. All the regressions include a constant term. Regressions are run on the same observations in all specifications. Robust standard errors clustered at country and firm level are reported in parenthesis below the coefficients. Asterisks denote significance levels (***:p<1%; **: p<5%; *: p<10%).

References

Acharya, R. C. and Keller, W. (2009). Technology transfer through imports, *Canadian Journal of Economics* **42**(4): 1411–1448.

Amiti, M. and Konings, J. (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from indonesia, *American Economic Review* **97**(5): 1611–1638.

Anderson, J. E. and van Wincoop, E. (2004). Trade costs, *Journal of Economic Literature* **42**(3): 691–751.

Baldwin, R. and Harrigan, J. (2011). Zeros, quality, and space: Trade theory and trade evidence, *American Economic Journal: Microeconomics* **3**(2): 60–88.

Bas, M. and Strauss-Kahn, V. (2010). Does importing more inputs raise exports? firm level evidence from france, *MPRA Paper 27315*, University Library of Munich, Germany.

Bernard, A. B., Grazzi, M. and Tomasi, C. (2011). Intermediaries in international trade: Direct versus indirect modes of export, *NBER Working Papers 17711*, National Bureau of Economic Research, Inc.

Bernard, A. B. and Jensen, J. B. (2004). Why some firms export, *The Review of Economics and Statistics* **86**(2): 561–569.

Bernard, A. B., Jensen, J. B., Redding, S. J. and Schott, P. K. (2007). Firms in international trade, *Journal of Economic Perspectives* **21**(3): 105–130.

Castellani, D., Serti, F. and Tomasi, C. (2010). Firms in international trade: Importers' and exporters' heterogeneity in italian manufacturing industry, *The World Economy* **33**(3): 424–457.

Chaney, T. (2008). Distorted gravity: the intensive and extensive margins of international trade, *American Economic Review* **98**(4): 1707–1721.

Crozet, M. and Koenig, P. (2010). Structural gravity equations with intensive and extensive margins, *Canadian Journal of Economics* **43**(1): 41–62.

Djankov, S., Freund, C. and Pham, C. S. (2010). Trading on time, *Review of Economics and Statistics* **92**(1): 166–173.

Eaton, J., Kortum, S. and Kramarz, F. (2004). Dissecting trade: Firms, industries, and export destinations, *American Economic Review* **94**(2): 150–154.
URL: *http://ideas.repec.org/a/aea/aecrev/v94y2004i2p150-154.html*

Eaton, J., Kortum, S. S. and Kramarz, F. (2011). An anatomy of international trade: Evidence from French firms, *Econometrica* **79**(5): 1453–1498.

Feng, L., Li, Z. and Swenson, D. L. (2012). The connection between imported intermediate inputs and exports: Evidence from chinese firms, *NBER Working Papers 18260*, National Bureau of Economic Research, Inc.

Grossman, G. M. and Helpman, E. (1991). *Innovation and Growth in the Global Economy*, Cambridge, Mass. ; London : MIT.

Halpern, L., Koren, M. and Szeidl, A. (2011). Imported inputs and productivity, *CeFiG Working Papers 8*, Center for Firms in the Global Economy.

Helpman, E., Melitz, M. and Rubinstein, Y. (2008). Estimating trade flows: Trading partners and trading volumes, *The Quarterly Journal of Economics* **123**(2): 441–487.

Hummels, D., Ishii, J. and Yi, K.-M. (2001). The nature and growth of vertical specialization in world trade, *Journal of International Economics* **54**(1): 75–96.

Kasahara, H. and Lapham, B. (2013). Productivity and the decision to import and export: Theory and evidence, *Journal of International Economics* **89**(2): 297–316.

Kasahara, H. and Rodrigue, J. (2008). Does the use of imported intermediates increase productivity? plant-level evidence, *Journal of Development Economics* **87**(1): 106–118.

Lawless, M. and Whelan, K. (2008). Where do firms export, how much, and why?, *Working Papers 200821*, School Of Economics, University College Dublin.

Levinsohn, J. and Petrin, A. (2003). Estimating production functions using inputs to control for unobservables, *Review of Economic Studies* **70**(2): 317–41.

Manova, K. and Zhang, Z. (2012). Export prices across firms and destinations, *The Quarterly Journal of Economics* **127**(1): 379–436.

Markusen, J. (1989). Trade in producer services and in other specialized intermediate inputs, *American Economic Review* **79**(1): 85–95.

Mayer, T. and Ottaviano, G. (2008). The happy few: The internationalisation of european firms, *Intereconomics: Review of European Economic Policy* **43**(3): 135–148.

Mayer, T. and Zignago, S. (2005). Market access in global and regional trade, *Working Papers 2005-02*, CEPII research center.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity, *Econometrica* **71**(6): 1695–1725.

Muuls, M. and Pisu, M. (2009). Imports and exports at the level of the firm: Evidence from belgium, *The World Economy* **32**(5): 692–734.

Nocco, A. (2012). Selection, market size and international integration: Do vertical linkages play a role?, *Review of International Economics* **20**(5): 960–973.

Rivera-Batiz, L. A. and Romer, P. M. (1991). International trade with endogenous technological change, *European Economic Review* **35**(4): 971–1001.

Roberts, M. J. and Tybout, J. R. (1997). The decision to export in Colombia: An empirical model of entry with sunk costs, *American Economic Review* **87**(4): 545–64.

Romer, P. M. (1990). Endogenous technological change, *Journal of Political Economy* **98**(5): S71–102.

Smeets, R., Creusen, H., Lejour, A. and Kox, H. (2010). Export margins and export barriers: Uncovering market entry costs of exporters in the netherlands, *CPB Documents 208*, CPB Netherlands Bureau for Economic Policy Analysis.
URL: *http://ideas.repec.org/p/cpb/docmnt/208.html*

Tinbergen, J. (1962). *Shaping the World Economy: sugggestions for an International Economic Policy*, Twentieth Century Fund, New-York.