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The dynamics of importer–exporter connections *

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ABSTRACT

This paper studies the dynamics of importer–exporter connections when importers source inputs from multiple exporters. I first develop a trade model in which heterogeneous importers invest in expanding the set of potential exporters they know and from which they can source. The model delivers three novel predictions. The lower the degree of substitutability among final goods and the higher the degree of substitutability among inputs of an importer: (i) the lower the growth rate in importer's connections, (ii) the more likely are connections to be discontinued, and (iii) the lower the trade value growth per surviving connection. I then provide evidence in favor of these predictions by using customs transaction data from Colombia. Finally, I show that the mechanism unveiled in this paper matters for the heterogeneity of the trade adjustment to macroeconomic shocks across sectors.

1. Introduction

International trade rests on a broad network of importer–exporter connections. Learning about how these connections are created, developed, and discontinued is critical to understanding how international trade reacts to macroeconomic shocks. Although importers usually buy multiple inputs from multiple exporters,¹ the literature has not considered that the evolution of each of an importer's connections might depend on other connections that the importer has.² However, given that firms import inputs to lower their marginal costs, all connections of an importer are linked through the importer's production function.

This paper addresses this gap in the literature and studies the survival probability and trade value growth of importerexporter connections when importers source inputs from multiple exporters. By doing so, I highlight a new mechanism by which, from the importer's perspective, connections with exporters are complements or substitutes. Furthermore, the complementarity or substitutability of connections has consequences on firm-level outcomes and on the transmission of macroeconomic shocks.

Motivated by some empirical regularities about importer–exporter connections, I first developed a dynamic theoretical model to analyze how importers decide from which exporters to source their inputs. As in Antràs et al. (2017), an important aspect of the model is that an importer's decision to source from an exporter influences its sourcing decision with all other, actual and potential, exporters. Then, I test the predictions of the model empirically using detailed transaction-level data from Colombian importers.

In the model, importers are heterogeneous in their productivity and in their degree of substitutability among final goods and among inputs. The main novelty of the model is that importers have incomplete knowledge about potential exporters and need to

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¹ For example, Bernard et al. (2018a) show that Colombian importers buy 14.73 products from 5.26 exporters on average.

² Antràs et al. (2017) consider the case in which importers' entry to different countries is affected by the countries in which they already operate, but does not consider the dynamic effects on importer–exporter connections.

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invest in their *supplier list*, defined as the set of exporters they know and with whom they can potentially create a connection to purchase an input. When an importer's supplier list expands, new exporters become available and the importer re-optimizes its set of connections, trading off two effects. While each additional connection decreases the importer's marginal cost of production, it simultaneously increases the cost of maintaining its connections. The main takeaway of the model is that the relevant determinant of connections' survival and trade value growth is an expression that increases in the importer's degree of substitutability among final goods and decreases in the importer's degree of substitutability among inputs. I label this expression the *elasticity gap.*³

The first result of the model is that importers with a smaller elasticity gap increase the number of connections over time at a slower rate. This result is the outcome of two distinct effects. On the one hand, the drop in marginal costs from additional connections is smaller, the higher the degree of substitutability among inputs. On the other hand, a given drop in marginal costs is boosting profits less, the lower the degree of substitutability among final goods. The elasticity gap concisely captures both effects. In other words, the elasticity gap is linked to how profitable each new connection is for the importer. Since importers with a smaller elasticity gap benefit less from new connections, they invest less in meeting new exporters.

The second result is that the connections of importers with a smaller elasticity gap have a lower survival rate. As new exporters are added to the supplier list, importers with a smaller elasticity gap are more prone to dropping existing connections. The mechanism for the lower survival rate of importers with a smaller elasticity gap is that, after an expansion of the supplier list, they concentrate their input purchases on high-productivity exporters. This reduces the trade value of their connections with low-productivity exporters, such that relatively more connections fall below the required profitability for maintaining the connection and are consequently discontinued.

The third result concerns connections' trade value growth: conditional on surviving, the connections of importers with a smaller elasticity gap exhibit lower trade value growth. Intuitively, importers facing a low degree of substitutability among final goods expand production less after reducing their marginal costs. At the same time, the reduction in marginal costs from connecting to new exporters is smaller when the degree of substitutability among inputs is higher. Again, the elasticity gap captures both effects: the smaller an importer's elasticity gap, the lower the increase in revenues when new exporters become available, which results in a smaller increase in the demand for inputs from each exporter. Thus, for importers with a lower elasticity gap, the increase in their overall demand for inputs after sourcing from an additional exporter results in a smaller increase in their demand for inputs from each exporter.

In terms of aggregate outcomes, the model predicts a larger trade elasticity to macroeconomic shocks for importers with a larger elasticity gap. The intuition behind this result is that the elasticity gap acts as an amplifier of changes in the importer's sourcing cost. This result is derived directly from the interaction of connections within the importer's production function: an increase in import costs causes some connections to be dropped, which in turn causes the other importer connections to become more or less profitable depending on the importer's elasticity gap.

I provide empirical support for the theoretical results of the model using detailed manufacturing and trade data from Colombia. First, I estimate the degree of substitutability among final goods and among inputs, which are then used to compute the elasticity gap at various levels of aggregation. Then, I test the model's predictions on the number of connections, survival probability, and trade value growth using transaction-level trade data from Colombian importers over more than ten years. The data allow me to control for year, country of the exporter, and imported product at the 6-digit HS level.

I show that, as predicted by the model, importers with a smaller elasticity gap show lower growth in the number of connections, and their connections have lower survival rates and lower trade value growth. Zooming in on the discontinued connections, I provide evidence for the mechanism behind the lower survival of connections in importers with a small elasticity gap. I do so by showing that trade value is a more relevant factor when deciding which connections to keep for importers with a smaller elasticity gap. All empirical results are robust to different methods of estimating the elasticity gap.

Finally, I empirically evaluate the predicted heterogeneity of macroeconomic shocks on imports. Specifically, I show that trade elasticities to tariffs and real exchange rate fluctuations are estimated to be up to four times larger in the sectors with the largest elasticity gap compared to the sectors with the lowest elasticity gap.

My paper contributes to four different strands of literature in a number of ways. First, it is related to the literature on twosided trade, characterized by models featuring individual, possibly heterogeneous, importers and exporters. Eaton et al. (2016, 2021) also feature a model with survival and growth of importer–exporter connections in international markets. However, Eaton et al. (2016, 2021) take connections' survival probability as exogenous while it is endogenous in my model. Eaton et al. (2011) and Bernard et al. (2018b) explain features in the data from the perspective of the exporter facing different importers and explore how importer–exporter connections interact with trade costs, but do not consider dynamic connections. I extend their models by adding the time dimension with a reduced form search mechanism on the importer side and introducing different elasticities of substitution in the inputs and final goods markets.

My paper also relates to the literature on relationships between firms in international markets, particularly to Rauch and Watson (2003), Besedeš and Prusa (2006a), Besedeš (2008), Nitsch (2009), Besedeš and Prusa (2011), Esteve-Pérez et al. (2013), Cadot et al. (2013), Macchiavello and Morjaria (2015), Araujo et al. (2016), Monarch (2021), and Martin et al. (2022). One result of this literature is that the trade duration is positively correlated with product differentiation (Besedeš and Prusa, 2006b) and product elasticity (Nitsch, 2009). My paper contributes to this literature by providing a theoretical foundation for the correlation between

³ The specific functional form of the elasticity gap is a result of the CES setup in the theoretical model.

product elasticity and trade duration, as well as refining the idea of product differentiation and product elasticity into a theory-based parameter: the elasticity gap.

My paper also contributes to the literature on networks and trade, with Oberfield (2018) and Bernard et al. (2019b,a) being the closest references in this literature. Although I do not explicitly model network formation as in Oberfield (2018), my model implies that, when extending the production function to more than one input, the degree of substitutability among inputs becomes an important determinant for firm size. My paper also complements Bernard et al. (2019a). They explain within-sector variation in connections' trade value using a relationship capability parameter, while I explain differences in connections' survival probability and trade value growth across importers and sectors using the elasticity gap.

Finally, my paper is related to a large literature that has estimated the trade elasticity to macroeconomic shocks. As is the case in Fitzgerald and Haller (2018) and Fontagné et al. (2018), my estimates of the trade elasticity to tariffs are larger than to exchange rate movements, with the trade elasticity to exchange rate movements well below unity. The heterogeneity of trade elasticities to macroeconomic shocks have been analyzed by Berman et al. (2012) and Amiti et al. (2019), among others. The contribution of my paper is to show that a different type of heterogeneity also affects the transmission of macroeconomic shocks into aggregate trade, namely the heterogeneity in the importer's degree of substitutability across final goods and across inputs.

The remainder of this paper is structured as follows. Section 2 shows some empirical regularities present in the Colombian customs data. Section 3 introduces the theoretical model. Section 4 describes the data and develops the empirical strategy used to test the model predictions. Section 5 presents the main empirical results. The results on the heterogeneity of trade adjustment to shocks are in Section 6. Section 7 concludes.

2. Empirical regularities

In this section, I describe the data and introduce some empirical regularities concerning the survival probability and trade value growth of importer–exporter connections.

Data - I employ the Colombian customs data, provided by the Colombian statistical office (DANE). The data is a transaction-level register of all foreign inputs purchased by Colombian firms during the years 2008 to 2019. In each transaction, there is information about the importing and exporting firms as well as the product at a 10-digit product category and the value traded. All values are expressed in 2015 Colombian pesos. Given the nature of the theoretical model, I restrict the set of importing firms to those industry codes recognized as manufacturing.⁴

Colombian importers are identified with their tax number, which is constant over time. Foreign exporters are identified by their name and the country in which they are located. As in Armington (1969), Broda et al. (2006), and Soderbery (2018), I treat the same product from different countries as different varieties. The procedure for matching exporter names and addressing problems related to misspelling and alternative names is explained in Appendix A.

Stylized facts - The first fact is that the survival rate of connections and the trade value growth vary widely across the importer's industry. This can be seen in Fig. 1(a), which illustrates the high variance in connection's survival between industries, calculated as the share of connections surviving from one year to the next over the period 2008 to 2019. Survival rates range from 59% in Division 35 (Manufacturing of other transport equipment) to 33% in Division 22 (Publishing, printing, and reproduction of recorded media). The differences in median yearly trade value growth per surviving connection, in Fig. 1(b), are very large as well, with values ranging between -2.5% and 6% per year.⁵

The second fact is that the differences between industries are persistent over the connection life-cycle. One possible concern of Fig. 1 is that these dynamics are dominated by connections during the first year and do not reflect the survival rate and trade value growth of connections over time. I address this in Fig. 2, where I split the sample between those industries above the mean survival rate in the sample and those below. Fig. 2(a), using those connections starting after 2008, shows that the survival rate of connections, conditional on having survived the previous year, increases in the number of years survived. It starts from a low level, around 30%, to sharply increase during the first few years and reach 80% after 8 years. The conditional survival of the industries with an above-average survival rate is systematically above that of the industries below-average, starting with a 6% higher conditional survival (32% vs. 26%), and remaining above until the eighth year.⁶

Concerning the trade value growth of connections, those industries with higher survival rates are also those with higher trade value growth at the connection level. Fig. 2(b) shows the mean and median trade value of connections over time for the two groups of industries. The trade values in Fig. 2(b) are indexed to 100 in the first year of each connection to make them comparable and have been winsorized at the 5th and 95th percentile each year to remove outliers. The median trade value of the connections after 10 years grows to roughly three times the initial sales in the industries with an above-average survival rate, while it is only around two times larger in the industries below average. The mean trade value of connections follows a similar trend at a larger scale.

⁴ In the Colombian industry codes (CIIU v3), this is 1500 to 3720. Industry codes changed in 2012 to CIIU v4 and have been translated to CIIU v3 using a correspondence table provided by the DANE.

⁵ Very similar differences can be observed in the figure on mean trade value growth of connections at the 2-digit industry, in Appendix B.

⁶ As in Bernard et al. (2018a), the data shows a large turnover of suppliers among Colombian importers in all industries, with only slightly more than one-quarter of the connections lasting more than a year. In absolute terms, from the around 100,000 connections starting in 2008, some 20,000 remained after four years, and only 5,000 after eleven years.

(a) Survival rate

(b) Median trade value growth



Fig. 1. Differences across 2-digit industry of importer.



Fig. 2. Conditional survival and trade value of connections. Note: Group 1 includes those importing industries with a higher survival rate than the sample average, while Group 2 contains the importing industries with a lower survival rate than the sample average.

The third fact is that sectors with higher survival rates also tend to show higher trade value growth in their connections, as shown in Fig. 3. If importers started sourcing low amounts from several exporters, just to center their purchases in one exporter over time and discontinue the other connections, as indicated in Rauch and Watson (2003), Araujo et al. (2016), and Egger et al. (2019), the correlation in Fig. 3 would be negative. The positive correlation between survival rates and trade value growth indicates that the existing evidence on importer–exporter connections is not sufficient to explain cross-sector variations in survival rates and trade value growth. Hence, Fig. 3 points to other mechanisms for the dynamics of importer–exporter connections when looking at aggregated data across sectors.

In sum, although it is well known in the international trade literature that conditional survival and trade values grow over the connection life-cycle,⁷ the large and persistent differences among sectors observed in Figs. 1 and 2, as well as the correlation shown in Fig. 3, have not been reported before. This heterogeneity indicates that firms across sectors exhibit different behaviors toward their connections in the international markets. In the next section, I develop a theoretical model with firm-to-firm trade to identify the determinants of these differences, while generating the positive correlation shown in Fig. 3.

⁷ For example, Fitzgerald et al. (2016), Ruhl and Willis (2017), and Bernard et al. (2017) show the same patterns, aggregated at the exporter level.



Fig. 3. Survival rate and trade value of connections.

3. Model

This section develops a dynamic partial equilibrium model in which importers invest in meeting new exporters and endogenously decide from which exporters they want to source their inputs. The idea of firms actively searching for clients or suppliers has been recurrent in the international trade literature, and the approach taken here is similar to that in Drozd and Nosal (2012) and Fitzgerald et al. (2016), who modeled a *list of customers* and a *customer base*, respectively.⁸

The world consists of two countries,⁹ Home and Foreign. Firms can be importers or exporters. Importers produce varieties of a final good by combining varieties of an input, which are produced by exporters. Given the data available in the empirical part of the paper, I focus the discussion of the model only on the case of importers in Home that purchase their inputs from exporters in Foreign.

Households - The country Home is populated by a continuum of *L* consumers and their preferences are given by the following utility function:

$$U_{t} = \sum_{s=1}^{S} \kappa_{s} \log U_{st} \qquad \text{with } \sum_{s=1}^{S} \kappa_{s} = 1$$

$$U_{st} = \left[\int_{\Omega_{s}} C_{it}^{\alpha_{s}^{F}} di \right]^{\frac{1}{\alpha_{s}^{F}}}, \qquad (1)$$

where *s* denotes sectors, *i* are varieties of a final good, and $\alpha_s^F \in (0, 1)$ captures the degree of substitutability among varieties of the final good within the sector. The demand elasticity across final good varieties within sector is $\sigma_s^F = 1/(1 - \alpha_s^F)$. Finally, the set of varieties available to the consumers in each sector is given by Ω_s .

From the consumer's utility maximization problem, the optimal aggregated demand for each variety is

$$C_{it} = \left(\frac{Q_{st}^{\alpha_s^F}}{P_{it}}\right)^{\frac{1}{1-\alpha_s^F}} E_s,$$
(2)

where C_{it} and P_{it} are, respectively, the consumption and price of the final good variety *i* at time *t*, E_s is total expenditure in sector *s*, and Q_{st} is the price index in sector *s*.

Importers - Final good varieties are produced in Home by importing firms. Importers purchase input varieties from exporters and use them in the production of a differentiated variety of the final good, which they then sell to domestic consumers. Importers are identified by the variety they produce (i) and are heterogeneous in two dimensions: first, in their productivity (denoted by Z_i),

⁸ Other forms of investing to reach out to new customers in other countries can be found, for example, in Arkolakis (2010) and Eaton et al. (2011).

⁹ The focus on only two countries is a strong simplification, but close to the empirical facts presented in previous literature. Bernard et al. (2018a) report that three-quarters of the importers with multiple suppliers source from a single country, and on average importers source from between two and three countries. The finding of Antràs et al. (2017) is similar using data for the US, with importing firms sourcing on average from only three countries. In my data, the median importer sources from 2 countries and almost 40% source from only one country.

which is randomly drawn from a distribution G(Z) and constant over time,¹⁰ and second, in the set of inputs used in production (Λ_{it}) . Their production technology is given by

$$Y_{it} = Z_i \left[\int_{A_{it}} c_{it} (\lambda)^{a_s^I} d\lambda \right]^{\frac{1}{a_s^I}},$$
(3)

where Y_{it} is the quantity produced, $c_{it}(\lambda)$ is the quantity of the input variety λ consumed, and $\alpha_s^I \in (0, 1)$ is the degree of substitutability among input varieties in the production function of firms in sector *s*. The demand elasticity across input varieties in sector *s* is $\sigma_s^I = 1/(1 - \alpha_s^I)$. Without loss of generality, I refrain from imposing any restriction on the size of Λ_{it} , meaning that the importer can always increase production by adding more varieties to the production function. Restricting Λ_{it} to a range between 0 and 1, as in Bernard et al. (2019b) or Antràs et al. (2017), would not change any of my results.¹¹

The demand of an importer for a variety λ can be expressed as:

$$c_{it}(\lambda) = \left(\frac{q_{it}^a}{p(\lambda)}\right)^{\frac{1}{1-a_s^f}} E_{it},\tag{4}$$

where E_{it} is the expenditure on inputs of importer *i*, $p(\lambda)$ is the price of the variety λ and q_{it} is the price index on inputs faced by the importer, which is given by:

$$q_{it} = \left[\int_{\Lambda_{it}} p(\lambda)^{\frac{a_s^I}{a_s^I - 1}} d\lambda \right]^{\frac{a_s^I - 1}{a_s^I}}.$$
(5)

Given the utility function introduced in Eq. (1), the price that an importer charges in the final goods market is a constant markup over its marginal cost:

$$P_{it} = \frac{1}{\alpha_s^F} \frac{q_{it}}{Z_i}.$$
(6)

Exporters - The inputs market is supplied by a continuum of exporters, each one producing a single differentiated variety of the input using labor as their only factor of production. They are heterogeneous on their productivity z, randomly drawn from a Pareto distribution with a lower bound z_L : $F(z) = 1 - (z_L/z)^{\gamma}$ and a shape parameter $\gamma > \alpha_s^I/(1 - \alpha_s^I)$. As in the case of importers, the productivity of the exporters does not change over time.

Because all relevant variables of an exporter are determined only by its productivity z, I will denote the exporter producing a variety λ by its productivity z. Given the importers' demand function in Eq. (4), the price at which an exporter with productivity z sells its variety is a constant markup over their marginal cost:

$$p(z) = \frac{1}{a_s^I} \frac{\tau^* w^*}{z},$$
(7)

where w^* is the wage in Foreign and $\tau^* \ge 1$ is the standard iceberg trade cost.

Supplier list - The number of firms in both economies is exogenous, with a mass N of importers in Home and a mass n of exporters in Foreign. Furthermore, importers only know a subset H_{it} of the exporters ($H_{it} \subset n$) at any time t. I label H_{it} the supplier list, and it is specific to each importer. The supplier list will be key in determining the set of inputs used in production by importer $i (\Lambda_{it})$, as importers can only source from exporters in their supplier list ($\Lambda_{it} \subset H_{it}$).

Importers can grow their supplier list over time by meeting new exporters. The mass of new exporters that an importer *i* meets in period *t* is denoted by A_{ii} . To keep the model tractable, I assume that all exporters have the same probability of being met, regardless of their productivity. As a result of this assumption, the subset H_{ii} of exporters is a random sample of the population *n*, and therefore the productivity distribution of exporters in H_{ii} is identical to *n*. The law of motion of H_{ii} is given by the following equation:

$$H_{it+1} = \min\{(1-\delta)H_{it} + A_{it}, n\},$$
(8)

where δ is an exogenous death rate of exporters in the economy. H_{it} has an upper bound in Eq. (8) equal to the total amount of exporters in Foreign, *n*. I am assuming for the rest of the analysis that *n* is large enough, such that the steady state of H_{it} is always smaller than n.¹²

Finally, to add new exporters to the supplier list importers need to incur a cost. The cost of meeting a mass A_{it} of exporters is determined by the cost function $D(A_{it})$:

$$D(A_{it}) = \phi \frac{A_{it}^2}{2},\tag{9}$$

¹⁰ This assumption could be relaxed leaving results qualitatively unchanged.

¹¹ In that case one would have to assume a setup in which importers can source these varieties either within the firm (Bernard et al., 2019b) or within the domestic country (Antràs et al., 2017) and the increase in imported varieties would then substitute costly domestic varieties with cheaper foreign ones. The result in the model would be the same: a decrease in the marginal cost from any additional variety imported.

 $^{^{12}}$ See Appendix D to see the necessary restriction on n such that $H_{ii} < n \, \forall i,t.$

where ϕ is a parameter governing the cost of meeting new exporters and A_{it} enters the cost function squared to reflect diminishing returns on investments in each period. This investment cost can be interpreted as identifying possible exporters as well as their prices, an activity that reveals the productivity of both firms to each other in the process. Because of the nature of the investment, I assume also irreversibility (i.e. $A_{it} \ge 0$).

Connections - To maintain each connection, i.e. each exporter that the importer is actively sourcing from, importers need to incur some fixed cost f_r .¹³ It can be shown that the revenue associated with a connection is increasing in the importer's and exporter's productivity. This, together with the fixed cost per connection, generates a sorting pattern in which an importer with the characteristics (Z_i , H_{it}) will purchase inputs from all exporters with productivity z above a certain threshold $\underline{z}(Z_i, H_{it})$ because all connections with exporters with productivity above $\underline{z}(Z_i, H_{it})$ increase the overall profit of the importer. Next, I find this productivity threshold by solving the static profit maximization problem of the importer for any period t.

The static problem of the importer - Given the previous final-good and input markets, the profits of an importer *i* in period *t*, without taking into account the investment cost on its supplier list, are given by the following equation:

$$\Pi(Z_i, H_{it}) = \max_{\underline{z}(Z_i, H_{it})} \{ R(Z_i, H_{it}) - E(Z_i, H_{it}) - F_r(Z_i, H_{it}) \},$$
(10)

where $R(Z_i, H_{it})$ is the importer's revenue, $E(Z_i, H_{it})$ importer's expenditure on inputs, and $F_r(Z_i, H_{it})$ the total amount of fixed costs an importer needs to pay to keep the connections with its exporters.

The first order condition of Eq. (10) with respect to $\underline{z}(Z_i, H_{it})$ implies:

$$\underline{z}(Z_i, H_{it}) = \left[\frac{\alpha_s^I}{\alpha_s^F(1 - \alpha_s^I)} \frac{f_r}{E_s}\right]^{\frac{1 - \alpha_s^F}{\alpha_s^F(1 - \gamma \eta_s)}} \left(\frac{\tau^* w^*}{k_1 Z_i}\right)^{\frac{1}{1 - \gamma \eta_s}} (k_2 H_{it})^{-\frac{\eta_s}{1 - \gamma \eta_s}},\tag{11}$$

where $k_1 = \alpha_s^F \alpha_s^I Q_{st}$, $k_2 = \frac{(1-\alpha_s^I)\gamma z_1^V}{(1-\alpha_s^I)\gamma - \alpha_s^I}$, and I define the *elasticity gap* (η_s) as

$$\eta_s \equiv \frac{\alpha_s^F - \alpha_s^I}{\alpha_s^F \alpha_s^I}.$$
(12)

The elasticity gap increases if there is a higher degree of substitutability among final good varieties (higher α_s^F), and if inputs have a lower degree of substitutability in the importer's production function (lower α_s^I).

An additional parametrical assumption necessary for the maximization problem to have an interior solution is that $\gamma \eta_s < 1$.¹⁴ In the cases where $\gamma \eta_s \ge 1$ the solution to the problem would be one in which importers either purchase inputs from all known exporters or have zero expenditure on inputs.

The relationship between the supplier list and the productivity cutoff depends on the elasticity gap and is summarized in Lemmas 1 and 2.

Lemma 1. The elasticity of the productivity cutoff with respect to the supplier list $(\epsilon_{z,H})$ is increasing on the elasticity gap (η_s) :

If
$$\varepsilon_{\underline{z},H} \equiv \left| \frac{\partial \ln \underline{z}(Z_i, H_{it})}{\partial \ln H_{it}} \right|$$
, then $\frac{\partial \varepsilon_{\underline{z},H}}{\partial \eta_s} > 0$.

Proof. See the Appendix C.

Lemma 2. The effect of an increase in the supplier list on the productivity cutoff depends on the elasticity gap as follows:

- (i) if $\eta_s < 0$, $\underline{z}(Z_i, H_{it})$ is increasing in H_{it} .
- (ii) if $\eta_s > 0$, $\underline{z}(Z_i, H_{it})$ is decreasing in H_{it} .
- (iii) if $\eta_s = 0$, $z(Z_i, H_{it})$ does not depend on H_{it} .

Proof. See the Appendix C.

Lemma 1 indicates that the larger the elasticity gap in absolute value the larger the elasticity of the productivity cutoff with respect to the supplier list. Specifically, when the importer faces a degree of substitutability among final good varieties that is very different from the degree of substitutability among its inputs, any change in the supplier list will have a strong effect on the productivity cutoff. The direction of this effect is given by Lemma 2.

¹³ The effect of this cost on the outcomes of the model is the same irrespective of which firm is bearing the cost. Since I focus my analysis on the importer side, I assume that importers are bearing the cost. See Bernard et al. (2018b) for the case where exporters are paying the cost.

¹⁴ This might seem a strong assumption, but it is a consequence of the simplicity of the production function and the assumption on the distribution of exporters' productivity. Reducing the importance of inputs in Eq. (3) by adding other factors of production or choosing a different exporters' productivity distribution would relax this assumption without influencing the results.

Lemma 2 states when exporters are substitutes or complements from the importer's perspective.¹⁵ If an importer faces a negative elasticity gap ($\eta_s < 0$), then exporters are substitutes for the importer: each additional connection decreases the profit that the importer derives from all other connections. This can be seen in Eq. (11) as an increase in the minimum productivity threshold $\underline{z}(Z_i, H_{ii})$ when the supplier list increases. If the elasticity gap of an importer is positive ($\eta_s > 0$), the importer reduces the minimum exporter's productivity required to establish a connection when its supplier list increases. Moreover, as mentioned above, in the cases where $\gamma \eta_s > 1$ the solution to the maximization problem degenerates into a corner solution: the complementarity effect is so strong that the importer always connects to all exporters in its supplier list.

Having determined the optimal $\underline{z}(Z_i, H_{it})$ for importers, I can calculate now the trade value of the connections. The implied trade value of a connection from importer's demand in Eq. (4), using the optimal $z(Z_i, H_{it})$ from Eq. (11), is:

$$r(z, Z_i, H_{it}) = \left(\frac{p(z)}{q(Z_i, H_{it})}\right)^{\frac{a_s}{a_s^f - 1}} E(Z_i, H_{it}) = X_1(z, Z_i) H_{it}^{\frac{\gamma \eta_s}{1 - \gamma \eta_s}},$$
(13)

where

$$X_{1}(z, Z_{i}) = \alpha_{s}^{F} E_{s} \left(\frac{Z_{i}k_{1}}{\tau^{*}w^{*}}\right)^{\frac{\gamma}{1-\gamma\eta_{s}}} z^{\frac{\alpha_{s}^{I}}{1-\alpha_{s}^{I}}} k_{2}^{\frac{\gamma\eta_{s}}{1-\gamma\eta_{s}}} \left[\frac{\alpha_{s}^{I}}{\alpha_{s}^{F}(1-\alpha_{s}^{I})} \frac{f_{r}}{E_{s}}\right]^{\frac{\alpha_{s}^{L}-\gamma(1-\alpha_{s}^{I})}{\alpha_{s}^{I}(1-\gamma\eta_{s})}}.$$

Eq. (13) shows that the relationship between the trade value of connections and the supplier list depends on the elasticity gap. This relationship is summarized in Lemmas 3 and 4.

Lemma 3. The elasticity of the trade value of connections with respect to the supplier list $(\varepsilon_{r,H})$ is increasing in the elasticity gap (η_s) :

If
$$\varepsilon_{r,H} \equiv \left| \frac{\partial \ln r(z, Z_i, H_{it})}{\partial \ln H_{it}} \right|$$
, then $\frac{\partial \varepsilon_{r,H}}{\partial \eta_s} > 0$.

Proof. See the Appendix C.

Lemma 4. The effect of an increase in the supplier list on the trade value of connections depends on the elasticity gap as follows:

(i) if η_s < 0, r(z, Z_i, H_{it}) is decreasing in H_{it}.
(ii) if η_s > 0, r(z, Z_i, H_{it}) is increasing in H_{it}.

(iii) if $\eta_s = 0$, $r(z, Z_i, H_{it})$ does not depend on H_{it} .

Proof. See the Appendix C.

The intuition for Lemmas 3 and 4 is that the reduction in marginal cost from adding new connections after an increase in the supplier list is translated into overall revenue growth, but this growth depends on the importer's elasticity gap. As is the case with the productivity cutoff, the direction of the change in the trade value of connections depends on the sign of the elasticity gap, while the strength of the change depends on its absolute value. In the case of importers with a negative elasticity gap, revenue increases relatively less than the number of new connections, such that the importer's demand from every single exporter is reduced. From an exporter's perspective, the increase in the importer's connections increases the competition within the importer, leading to the importer purchasing less from each exporter. The case is different for importers with a positive elasticity gap, for which the increase in input demand offsets the increase in competition within the importer. This leads to the importer increasing the trade value with all its connections.

The dynamic problem - Up to this point, I exogenously defined the supplier list at any time *t*. Now, I characterize the importer's investment decision to expand its supplier list over time. Thus, the mass of new exporters added to the supplier list A_{it} becomes endogenous. In the dynamic maximization problem, an importer *i* maximizes the expected flow of profits, discounted at a rate β , with $1 > \beta > 0$. The importer does so by choosing at time *t* the mass of new exporters to meet while taking its productivity and supplier list as given, subject to the law of motion described in Eq. (8), and using the optimal productivity threshold from Eq. (11). The Bellman equation of the problem is the following¹⁶:

$$V(Z_i, H_{it}) = \max_{A_{it} \ge 0} \left\{ \prod(Z_i, H_{it}) - D(A_{it}) + \beta V(Z_i, H_{it+1}) \right\},$$
(14)

s.t. $H_{it+1} = \min\{(1-\delta)H_{it} + A_{it}, n\},\$

where $D(A_{il})$ is the cost function, defined in Eq. (9) and $V(Z_i, H_{il+1})$ is the continuation value. Solving the maximization problem in Eq. (14) provides insights into the evolution of the supplier list over time. The main results are stated in Lemmas 5 and 6.

¹⁵ This result is similar to Antràs et al. (2017), who found that, depending on parametric restrictions, source countries can be substitutes or complements, i.e. an importer might be more or less likely to source from a country if it is sourcing from another country. In the case of Antràs et al. (2017), the parameters determining whether source countries are substitutes or complements are the value of the elasticity of demand faced by the importer and the dispersion of input productivities across countries.

¹⁶ Note that there is no uncertainty in future profits. Uncertainty could easily be added by incorporating shocks to the importer's productivity or demand, for example. However, this would not change any of the results presented here and I abstract from such shocks for the sake of simplicity.

Lemma 5. The steady state supplier list is given by

$$H_{iss} = \left(\frac{\beta X_2 Z_i^{\frac{\gamma}{1-\gamma\eta_s}}}{\phi\delta(1-\beta(1-\delta))(1-\gamma\eta_s)}\right)^{\frac{1-\gamma\eta_s}{1-2\gamma\eta_s}}$$
(15)

and depends positively on the degree of substitutability among final goods (α_s^F) and negatively on the degree of substitutability among inputs (α_s^I). Moreover, a steady state can only exist if $\gamma \eta_s < 1/2$.

Proof. See the Appendix C.

Lemma 5 states how the steady state supplier list depends on the importer's degree of substitutability among final goods and among inputs. The inclusion of multiple inputs introduces an additional dimension along which the growth of importers can vary, namely the degree of substitutability among inputs. This implies that importers with a lower degree of substitutability among inputs have a larger supplier list in the steady state because every exporter is more valuable, everything else constant. This result is similar to Oberfield (2018), in which a market with high final elasticity causes the emergence of "stars", i.e. firms with many connections. However, in Oberfield (2018) there are no complementarities between suppliers because each firm can choose only one supplier.

Lemma 6. Conditional on the initial supplier list, the growth in supplier list (H_{ii}) over time depends positively on the degree of substitutability among final goods (α_r^F) and negatively on the degree of substitutability among inputs (α_r^I).

Proof. See the Appendix C.

Lemma 6 states that an importer's investment in its supplier list depends systematically on the degree of substitutability among final goods and among inputs it faces. As is the case with the elasticity gap, this dependence reflects the higher return on each additional connection. That is, the larger the elasticity gap, the larger the benefits of an additional connection for the importer. This leads the importers with higher α_s^F and lower α_s^I to search more intensively for new exporters (Lemma 6) and to reach a higher supplier list steady-state (Lemma 5).

Combining Lemma 6 with Lemmas 1 and 2, leads to the following proposition about the evolution of the number of connections, denoted by $|A_{it}| = (1 - F(\underline{z}(Z_i, H_{it})))H_{it})$, over time:

Proposition 1. The growth in the number of connections over time depends positively on the degree of substitutability among final goods (α_{i}^{F}) and negatively on the degree of substitutability among inputs (α_{i}^{F}) .

Proof. See the Appendix C.

Proposition 1 indicates that importers with a high degree of substitutability among final goods and a low degree of substitutability among inputs will grow more in terms of connections over time. This result follows from importers with a high degree of substitutability among final goods and a low degree of substitutability among inputs: searching for exporters with higher intensity (Lemma 6), being less likely to discontinue connections as their supplier list grows (Lemma 1), and discontinuing a smaller share of connections (Lemma 2).

Survival of connections - The model predicts two manners in which the discontinuation of connections might occur. The first is that the exporter is affected by the death shock δ , which is, as implied by Eq. (8), independent from the exporter's and importer's productivity. The second is the increase in the minimum productivity threshold of the importer. This form of discontinuing connections depends on the importer's elasticity gap and on the exporter's productivity.

The share of connections that importer *i* discontinues between *t* and t+1 due to an increase in its productivity threshold is given by:

$$\psi_{it+1} \equiv \frac{\left[(1 - F(\underline{z}(Z_i, H_{it}))) - (1 - F(\underline{z}(Z_i, H_{it+1})))\right]H_{it}}{(1 - F(\underline{z}(Z_i, H_{it})))H_{it}} = 1 - \left(\frac{\underline{z}(Z_i, H_{it})}{\underline{z}(Z_i, H_{it+1})}\right)^{\gamma}.$$

The prediction of the model with respect to the survival of connections is summarized in Proposition 2.

Proposition 2. For a given relative increase in the supplier list, importer–exporter connections are more likely to be discontinued if the elasticity gap of the importer is low.

Proof. See the Appendix C.

This result follows from Lemmas 1 and 2. In Lemma 1, a higher elasticity gap in absolute value implies a larger movement of the productivity threshold for any given increase in the supplier list. In Lemma 2, the direction in which the productivity threshold moves depends on the sign of the elasticity gap: a negative elasticity gap implies an increase in the productivity threshold. The larger the increase in the productivity threshold, the larger the share of connections to be discontinued (ψ_{it+1}), which increases the likelihood of a connection being discontinued. Notice that the connections being destroyed are the ones with exporter productivity between $\underline{z}(Z_i, H_{ii})$ and $\underline{z}(Z_i, H_{it+1})$, that is, the connections with the lowest productivity at time *t*.

Trade value growth - The effect of a change in the supplier list on the trade value of connections is given by Lemmas 3 and 4. Combining these two lemmas and Lemma 6, the model predicts differences in the trade value growth of connections depending on the degrees of substitutability faced by the importer.

Proposition 3. The growth in the trade value of importer–exporter connections depends positively on the degree of substitutability among final goods (a_s^F) and negatively on the degree of substitutability among inputs (a_s^I) .

Proof. See the Appendix C.

Discussion - Propositions 1, 2, and 3 characterize how the dynamics of importers and their connections with exporters are different based on their elasticity gap. Importers can have a small elasticity gap either because they face little competition in their final goods market or because their inputs are easy to substitute. In this case, their gains from adding connections are small relative to importers with a large elasticity gap. The lower gains from adding connections cause importers to search for exporters with lower intensity, reducing their growth in the number of connections (Proposition 1). Furthermore, after searching for exporters and creating new connections, these new connections are to a larger degree substituting older connections. Thus, existing connections are more likely to have lower trade value growth (Proposition 3) and, if the exporter's productivity is low enough, to be discontinued (Proposition 2).

In this section, I have presented a mechanism that determines the survival rate and the trade value growth of connections as a function of the degree of substitutability among final goods and among inputs. Specifically, the mechanism depends on the elasticity gap of the importer. When the elasticity gap is small, the importer's profit is less sensitive to any price changes of its final good, and there are larger substitutabilities in its production function. This has two implications. First, the importer is more selective in its connections, decreasing the survival rate. Second, its trade value grows less because the final demand reacts less to the reduction of marginal costs from adding new connections.

4. Connecting theory and empirics

The objective of this section is to define an approach to test the predictions of the theoretical model. This is done in two steps: first, I estimate the two main parameters from the theoretical model, the demand elasticities in the final goods market σ^F and in the inputs market σ^I . From these two parameters I can calculate α^F , α^I , and η . Then, I present the identification strategy to test Propositions 1, 2, and 3. Note that I omit the subscript *s* here because I will be able to estimate these parameters at the importer and sector levels. Hence, I use the subscript in the empirical part to denote the level at which the parameter is estimated.

4.1. Estimation of elasticities

Final goods - I draw from the literature on trade and markups to estimate σ^F in my model.¹⁷ Specifically, I calculate the demand elasticity across final goods at the industry 2-digit ISIC level (σ_s^F), using the Colombian Annual Manufacturing Survey from 2000 to 2014 and closely following De Loecker (2011). The description of the procedure and the results by sector can be found in Appendix E.1. The degree of substitutability among final goods is then $\alpha_s^F = (\sigma_s^F - 1)/\sigma_s^F$.

Inputs - To estimate the parameter for the demand elasticity across inputs I make use of the literature on the impact of new varieties on the gains from trade.¹⁸ This literature estimates the import demand elasticities based on trade data. To be able to transfer their approach to my estimation of σ^I , I assume that the only demand for foreign goods comes from the production function of the final good producers, such that the import demand is given by the aggregation of the demand of final good producers following the production technology in Eq. (3).

I map the elasticities at the product level to each importer using trade weights. I use the import demand elasticities from Soderbery (2018), which are calculated for South America at the 4-digit HS level.¹⁹ However, estimating the demand elasticity across inputs at the importer level faces two potential issues. That is, the set of inputs that an importer is importing is (i) too limited to estimate σ^I consistently and (ii) very likely to be endogenous. To address these concerns, I proxy the demand elasticity across inputs for each importer with the σ_{it}^I estimated using trade weights at the 4-digit ISIC *excluding* the importer. A more detailed explanation of the construction of σ_{it}^I can be found in Appendix E.2. The degree of substitutability among inputs is then $\alpha_{it}^I = (\sigma_{it}^I - 1)/\sigma_{it}^I$.

Elasticity gap - Both elasticity parameters can be combined, following the theoretical model, into the structural parameter $\eta_{ii} = (\alpha_s^F - \alpha_{ii}^I)/(\alpha_s^F \alpha_{ii}^I)$, where I included the subscripts to indicate the level at which each parameter is estimated: *i* for importer and *s* for sector. The summary statistics for the estimated elasticities and the elasticity gap are in Table 1. It is important to note that for industry 23 the demand elasticity across final goods is estimated to be very large (48.26). Given how the elasticity gap is calculated, this is not an issue, with values for the elasticity gap falling between roughly –2 and 1. However, in Section 5.1 I show that all results hold when excluding firms in industry 23.

¹⁷ See De Loecker (2011), De Loecker and Warzynski (2012) and De Loecker et al. (2016), among others.

¹⁸ Examples of this literature are Feenstra (1994), Broda and Weinstein (2006), Broda et al. (2006), and Soderbery (2018).

¹⁹ As a robustness check, I also use the import demand elasticities from Broda et al. (2006), calculated for Colombia at the 3-digit HS level. The elasticities reported by Broda et al. (2006) are for the period 1994–2003 while those in Soderbery (2018) are for the period 1991–2007. The results using these alternative import demand elasticities are in Appendix G.

Table 1	
C	atatio

Summary	Summary statistics.							
	Mean	Std.Dev.	Min.	Max.	Obs.			
σ_{it}^{I}	3.20	0.81	1.51	13.77	1,409,055			
σ_s^F	3.94	4.85	1.39	48.26	1,410,298			
α^{I}_{it}	0.68	0.04	0.34	0.93	1,409,055			
α_s^F	0.65	0.15	0.28	0.98	1,410,298			
η_{it}	-0.19	0.67	-2.17	1.22	1,409,036			

4.2. Identification strategy

My empirical analysis estimates how the survival probability and trade value growth of connections depend on the elasticity gap faced by the importer. Because the theory has also implications for firm-level outcomes, I estimate in addition how the growth in the number of connections and the trade value of importers depend on the elasticity gap. Hence, a set of regressions uses data at the connection level and another uses data at the importer level.

Note that although Propositions 1 and 3 are expressed in terms of the degree of substitutability among final goods and among inputs (α^F and α^I), the predicted effect is non-linear. This is because the effect of α^F and α^I on the supplier list's growth and steady-state is mainly through the elasticity gap, which is a non-linear combination of the individual parameters. Furthermore, the elasticities $\varepsilon_{\underline{z},H}$ and $\varepsilon_{r,H}$, which also influence Propositions 1 and 3, depend on the elasticity gap rather than on α^F and α^I individually. Because of these non-linearities, I focus the empirical approach on the elasticity gap, rather than on the degree of substitutability among final goods or among inputs individually.

To control for possible confounders, such as the exporter's market size and the number of exporters in the market, I use a full set of fixed effects at the HS6/country/year level.²⁰ These fixed effects capture supply shocks at the product-country-year level that affect importer–exporter connections independent of the elasticity gap. It is important to note that there is still some variation remaining in the product dimension since a connection is defined at the 10-digit code level.

The only dimension I cannot control for with fixed effects is the industry of the importer because, although the estimated elasticity gap is a variable at the importer level, the degree of substitutability among final goods is estimated at the 2-digit industry level. However, the degree of substitutability among final goods could be correlated with industry growth, and industry growth is correlated with the survival probability and the trade value growth of connections. To control for the effect of industry growth on the variables of interest, I include the growth rate of total imports in the industry as well as the growth rate of the total number of connections in the industry. The same reasoning works for productivity growth differences across sectors, which are also controlled for with these sector-level variables.

Finally, the predictions in Lemma 6 have the caveat of requiring comparing importers with similar supplier lists and this lemma is used in Propositions 1 and 3. Hence, I include importer and connection length dummies (that is, how many years the importer or the connection have been active) to proxy for the size of the importers' supplier list when testing Propositions 1 and 3 respectively. The assumption is that the size of the supplier list is correlated with the time that the importer is actively importing, which seems reasonable.

5. Empirical results

Growth in the number of connections - Proposition 1 predicts that the importer's growth in connections is positively correlated with its degree of substitutability among final goods and negatively correlated with its degree of substitutability among inputs. As explained above, this relationship is better approximated by the elasticity gap than by each individual parameter. Hence, the regression equation to bring Proposition 1 to the data is the following:

$$\Delta \log Con_{it} = \beta_1 \eta_{it} + \mathbf{X}_{it} + \mathbf{X}_{st} + \mu_t + \epsilon_{it},$$

(16)

where *i* refers to an importer, *s* to an industry, and *t* to a year. $\Delta \log Con_{it}$ is the growth rate of connections between *t* and *t* + 1, \mathbf{X}_{it} contains a full set of dummies indicating the number of years a firm has been importing at time *t*. The idea behind this set of dummies is, as mentioned above, to proxy for the size of the supplier list of importers. The coefficient of interest is β_1 , which indicates whether importers with different elasticity gaps differ in their growth rate of connections. The results of the regression are in Table 2.

The main result is the coefficient in column (5): an increase of one in the elasticity gap of an importer leads to an increase in the yearly growth rate of connections of 1.5 percentage points. As can be seen in column (3), most of this effect comes from the differences in the degree of substitutability among final goods, with the effect from the degree of substitutability among inputs being statistically insignificant. This points to the elasticity gap as the main reason for the differences in the growth rate of connections. Table 2 shows that the search mechanism in the model can be seen in the data: importers with a large elasticity gap tend to have higher growth in the number of connections over time, consistent with them investing more into searching for exporters.

²⁰ Results do not change if I use 4 or 10-digit products instead.

Table 2

Growth in connections.					
	(1)	(2)	(3)	(4)	(5)
	$\Delta \log Con_{it}$				
$1/\alpha_{it}^{I}$	-0.008 (-0.29)		-0.010 (-0.35)		
$1/\alpha_s^F$	-0.012** (-2.49)		-0.012** (-2.51)		
η_{it}		0.011** (2.40)		0.011** (2.40)	0.015*** (3.10)
Controls	No	No	No	No	Yes
Fixed effects:					
μ_t	No	No	Yes	Yes	Yes
R^2	0.0001	0.0001	0.006	0.006	0.026
Observations	42,244	42,244	42,244	42,244	42,244

* p < 0.10, *** p < 0.05, *** p < 0.01. t statistics in parentheses. Standard errors clustered at the importer level. Controls include industry controls and importing length dummies.

Survival of connections - The model delivers a clear prediction about the connection's survival in Proposition 2: those importers with a low elasticity gap should show lower survival rates. Moreover, the model's mechanism predicts that the lower survival rate should affect especially the less productive exporters. The reason behind this difference is that for importers with a lower elasticity gap, as the supplier list grows, new connections substitute old ones (i.e. the productivity threshold increases). Furthermore, this substitution effect should be larger the smaller the elasticity gap is.

To test this result from the model, I follow closely Cadot et al. (2013), Albornoz et al. (2016), and Egger et al. (2019). They used transaction-level data to study the survival of firms in the international markets with a binary choice model that can be estimated using a linear probability model or a probit.²¹ Specifically, I regress the survival of a connection on the structural parameter η_{it} as follows:

$$Surv_{ijt} = \beta_1 \eta_{it} + \mu_{hct} + \mathbf{X}_{st} + \epsilon_{ijt},\tag{17}$$

where *i* refers to an importer, *j* to an exporter, *s* to an industry, *h* to a product, *c* to a sourcing country, *t* to a year, and *Surv* is a dummy variable that takes the value 1 if the connection continues in t + 1 and 0 otherwise.

Proposition 2 implies a lower survival probability of connections for importers with lower elasticity gaps, and this effect should be especially prominent in connections with less productive exporters. As such, for importers with a lower elasticity gap, the survival of connections should depend on the exporter's productivity, that is, whether the connection is close to the productivity threshold \underline{z} , while this productivity should be less important for a connection's survival for importers with a larger elasticity gap. To proxy for the exporter's productivity, I use the exporter's sales within the same HS4 product category to all Colombian importers. Hence, the coefficient of the interaction between exports and the elasticity gap is expected to be negative. The equation to be estimated in this case is:

$$Surv_{iit} = \beta_1 \eta_{ii} + \beta_2 \log exports_{ii} + \beta_3 \eta_{ii} \times \log exports_{ii} + \mu_{hct} + \mathbf{X}_{st} + \epsilon_{iit},$$
(18)

where *exports* is measured in thousands of 2015 Colombian pesos.

First, I regress both components of the elasticity gap on the survival dummy in column (1). The results show that the survival of a connection depends on the estimated parameters with the sign predicted by Proposition 2: the probability of survival is increasing in the inverse of the degree of substitutability among inputs and decreasing in the inverse of the degree of substitutability among final goods. That the coefficient of the inverse of the degree of substitutability among inputs is significant points in the direction indicated by Goldberg et al. (2010) and Halpern et al. (2015), who underlines how the degree of substitutability among inputs is relevant for importers' sourcing decisions. Column (1) shows that importers with a lower degree of substitutability among inputs are more likely to keep their connections, in line with these importers profiting more from each additional imported input.

The coefficient for the elasticity gap in column (6), with the full set of controls and fixed effects but without exporter productivity, is positive and statistically significant. Considering that the standard deviation of the elasticity gap is 0.67 (see Table 1), Table 3 predicts that an increase of one standard deviation in the elasticity gap of an importer increases the survival probability of its connections by roughly 1.4 percentage points per year. This is a substantial increase in the survival probability of connections, considering that the average survival rate in the sample is 44.8% and in the first year of the connection as low as 30.7%. Note that columns (1) to (6) do not take into account the productivity of the exporter, and are just looking at differences in the average survival probabilities across importers.

The main specification of Table 3 is in column (9), which includes all controls, fixed effects, the proxy for the exporter's productivity, and its interaction with the elasticity gap. The result shows that the effect of the elasticity gap on the survival

²¹ Another segment of the literature uses a Cox hazard model, for example, Besedeš (2008), Nitsch (2009), and Esteve-Pérez et al. (2013).

Table 3

Survival probability, OLS regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$Surv_{ijt}$	$Surv_{ijt}$	$Surv_{ijt}$	$Surv_{ijt}$	$Surv_{ijt}$	$Surv_{ijt}$	$Surv_{ijt}$	$Surv_{ijt}$	$Surv_{ijt}$
$1/\alpha_{it}^{I}$	0.204*** (3.84)								
$1/\alpha_s^F$	-0.027*** (-2.75)								
η_{it}		0.036*** (3.35)	0.037*** (3.44)	0.031*** (3.38)	0.022** (2.32)	0.021** (2.49)	0.013 (1.64)	0.056*** (4.21)	0.058*** (4.34)
$\log exports_{jt}$							0.061*** (64.62)	0.060*** (64.40)	0.060*** (64.49)
$\log exports_{jt} \times \eta_{it}$								-0.004*** (-3.59)	-0.004*** (-3.67)
Controls	No	No	No	No	No	Yes	No	No	Yes
Fixed effects:									
μ_t	No	No	Yes	No	No	No	No	No	No
μ_c	No	No	No	Yes	No	No	No	No	No
μ_h	No	No	No	No	Yes	No	No	No	No
μ_{hct}	No	No	No	No	No	Yes	Yes	Yes	Yes
R^2	0.003	0.002	0.005	0.011	0.062	0.223	0.275	0.275	0.276
Observations	1,287,821	1,287,821	1,287,821	1,287,809	1,287,668	1,134,323	1,134,323	1,134,323	1,134,323

* p < 0.10, ** p < 0.05, *** p < 0.01. t statistics in parentheses. Standard errors clustered at the importer level. Estimated with OLS. $Surv_{ijt}$ takes value 1 at time t if the connection is active in t + 1.

probability of a connection decreases with the exporter's productivity. That is, the elasticity gap is more important for survival probability in connections with lower exporter productivity. Table 3 highlights the importance of the theory, which delivers the specific form in which the degree of substitutability among final goods and among inputs affects the survival of connections.²²

Trade value growth - Proposition 3 implies that importers with a larger elasticity gap should exhibit a larger trade value growth in each of their connections. This is because for these importers the trade value of their connections grows more when they increase the number of connections. I test this prediction with Eq. (19):

$$\Delta \log sales_{ijt} = \beta_1 \eta_{it} + \mathbf{X}_{ijt} + \mathbf{X}_{st} + \mu_{hct} + \epsilon_{ijt}, \tag{19}$$

where $\Delta \log sales_{ijt}$ is the growth rate in the trade value of a connection between *t* and *t*+1 and \mathbf{X}_{ijt} is a full set of dummies indicating the number of years a connection has been active at time *t*. The idea behind this set of dummies, as mentioned above, is to control for the supplier list of importers. To control for supply shocks, I also include fixed effects at the HS6/country/year level.

I also test the implications of Proposition 3 in combination with Proposition 1. That is, for importers with larger elasticity gaps, not only does the trade value of each connection grow faster, but also the overall trade value grows faster. Therefore, I regress Eq. (20) after aggregating the data to the importer level, such that the left-hand side variable is the total trade value of a given importer in a year:

$$\Delta \log sales_{it} = \beta_1 \eta_{it} + \mathbf{X}_{it} + \mathbf{X}_{st} + \mu_t + \epsilon_{it}, \tag{20}$$

analogously to Eq. (19), $\Delta \log sales_{it}$ is the growth rate of an importer's trade value between t and t + 1. To control for the supplier list of importers, \mathbf{X}_{it} is a full set of dummies indicating the number of years a firm has been importing at time t.

I report the results of the trade value growth regressions in Table 4. Columns (1) to (3) show the results of the regressions at the connection level, as defined in Eq. (19). The empirical pattern is in line with the model predictions: the coefficient of η_{it} is significant and positive, implying that the trade value of connections grows less over time in importers with a smaller elasticity gap. Similarly, the results of the regressions for Eq. (20), in columns (4) to (6), show that the trade value of importers also grows less over time.

5.1. Robustness

Here, I address some of the possible concerns about the results presented in the last section. Specifically, I estimate the elasticity gap using alternative values, at different levels of aggregation, and using a subset of industries. The detailed regression tables of the different robustness checks can be found in Appendix G. The summarized results are in Table 5.

First, I calculate the demand elasticity across inputs using the import demand elasticities from Broda et al. (2006) instead of those from Soderbery (2018). The results of the alternative measure for the demand elasticity across inputs show that the method used does not affect my main results, with all relevant coefficients having the same sign and being statistically significant.

²² Furthermore, all effects remain significant if Eqs. (17) and (18) are estimated using a probit model. See Appendix G.

Table	4	
Trade	value	growth.

frade fande grotta						
	$\Delta \log Sales_{ijt}$ (C	onnection level)		$\Delta \log Sales_{it}$ (
	(1)	(2)	(3)	(4)	(5)	(6)
$1/\alpha_{it}^{I}$	0.086** (2.10)			0.024 (0.52)		
$1/\alpha_s^F$	-0.034*** (-3.41)			-0.017** (-2.25)		
η_{it}		0.036*** (3.73)	0.020* (1.84)		0.017** (2.40)	0.023*** (3.19)
Controls	No	No	Yes	No	No	Yes
Fixed effects:						
μ_{hct}	No	No	Yes	No	No	No
μ_t	No	No	No	No	No	Yes
R^2	0.0004	0.0003	0.212	0.0001	0.0001	0.024
Observations	568,616	568,616	462,303	42,244	42,244	42,244

* p < 0.10, *** p < 0.05, *** p < 0.01. t statistics in parentheses. Standard errors clustered at the 4-digit industry level. Controls include industry controls and importing length dummies.

Second, I calculate the demand elasticity across inputs using the trade-weights *only* of the importer instead of using the trade-weights of all other importers in the 4-digit ISIC industry. This allows me to exploit a larger degree of heterogeneity in my main explanatory variable. As discussed in Section 4.1, the drawback of this approach is the possible endogeneity of σ^I due to self-selection. To mitigate this concern, I use all observations of the importer to calculate a time-invariant value of the demand elasticity across inputs per importer. The results of this exercise are in line with the results presented above.

Third, I map the elasticities to each 4-digit ISIC by calculating the trade-weighted average of the 4-digit HS elasticities. This approach is very similar to that of Alfaro et al. (2019), who use the same method to calculate the demand elasticity across inputs at the 4-digit ISIC in the US market. The difference from the estimates for σ^I in the main specification is that I do not exclude the importer from the calculation of the elasticity. Again, although η is only defined at the industry level, the results are in line with the results presented above.

Finally, I exclude possible outliers from the regressions. Specifically, I exclude industry 23, which has the largest demand elasticity across final goods (48.26). Again, results remain unchanged.

6. Trade adjustment to shocks

In this section, I show that a direct implication of the model is that the elasticity of imports to macroeconomic shocks is heterogeneous across sectors. I provide also empirical evidence of this heterogeneity in the case of tariff and real exchange rate shocks. Adding the parameter ϵ for the real exchange rate to Eq. (7) and interpreting τ^* as the tariff rate:

$$p(z) = \epsilon \frac{1}{\alpha_s^I} \frac{\tau^* w^*}{z},$$
(21)

where p(z) is expressed in domestic currency. In my data, an increase in ϵ implies a depreciation of the Colombian Peso with respect to the foreign currency.

Formally, the elasticity of the minimum productivity threshold $z(Z_i, H_{ii})$ with respect to tariffs:

$$\varepsilon_{\underline{z},\tau} \equiv \left| \frac{\partial \ln \underline{z}(Z_i, H_{ii})}{\partial \ln \tau^*} \right| = \frac{1}{1 - \gamma \eta}$$

$$\frac{\partial \varepsilon_{\underline{z},\tau}}{\partial \eta} = \frac{\gamma}{(1 - \gamma \eta)^2} > 0.$$
(22)

Hence, small changes in price due to a tariff change have a larger effect on connections' survival when the elasticity gap is large. The intuition behind this result is linked to the idea of exporters being substitutes or complements introduced in Lemma 2. The increase in import prices causes all importers to discontinue the connections with the least productive exporters. However, in the case of importers with a larger elasticity gap, the loss of connections causes a larger increase in marginal costs and a larger decrease in revenues, which leads to a larger portion of connections becoming unprofitable.

This can also be seen in the elasticity of trade value with respect to tariffs:

$$\varepsilon_{r,\tau} \equiv \left| \frac{\partial \ln r(z, Z_i, H_{it})}{\partial \ln \tau^*} \right| = \frac{\gamma}{1 - \gamma \eta_s}$$
$$\frac{\partial \varepsilon_{r,\tau}}{\partial \eta_s} = \frac{\gamma^2}{(1 - \gamma \eta_s)^2} > 0,$$

Table 5

Results of robustness checks.

(a) Using import demand	elasticities from Broda et a	al. (2006)			
	(1) $\Delta \log Con_{it}$	(2) Surv _{ijt}	(3) Surv _{iji}	(4) $\Delta \log sales_{ijt}$	(5) $\Delta \log sales_{it}$
η_{it}	0.008* (1.92)	0.016* (1.97)	0.057*** (4.43)	0.013 (1.29)	0.019*** (2.79)
$\log exports_{ijt}$			0.060*** (63.37)		
$\log exports_{ijt} \times \eta_{it}$			-0.004*** (-4.10)		
Controls	Yes	Yes	Yes	Yes	Yes
Fixed effects:	μ_t	μ_{hct}	μ_{hct}	μ_{hct}	μ_t
(b) Alternative σ^I at the	importer level				
	(1)	(2)	(3)	(4)	(5)
	$\Delta \log Con_{it}$	$Surv_{ijt}$	Surv _{ijt}	$\Delta \log sales_{ijt}$	$\Delta \log sales_{it}$
η_i	0.011**	0.019**	0.058***	0.019*	0.019**
	(2.57)	(2.37)	(4.46)	(1.73)	(2.70)
log exports _{ijt}			0.060***		
			(65.05)		
$\log exports_{ijt} \times \eta_i$			-0.004***		
			(-3.94)		
Controls	Yes	Yes	Yes	Yes	Yes
Fixed effects:	μ_t	μ_{hct}	μ_{hct}	μ_{hct}	μ_t
(c) Alternative σ^I at the	4-digit industry level				
	(1)	(2)	(3)	(4)	(5)
	$\Delta \log Con_{it}$	$Surv_{ijt}$	Surv _{ijt}	$\Delta \log sales_{ijt}$	$\Delta \log sales_{it}$
η_s	0.011***	0.022**	0.060***	0.019**	0.019**
	(5.36)	(2.26)	(5.39)	(2.28)	(4.52)
log exports _{ijt}			0.060***		
			(47.22)		
$\log exports_{ijt} \times \eta_s$			-0.004***		
			(0.09)		
Controls	Yes	Yes	Yes	Yes	Yes
Fixed effects:	μ_t	μ_{hct}	μ_{hct}	μ_{hct}	μ_t
(d) Excluding industry 23	}				
	(1)	(2)	(3)	(4)	(5)
	$\Delta \log Con_{it}$	$Surv_{ijt}$	Surv _{ijt}	$\Delta \log sales_{ijt}$	$\Delta \log sales_{it}$
η_{it}	0.014***	0.023***	0.058***	0.021**	0.021***
	(2.94)	(2.71)	(4.28)	(1.98)	(2.84)
log exports _{ijt}			0.060***		
log experts - X #			(65.18)		
$\log exports_{ijt} \times \eta_{it}$			-0.004^^^		
0 1			(-3.43)		
Controls Fixed offects:	Yes	Yes	Yes	Yes	Yes
FIXED ETTECTS:	μ_t	μ_{hct}	μ_{hct}	μ_{hct}	μ_{t}

* p < 0.10, *** p < 0.05, *** p < 0.01. t statistics in parentheses. Standard errors clustered at the importer level except in (c), which are clustered at the 4-digit industry level. $Surv_{ijt}$ takes value 1 at time t if the connection is active in t + 1.

in which the reduction of trade value per connection is larger, the larger the elasticity gap. Hence, the model predicts that the reactions of importers to tariffs are increasing in the elasticity gap. Note that the result is the same if the change in prices occurs through the RER instead of tariffs.

Although in my model there is no endogenous entry and exit of firms, Berman et al. (2012) have shown that exchange rate changes affect exporters' entry decisions. These entry and exit decisions can have an effect on the sector-level responses to shocks, especially when considering the number of connections. Hence, to abstract from firm entry and exit and to capture the aggregate effects at the sector level, I aggregate the data to the 4-digit ISIC. To capture the survival of connections at the industry level, I follow Egger et al. (2019) and define stability as the share of connections in time *t* that are still active in time t + 1.

Tariffs - The regression equation for the trade elasticity to tariffs is:

$$Y_{scht} = \beta_1 \log \tau_{cht} + \beta_2 \eta_{st} \times \log \tau_{cht} + \mu_{st} + \mu_{ct} + \mu_{ht} + \mu_{ch} + \mathbf{X}_{st} + \epsilon_{scht},$$
(23)

where Y_{scht} stands for either stability or log of trade value, X_{st} are industry controls, *s* indicates sector, *c* country, *h* product (HS4) and *t* year.

Table 6 Effect of tariffs.

Effect of tarifis.

(24)

	Stability _{shet}				log sales _{shet}			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
η_{st}	0.019*** (4.14)		0.025*** (3.68)		0.055*** (3.17)		0.070*** (3.09)	
$\log \tau_{cht}$		-0.106** (-2.49)	-0.132*** (-3.04)	-0.128*** (-3.00)		-1.412*** (-7.29)	-1.479*** (-7.81)	-1.524*** (-8.13)
$\eta_{st} \times \log \tau_{cht}$			-0.089* (-1.79)	-0.135*** (-3.65)			-0.239 (-1.32)	-0.508*** (-2.80)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects:								
μ_{ht}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
μ_{ct}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
μ_{ch}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
μ_{st}	No	No	No	Yes	No	No	No	Yes
R^2	0.256	0.255	0.255	0.265	0.504	0.503	0.503	0.506
Observations	345,030	344,178	344,178	344,178	377,758	376,535	376,535	376,535

* p < 0.10, ** p < 0.05, *** p < 0.01. t statistics in parentheses. Standard errors clustered on both country-year and industry-year.

Columns 1 and 5 of Table 6 indicate that, as shown in the previous section, sectors with larger elasticity gaps discontinue fewer connections and have larger trade values. Moreover, as the theory predicts, sectors with a larger elasticity gap show a larger elasticity to tariffs, both in terms of the stability of connections as well as in trade values. Specifically, column 2 shows that an increase in tariffs of 10% reduces the stability of connections by around 1.1% on average, but as shown in column 4 the effect is heavily dependent on the elasticity gap of the sector.

The trade elasticity to tariffs is estimated to be 1.4 in column 6, which is in line with the literature: Fontagné et al. (2018) find a trade elasticity to tariffs of around 2. However, there is large heterogeneity in the trade elasticity to tariffs across sectors due to the different elasticity gaps. For sectors with the minimum elasticity gap (-2.17), the estimated tariff elasticity is around 0.4, while for sectors with the maximum elasticity gap (0.48) the value is almost 2.

Real exchange rate - The regression equation for the trade elasticity to the real exchange rate is:

$$Y_{sct} = \beta_1 \eta_{st} \times \epsilon_{ct} + \mu_{st} + \mu_{ct} + \mathbf{X}_{st} + \epsilon_{sct},$$

where Y_{sct} stands for either stability or log of trade value, X_{st} are industry controls, *s* indicates sector, *c* country and *t* year. Note that in this case, I aggregate across the product dimension and use only the variation across sectors and countries.

The results of the regression in Eq. (24) are presented in Table 7. As shown in the literature, the trade elasticities are lower when considering RER than in the case of tariffs. The estimates for trade value, in column 6, indicate a trade elasticity of 0.13, which is somewhat lower than other estimates in the literature, for example, Fontagné et al. (2018) report a value of 0.6, and Berman et al. (2012) report a value of 0.81. Moreover, there seems to be no effect of the RER on the stability of connections, which is not surprising given the small effect that the RER has on trade values. The important result in Table 7 is that, as predicted, the trade elasticity to the RER is larger for sectors with a larger elasticity gap. This effect survives even the inclusion of a full set of country/time, sector/country, and sector/time dummies.

Discussion - The results in Tables 6 and 7 indicate that sectors with a larger elasticity gap show larger trade elasticity to macroeconomic shocks. Specifically, taking the coefficients in column 8 of Table 6 and column 7 of Table 7, the estimated trade elasticity to tariffs and RER for the sectors with the maximum elasticity gap is four times larger than for the sectors with the minimum elasticity gap (approximately 1.7 vs. 0.4 tariff elasticity and 0.16 vs. 0.04 RER elasticity).

The results also support that this larger trade elasticity also has an effect on the discontinuation of connections, with a larger decrease of stability in sectors with a larger elasticity gap. Here, however, the effect of RER is insignificant, possibly due to the small trade elasticity (the well-known international elasticity puzzle). One explanation offered for the international elasticity puzzle, proposed already by Ruhl (2008), is that RER shocks are temporary while tariffs are permanent. The small effect that RER has on my measure for connection stability supports this idea, especially when considering the large cost estimates for creating a connection found in Eaton et al. (2021), with up to \$50,000 for an expected yield of just one connection.

7. Conclusion

In this paper, I analyze the reason behind the differences in survival rates and trade value growth of importer–exporter connections and show that these differences create heterogeneity in the trade adjustment to macroeconomic shocks. To explain those differences, I developed a dynamic model of importer–exporter connections, in which importers endogenously decide from which exporters to source. The model features importers that are heterogeneous in their productivity and in their degree of substitutability

Table 7 Effect of RER

	$Stability_{sct}$	Stability _{sct}				log sales _{sct}			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
η_{st}	0.024*** (4.98)				0.152*** (2.97)				
$\log RER_{ct}$		-0.006 (-0.87)	-0.004 (-0.70)			-0.138*** (-5.92)	-0.140*** (-6.09)		
$\eta_{st} \times \log RER_{ct}$			0.003 (0.45)	0.001 (0.17)			-0.048** (-2.26)	-0.052** (-2.46)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fixed effects:									
μ_{ct}	Yes	No	No	Yes	Yes	No	No	Yes	
μ_{sc}	No	Yes	Yes	Yes	No	Yes	Yes	Yes	
μ_{st}	No	No	Yes	Yes	No	No	Yes	Yes	
R ² Observations	0.073 37,048	0.376 36,198	0.417 36,135	0.441 35,958	0.379 40,410	0.806 39,509	0.806 39,509	0.816 39,311	

* p < 0.10, ** p < 0.05, *** p < 0.01. t statistics in parentheses. Standard errors clustered on both country-year and industry-year.

among final goods and among inputs. Consequently, they differ in the intensity of their search for exporters and their choice of which connections to keep over time.

My main theoretical result is that the benefits of connecting to new exporters depend on the difference in the degree of substitutability that importers face among their final goods and among their inputs. The intuition is that each of these degrees of substitutability governs one side of the importer decision: the degree of substitutability among final goods determines the increase in profits from a reduction in the price the importer charges to consumers, while the degree of substitutability among inputs governs how important a new exporter is to decrease the importer's marginal costs and hence its price. This effect is captured by a term that I label the elasticity gap, which decreases in the degree of substitutability among final goods and increases in the degree of substitutability among final goods.

The model delivers three testable implications on importer–exporter connections. First, importers with a larger elasticity gap invest more in finding new suppliers and, therefore, have a larger growth rate in the number of connections. Second, importers with a larger elasticity gap are less likely to drop old connections as new ones are established, creating a difference in survival rates across importers. Third, the sales-boosting effect of incorporating new exporters into the production function causes importers with a larger elasticity gap to also increase the trade value of their existing connections as well as their trade value overall. Furthermore, this mechanism also reveals an additional source of heterogeneity for the transmission of macroeconomic shocks to trade, in which sectors with larger elasticity gaps react more to tariffs and real exchange rate movements.

I provide empirical evidence for these theoretical predictions using transaction-level data for Colombian importers from 2008 to 2019. The empirical results show that connections of importers with a larger elasticity gap grow more in terms of the number of connections, and these connections have a higher survival rate and trade value growth. I further document empirical patterns consistent with the predicted channel: the effect of the elasticity gap on the connection's survival rate decreases on exporter productivity. This is because the connections affected in importers with a small elasticity gap are those with low-productivity exporters. Finally, the estimated trade elasticity to macroeconomic shocks is estimated to be around four times larger for sectors with the maximum elasticity gap compared to sectors with the minimum elasticity gap.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.euroecorev.2023.104638.

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