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Decomposing the Trade Transmission Channel of External Growth

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Abstract

The objective of this paper is to quantify the effect of the economic growth of trading partners on the aggregate quantities of goods exported by a small open economy and to disentangle some of the factors behind this behavior. We decompose this effect to explore two sources of variations: i) the extensive and intensive margin of the export decision; and ii) the heterogeneity of this effect among different sectors. Results show that there is a positive correlation between economic activity of trading partners and the quantities exported of both entering (extensive margin) and surviving firms (intensive margin). However, the flow of firms at both margins, namely the probability of entering, exiting and surviving within the export market seems not be affected by external demand. Regarding the second source of variation, there is evidence of an heterogenous effect of international growth on exports by sectors. In particular, the volumes exported by the commodity sector, especially oil exports, respond more to variations of the economic growth of trading partners than the manufacturing sector.

JEL Classification: F14, F43, F44
Keywords: Exports, international trade, transmission channels

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1 Introduction

Articles in the line of Frankel and Rose (1998) or Glick and Rose (1999) have widely documented that international trade is an important propagation mechanism of foreign shocks, especially in small open economies. However, economic literature has paid little attention to the way in which the GDP growth of the trading partners of a country affects the decision to export of a firm. Hence, the objective of this article is to help to fill some of the existing gaps by quantifying the effect of the economic growth of trading partners on the aggregate quantities of goods exported by a small open economy and by disentangling some of the factors behind this behavior. To do so we decompose this effect to explore two sources of variations: i) the extensive and intensive margin of the export decision; and ii) the heterogeneity of this effect among different sectors.

We use a detailed panel dataset for Colombian exporters between 2000 and 2014, containing information for firms at the level of the category for which the export basket pertains (according to the 3 digit International Standard Industrial Classification (ISIC, rev. 4)) and to a specific country of destination. This is especially usefull for the exploration of the intensive and extensive margin as it allows to categorize firms as entrying, exiting and surviving. The data also allows to work with export volumes, which is a positive trait as it abstracts from the volatility of prices, especially in the context of a net commodity exporter, and it allows to control for the fact that this economies are not usually price setters in international markets. This information is hence complemented with macroeconomic variables from publicly available sources, like the World Economic Outlook of the International Monetary Fund.

Results show that there is a positive correlation between economic activity of trading and the quantities exported of both entering (extensive margin) and surviving firms (intensive margin). However, the flow of firms at both margins, namely the probability of entering, exiting and surviving within the export market seems not be affected by external demand. Regarding the second source of variation, there is evidence of an heterogenous effect of international growth on exports by sectors. In particular, the volumes exported by the commodity sector, especially oil exports, respond more to variations of the economic growth of trading partners than the manufacturing sector.

The results of this article contribute in several ways to the existing economic literature. First of all, it ratifies that there is a positive relationship between GDP growth of trading partners and exports. This adds to the already ample evidence that identify international trade as an important propagation mechanism of extenal shocks and thus shed some light on the stylized fact that business cycles tend to be correlated between countries. This way, our findings are in line with those of Ibrahim (2012) and Obiora (2009), among many others. However, we additionally extend the results of the existing literature by exploring the existence of hetoregenous effects between sectors and by disentangling the dynamics found at the extensive and intensive when assessing the impact of external growth on exports. To the best of our knowledge, these two facts had not been previously documented in economic literature. We hope that showing these two intereseting stylized facts we may motivate further research on the topic and serve as an anchor for future theoretical contributions.

Besides this introduction, this article is composed of four sections: section 2 includes a brief literature review; section 3 describes the data; section 4 presents the empirical methodology and results; and section 5 concludes.

2 Literature Review

Recently there has been an increasing interest by empirical economic literature to understand export dynamics and to disentangle the factors behind these movements. This paper fits perfectly into this broad category as its main purpose is to quantify the effect of the economic growth of trading partners on the quantities of goods exported by a small open economy and to study this effect at the extensive and intensive margin of the export decision. Moreover, we want to verify if this effect is heterogeneous between sectors. Thus, we have identified that this empirical paper fits well on two particular strands of this literature.

First of all it is in line with papers that intend to show that international trade, in particular exports, act as a transmission mechanism of shocks to economic activity abroad. One of the most prominent examples of this strand of literature is the seminal paper of Glick and Rose (1999), which uses a cross-sectional dataset with information from over 150 countries to show that trade is the main transmission mechanism of currency crises abroad through diminished demand for exports. These results are complemented by Frankel and Rose (1998), who show that there is a close relationship between bilateral trade intensity and their business cycles and that the reduction of trade barriers leads to greater correlation between cycles.

Another good example of this type of literature is the paper by Forbes (2004), ratifies earlier results that show that trade is an important transmission channel to explain contagion between countries. This author also argues that there are two potential channels that allow the transmission of external shocks through international trade: i) a competitiveness effect, due to changes in relative prices; and ii) an income effect, as a result of the lower disposable income, leading to a reduced demand.

Other example of most recent papers are the ones of Ibrahim (2012) that uses pooled panel data for Egypt between 1990 and 2008 to measure the effect in exports of shocks to the external growth and finds that changes in this variables lead to an increase of less than one percent of Egyptian exports. Meanwhile, Obiora (2010) uses panel data for Nigeria between 1996 and 2008 to gauge the impact of trading partners on this country's GDP and finds that trade linkages play an important role on the transmission of foreign growth shocks.

It is important to mention that, although all of the aforementioned papers use different types of empirical strategies, they all have in common that they intend to gauge the effect of foreign growth on aggregate domestic exports. In this sense, the results of our paper are in line with this strand of literature as we also find a positive relationship between the economic growth of trading partners and exports at the aggregate level using Colombian data. However, our contribution to this strand of literature is that we extend this results to evaluate its hetorogeneity among sectors, which is interesting in the sense that the transmission of foreign shocks to a given country could vary depending on their trade structure.

Additionally, we further decompose this aggregate effect of the economic growth of trading partners on exports by exploring it at the extensive and intensive margin, which is the second strand of the empirical literature of exports where our paper can be embedded.

This type of analysis has recently acquired importance on economic literature as a wide array of papers have started exploring these dimensions of exports. For instance, Coughlin (2012) and Minondo and Requena (2011) use regional

data for the United States and for Spain, respectively, to decompose export growth into the intensive and extensive margin to find important heterogeneity in the importance of each between regions.

Also, Besedes and Prusa (2007) is a good example of this type of analysis as this author uses a sample of bilateral manufacturing exports for more than 40 countries between 1975 and 2003 to explore their dynamics in terms of the extensive and intensive margin. This author finds that the extensive margin has little impact on long term export growth, while small changes on the survival and deepening dimensions of the intensive margin result on significant changes of long term export growth.

It is important to note four main features of the existing literature about the subject that are relevant for our contributions within this strand of empirical literature. First of all, results are diverse and depend on the specific markets and heterogeneity that the authors manage to explore from the data, which means that the results obtained from a small open economy that is highly dependent of commodities, like the Colombian, is by itself a contribution to this still incipient literature. Secondly, from the best of our knowledge, none of the reviewed articles explores the effects of the growth of economic growth of the trading partners on the export decisions at these margins, so we are the first to document the decomposition of this effect. Thirdly, the literature on the extensive and intensive margin of exports has focused mostly on the indivual characteristic of firms, but has not explored how shocks to external growth affect this decision. Finally, and closely related to the last point, there is not a unanimous definition of each margin and of the exit, survival and entry rates, as different authors vary their specifications according to the available data and to the nature of their exercise. This means, that another contribution of this paper is to provide suitable definitions for these concepts given the purpose of this paper.

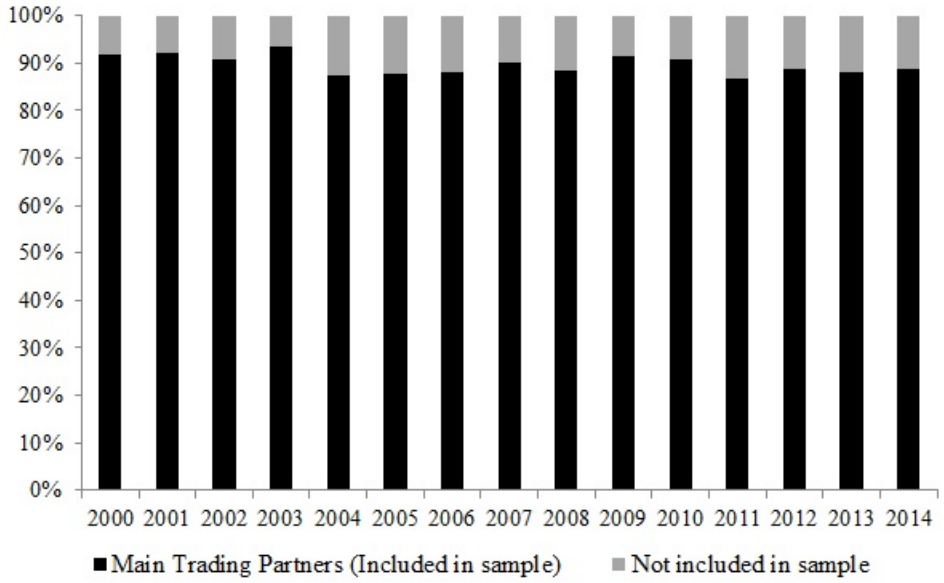
3 Data

In order to be able to account for the way that firms base their decisions to sell abroad, both at the extensive and intensive margin, and for the heterogeneity found between sectors, we use a detailed transaction level database for Colombian exports of goods. This data is from the National Customs Office (DIAN) and at the aggregate level adds to the figures that are used as input for the estimation of the gross domestic product (GDP) and the balance of payments. Each registry of a transaction includes the volume exported in net kilograms (excluding the weight of the container) and its current value in US dollars, an identification number for each firm, its industrial classification (according to the 3 digit International Standard Industrial Classification (ISIC, rev. 4)) and the country of destination. This dataset has been previously used for the characterization of different traits of Colombian exports,[2] but, to the best of our knowledge, it has never been used to evaluate the impact of trading partners' growth on exporting decisions, both on the extensive and intensive margin, and its heterogeneity between sectors.

Although this data is available monthly since the early 1990s, we decided to work with an annual frequency since 2000 until 2014. The reason why we start at 2000 is that until September 1999 Colombia had a crawling peg exchange rate regime, so we wanted to avoid any statistical problems that could arise from this structural change. Regarding the choice of a lower frequency, this responds to the readily available macroeconomic series at a yearly frequency that have already been homologated by the International Monetary Fund (IMF).

[2]See for instance Eaton et al. (2008), Montes et al. (2008) and Montes et al. (2010).

Figure 1: Exports to the main trading partners of Colombia as a share of total nominal exports



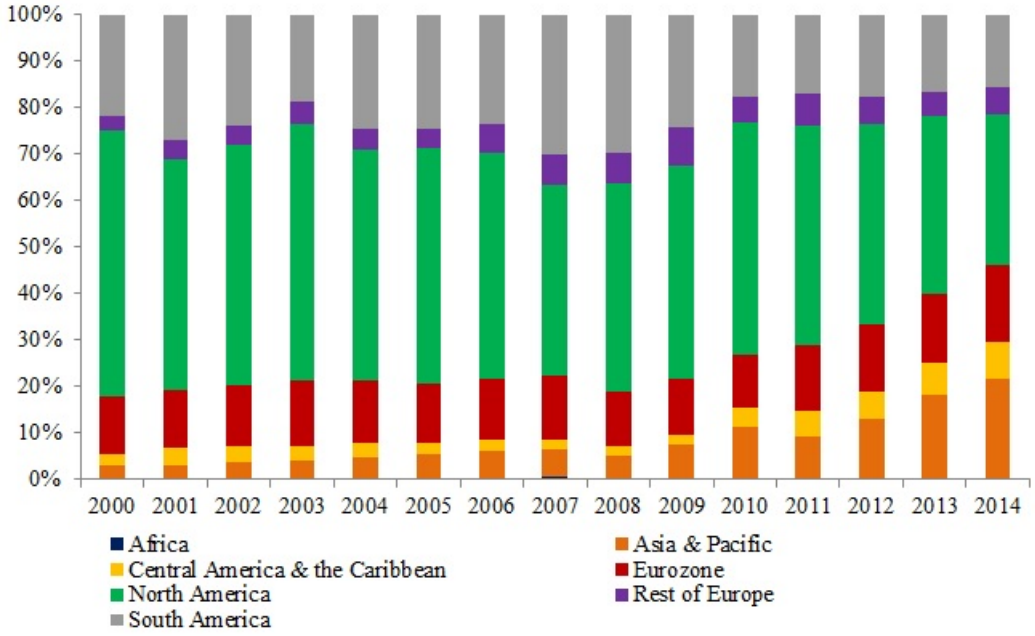
Source: DIAN. Authors' calculations.

The original database was comprised of 189 export destinations, but we limited the sample of trading partners to those that constituted a considerable proportion of the exported quantities and for which there was enough reliable macroeconomic information at the required frequency. This group of destinations, which will be henceforth denominated Colombia's main trading partners, is comprised of 48 countries[3] that accounted for 91.6% of the volume of goods exported and 89.7% of nominal exports between 2000 and 2014. Figure 1 that there has been very little fluctuations in the participation of these countries throughout the sample period. However, Figure 2 shows that the participation of each region[4] as a destination for exports has shown important changes through time, as Colombia has become more diversified in terms of trading partners since 2010.

Additionally, for the second part of the exercise, in which we explore the sector heterogeneity of the effect of external growth on exports, we grouped them into seven different sectors[5]: 1) agriculture and food industries; 2) mining (excluding oil); 3) oil (and its derivatives); 4) chemical manufacturing; 5) textile and footwear manufacturing; 6) other manufacturing; and 7) rest of exports. As shown in Figure 3, commodity related sectors (1 to 3) have dominated Colombian exports throughout the sample, especially oil, which has increased its participation systematically between 2008 and 2014. The participation of manufacturing sectors (4 to 6) has been falling at the expense of oil since the beginning of the period of analysis, but has remained relatively stable for the last 5 years in the sample. Additionally, the rest of exports (sector 7) have had a very small share since 2000, so, given that the very dissimilar nature of the ISIC categories grouped into this sector could difficulty its interpretation, we decided to limit the analysis to sectors 1 to 6, which represent 96.8% of nominal exports on the sample period and 92.3% of exports in volumes.

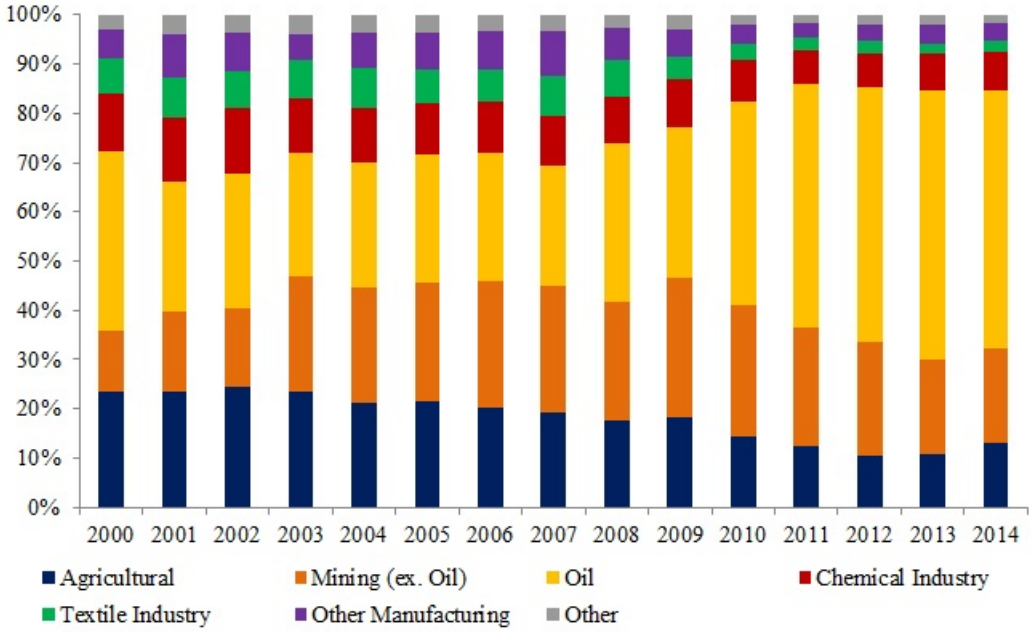
[3]See Appendix 7.1. for a complete list of the selected countries.
[4]See Appendix 7.1. for the region classification used in the figure.
[5]See Appendix 7.2. for the ISIC (3 digit, rev. 4) categories included in each sector.

Figure 2: Division by regions of the nominal exports to the main trading partners of Colombia



Source: DIAN. Authors' calculations.

Figure 3: Exports for each sector as a share of total exports



Source: DANE. Authors' calculations.

It is important to highlight that when analyzing by sector we maintain the same selection of trading partners as for the aggregate exports, since for each sector they represent more than 80% of total nominal exports, as can be observed in figure 4. However, as shown in Figure 5, there is a significant heterogeneity between sectors regarding the regional participation of the countries included in the sample of trading partners. In the case of agriculture and food industries and of mining (excl. oil) there is an important share of exports going to North America, South America and the Eurozone. Meanwhile, the oil sector was broadly dominated by North America (mainly the United States) until 2008, and since that period it has been losing participation to Asia and Pacific, Central America and the Caribbean, and the Eurozone. Finally, for manufacturing sectors (4 to 6) most of the exports go to South America and, to a lower extent, to North America.

As mentioned earlier, we focus on quantities because in the context of the Colombian economy most exporting firms do not hold a significant share in global markets, and hence have limited power about pricing decisions. This means that the variable of interest will be the volume sold abroad in kilograms. However, this measure has some shortcomings regarding the aggregation within sectors of goods that are not fully comparable, especially between goods that have similar weight, but very different qualities. To bypass this limitation we build a quantity index following the methodology proposed in Garavito et al. (2011). Using data at the level of individual goods from customs and trade figures, we retrieve their unit price in US dollars and aggregate them in a chained price index for each sector using weights for each good based on their average participation in the sector's trade during the period of analysis. This price index is hence used to deflate the nominal exports in US dollars to build a quantity index for each sector.

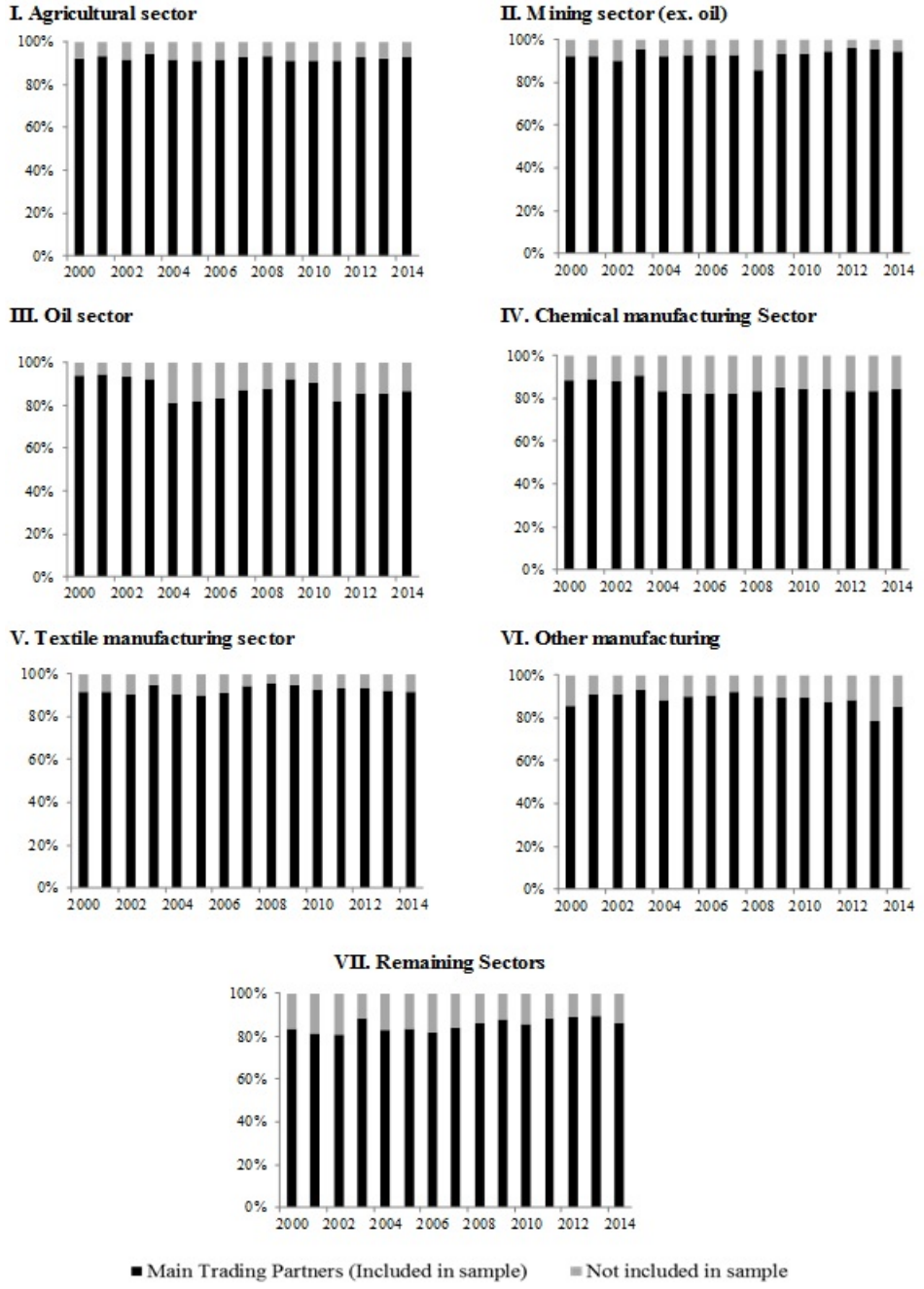
We complement the export data with a GDP chained index of each of the countries included as trading partners, based on the observed annual growth of the country as reported in the October 2015 edition of the IMF World Economic Outlook.

Finally, it is important to mention that, although most estimations are conducted at a country level data, we used the transaction level data to be able to identify firms exporting goods to a specific destination to classify them in the different categories that are needed to distinguish whether they belong to the intensive o extensive margin. In particular, firms that belong to the intensive margin at time t, henceforth denominated surviving firms, are those that exported goods to country c at periods $t-1$ and t. We also define the surviving rate for country c at year t as the number of remaining firms as a proportion of the total number of firms exporting goods at $t-1$ to destination c. This rate is expressed as a percentage.

Meanwhile, we define two type of firms at the extensive margin: i) entering firms at t, which are those that did not export any goods to country c at $t-1$, but are present in the sample at t; and ii) exiting firms at t, as those that export goods to country c at $t-1$, but are not in the sample at t. Similarly, we define the exiting rate for country c at year t as the number of exiting firms for those dimensions as a share of the total number of firms exporting goods at $t-1$ to destination c. Additionally, the entry rate for country c at year t is the number of entering firms as a share of the total number of firms that exported goods to destination c at any point of the sample period . Note that this categorization of firms is not defined for the first year of the sample, namely year 2000, so the exercises below are conducted for the period between 2001 and 2014.

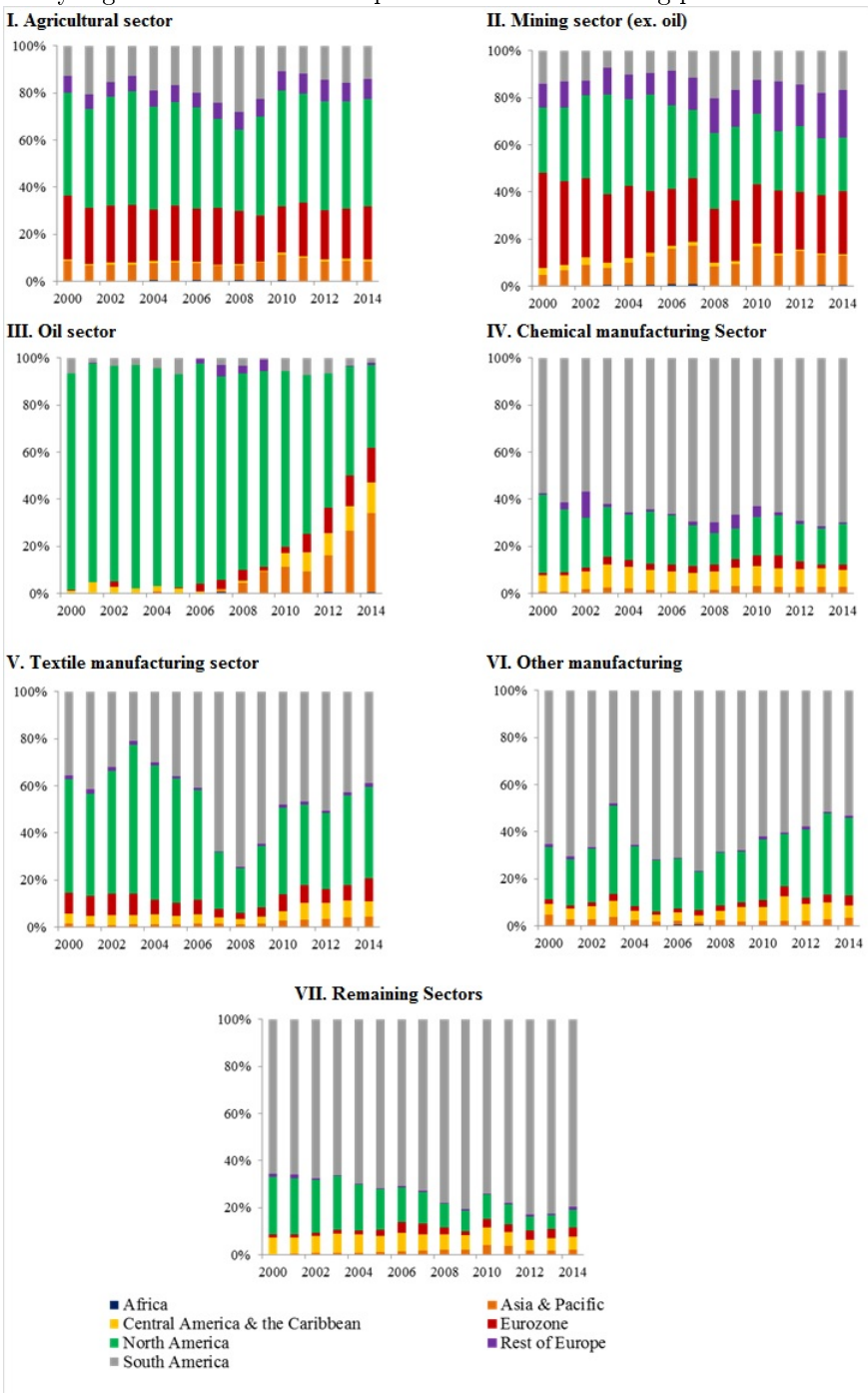
Table 1 presents descriptive statistics of the logarithms of the quantity and nominal value of exports for the entire dataset at the country level. This table also reports the average GDP growth of Colombia trading partners, which

Figure 4: Exports to the main trading partners of Colombia as a share of total nominal exports, by sector



Source: DIAN. Authors' calculations.

Figure 5: Division by regions of the nominal exports to the main trading partners of Colombia, by sectors



Source: DIAN. Authors' calculations.

Table 1: Descriptive Statistics

	All Countries				
	Mean	Median	Q1	Q4	Sd.
Exports (ln kg)	19.207	19.819	16.940	21.405	2.920
	(0.142)				
Nominal Exports (ln)	18.911	19.103	17.446	20.326	2.092
	(0.102)				
Number of firms	3,889,833	1,169.5	392	6,547	5,558,809
	(1,014.895)				
Entry Rate	7.864	7.504	5.941	9.174	3.162
	(0.154)				
Exit Rate	46.255	43.155	37.132	50.261	15.306
	(0.747)				
Survival Rate	53.745	56.845	49.739	62.868	15.306
	(0.747)				
GDP Growth (YoY)	3.614	3.382	1.946	4.714	2.074
	(0.379)				

Standard errors in parenthesis.

Table 2: Annual average of the variables of interest by Sector

	Agric. & Food	**Mining**	**Oil**	**Chemical**	**Textile**	**Other Man.**
Exports (ln kg)	12.673	13.592	13.170	11.637	9.205	9.151
	(0.175)	(0.293)	(0.528)	(0.258)	(0.212)	(0.236)
Nominal Exports (ln)	13.685	13.762	13.094	12.953	12.194	12.447
	(0.144)	(0.205)	(0.480)	(0.223)	(0.190)	(0.175)
Number of firms	854,382	874,248	84,117	1,136,298	1,220,805	1,549,908
	(65.170)	(58.245)	(4.936)	(75.118)	(83.951)	(107.785)

is worth highlighting that it is higher than the long term growth estimated for advanced economies during the sample period of approximately two percent. This pattern found in our data reflects the fact that an important proportion of Colombian exports have as destination countries emerging economies in Latin America and in Asia Pacific, which exhibited higher growth during this period.

Table 2 exhibits the descriptive statistics by sector. Results show a high degree of hetorogeneity among sectors in terms of the number of firms and on the quantities exported. It is worth highlighting that the oil sector has the smallest number of firms of all, but is the one with the largest quantity exported.

4 Empirical Strategy and Results

The first issue that we intend to explore is which is the effect of the economic performance of trading partners on the quantity of Colombian export of goods. To do we use the specification outlined by equation 1, as follows:

$$QX_{ct} = \beta_0 + \beta_1 GDP_{ct} + Z_c\alpha + Z_t\lambda + Z_{ct}\gamma + \mu_c + \varepsilon_{ct} \quad (1)$$

where QX_{ct} represents the logarithm of the exported quantities (in net kilograms or the quantity index, depending on the specification), GDP_{ct} is the logarithm of the real gross domestic product index of the trading partner c at time t, μ_c is an unobserved characteristic of the destination country that is time invariant and ε_{ct} is a random shock. The sub-index c is the country of destination and t is the period of shipment of the export at an annual frequency. Finally, β_0 is a constant and β_1 is the marginal effect that we intend to identify as it shows the response in percentage points of the quantity exported of basket of goods to a destination c at time t after a shock the GDP of country c at a given quarter t.

To obtain a consistent estimate of β_1 we included the following controls that are represented in equation 1 by matrices Z_c, Z_t and Z_{ct}:

- The bilateral real exchange rate index with country c at period t (RER), which is built with the nominal exchange rate (defined as Colombian pesos per unit of foreign currency) and the Producer Price Index of finished goods for Colombia and for the destination country. A real depreciation of the Colombian peso (i.e. increases in the bilateral exchange rate) imply that local goods are relatively cheaper. In other words, with this variable we intend to capture the behavior of aggregate relative prices between Colombia and the destination country c at time t.
- A dummy that takes the value of 1 if Colombia has a valid foreign trade agreement with country c at year t (FTA), which proxies for the lack of possible trade barriers that might hinder trade with a given country.
- The volatility index of the Chicago Board Options Exchange (VIX) at time t. This variable is included as a proxy of financial conditions, because there is ample evidence in economic literature that they represent an important transmission mechanism of external shocks to international trade, either directly through limited access of firms to external financing or indirectly through contagion to local financial markets.[6]
- The Colombian business confidence index at time t (ind_conf), which intends to include the sentiment of local firms and to proxy for domestic economic conditions.
- The distance between Bogota (the capital city of Colombia) and the capital city of country c (dist), which is commonly found in gravity equations for international trade.[7]

[6] See for instance Coulibaly et al. (2013).
[7] See for instance Eaton and Kortum (2002).

Table 3: Marginal effect of a variation in the logarithm of the GDP of trading partners on quantities exported (complete sample)

	FE	RE
	QX	QX
GDP Index	3.089***	3.026***
	(0.571)	(0.569)
Observations	420	420
R-squared	0.448	
Number of countries	30	30

Robust standard errors in parenthesis
*** p- value < 0.01, ** p- value < 0.05, * p- value < 0.1

As a robustness check of the results this equation is then estimated under two different panel methodologies: the within estimator to control for the country fixed effect (FE) and the random effects (RE) estimator. The results for the effect of interest (β_1) are presented in Table 3, while the output of the total estimation can be found in Appendix 7.3.

The results for this first estimation show that an increase of one percent in economic activity of an average trading results in an increase of slightly more than three percent in the quantities exported. This result is statistically significant to a confidence level of 99%. Addtionally, it is economically significant if compared to the approximately 10% growth of the volumes of exported goods during the period of analysis. This result confirms the positive correlation existing between external growth and export volumes, as well as the importance of international trade as a transmission mechanism of external shocks in a small open economy, thus ratifying the stylized facts mentioned in the literature review above.

4.1 Analyzing the intensive and extensive margin

Since the main contribution of this article is the decomposition of the effect of the economic growth on exports, the next step is to explore the intensive and extensive margins. For the purpose of this analysis, recall from section 3 that the firms that belong to the intensive margin at time t, or surviving firms, are those that exported goods at periods $t-1$ and t. Meanwhile, we define two type of firms at the extensive margin: i) entering firms at t, which are those that did not export any goods at $t-1$, but are present in the sample at t; and ii) exiting firms at t that, in contrast, did export at $t-1$, but are not in the sample at t.

Based on the above, we explore two dimensions of the effect of the economic growth of trading partners on the export decisions of firms at the intensive margin, regarding the quantities exported by remaining firms and the probability that a firm remains from one period to the next. For the first one, we estimate equation 1, but limiting the sample to surviving firms only. The results for the effect of interest (β_1) are presented in Table 4, while the total output of the estimation can be found in Appendix 7.4.

Table 4: Marginal effect of a variation in the logarithm of the GDP of trading partners on quantities exported (remaining firms only)

	FE	RE
	QX	QX
GDP Index	2.020***	1.738***
	(0.456)	(0.466)
Observations	368	368
R-squared	0.053	
Number of countries	30	30

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results indicate that one percentage point of growth in the economic activity of the average trading partner results in an increase of roughly two percent in the quantity exported by surviving firms. In other words, external growth has a positive effect on the volume of goods of firms at the intensive margin, which reflects the decision of a surviving firm to increase its quantity sold abroad in the presence of greater dynamism of real activity of trading partners.

Once proven the positive relationship between foreign growth and quantities exported at the intensive margin, we explore whether the economic growth of trading partners affects the probability that a firm that exported at $t-1$ also does at t. That is, we wish to quantify how the real activity abroad increases the probability of a firm of belonging to the intensive margin at time t. To do so, we estimate equation 2, as follows:

$$P(i \in Survive)_{ct} = \beta_0 + \beta_1 GDP_{ct} + Z_c\alpha + Z_t\lambda + Z_{ct}\gamma + \mu_c + \varepsilon_{ct} \quad (2)$$

where $P(i \in Survive)_{ct}$ is approximated using the survival rate between $t-1$ and t of firms that export to country c. All other variables are defined exactly as in equation 1.

This specification is also estimated using the FE and the RE panel estimators. Table 5 shows the result for the marginal effect of interest, while the total output of the estimation can be found in Appendix 7.5.

Results for the marginal effect show the expected positive sign, suggesting that an increase in economic growth of trading partners would result in a higher likelihood of a firm exporting two periods in a row. Nonetheless, it is not statistically significant at the 90% confidence level for either of the estimation methods. This means that the results for the intensive margin indicate that there is positive effect on the quantities exported of increased economics growth abroad, but there is not evidence to conclude that the latter has any impact on the probability of a firm remaining as an exporter for two years in a row.

Once established the effect on the intensive margin, we explore the effect on firms on the extensive margin by measuring how much their exported quantities are influences by the growth of trading partners' economic activity,

Table 5: Marginal effect of a variation in the logarithm of the GDP of trading partners on the probability to remain

	FE P(remain)	RE P(remain)
GDP Index	3.823	4.264
	(11.15)	(8.335)
Observations	335	335
R-squared	0.006	
Number of countries	30	30

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Marginal effect of a variation in the logarithm of the GDP of trading partners on quantities exported (entering firms only)

	FE QX	RE QX
GDP Index	1.398**	1.121*
	(0.570)	(0.581)
Observations	408	408
R-squared	0.025	
Number of countries	30	30

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

as well as its impact on the probability of a firm entering or exiting the export market. The first exercise is analogous to the one exposed for the intensive margin in which equation 1 is estimated using a sample including only entering firms. The results of interest are presented in Table 6. Appendix 7.6. contains the complete output for the estimation.

The results suggest that incoming firms export more, on average, during periods in which economic growth of trading partners is higher. In particular, a one percent increase in the GDP index of the average destination country would result in exports at the extensive margin to rise by slightly more than one percent. However, the magnitude of this effect might be larger, due to the attenuation bias that exists on the measurement of the effect of foreign growth on the quantities in the extensive margin. The reason is that there is an exported volume foregone by exiting firms, which should be negatively correlated to economic growth of trading partners, since higher demand abroad should result on lower incentives to reduce the quantities exported. Nonetheless, this counterfactual is unobservable, since, by definition, exiting firms are exporting zero at time t.

The other dimension of the extensive margin that we explore in this paper is whether the probability of exit and of entry for a given firm exporting to destination c at year t is affected by the GDP of trading partners. To explore the likelihood of exit we estimate equation 3:

Table 7: Marginal effect of a variation in the logarithm of the GDP of trading partners on the probability to exit

	FE P(exit)	RE P(exit)
GDP Index	-3.823	-4.264
	(11.15)	(8.335)
Observations	335	335
R-squared	0.006	
Number of countries	30	30

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

$$P(i \in Exit)_{ct} = \beta_0 + \beta_1 GDP_{ct} + Z_c\alpha + Z_t\lambda + Z_{ct}\gamma + \mu_c + \varepsilon_{ct} \quad (3)$$

where $P(i \in Exit)_{ct}$ is approximated using the exiting rate between $t-1$ and t of firms that export to country c. All other variables are defined exactly as in equation 1.

Meanwhile, the probability to enter is estimated using equation , below:

$$P(i \in Enter)_{ct} = \beta_0 + \beta_1 GDP_{ct} + Z_c\alpha + Z_t\lambda + Z_{ct}\gamma + \mu_c + \varepsilon_{ct} \quad (4)$$

where $P(i \in Enter)_{ct}$ is approximated using the entering rate between $t-1$ and t of firms that export to country c.

These equations are estimated using the FE and RE panel estimators. Results of the marginal effect of interest are presented in Tables 7 and 8, while Appendix 7.7. and Appendix 7.8. contains the complete output for the estimation.

The results show that the effect of a rise the economic activity of the trading partners has no statistically significant effect on the probability to exit and entering, although the estimation has the expected signs. Regarding the probability to enter, it is worth mentioning that this measurement also suffers from an attenuation bias resulting from the fact that the denominator of this entry rate is underestimated, since we are defining the set of potential entering firms only as those that have exported during the sample period, and thus ignore existing firms that only supply the domestic market or even non-existing (and hence unobservable) firms that could be created.

In summary, the effect observed on aggregate exports as a response of a one percent increase in the GDP of trading partners is explained by the effect on both the intensive and extensive margin. For the first, the quantities exported by firms remaining in the sample explain the positive correlation with foreign growth, while the probability of a firm to survive as an exporter for the next year seems not be affected by this variable. In the case of the extensive

Table 8: Marginal effect of a variation in the logarithm of the GDP of trading partners on the probability to enter

	FE P(entry)	RE P(entry)
GDP Index	3.632	2.697
	(2.692)	(1.731)
Observations	420	420
R-squared	0.020	
Number of countries	30	30

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

margin, the quantities exported account for the direct relationship with the growth of the economic activity at the destination country. In contrast, there is no evidence that the probability of exit or entering is affected by changes in the dynamics of real activity abroad.

4.2 Heterogeneity among sectors

The next step is then to explore whether the results discussed above for aggregate exports apply equally among sectors or if there is significant heterogeneity among them. For the purpose of this analysis we use six broad sectors: agricultural and food industries, mining (excluding oil), oil, chemical manufacturing, textile and footwear manufacturing, and other manufacturing. As mentioned above, data is grouped in these sectors as they are considered to be the most representative of Colombian exports (they represent more than 90% of total exports for the period of study) and to facilitate the comparison and presentation of the results.

The methodology is very similar to the one employed for aggregate exports, where the key differences are that exports are a basket of goods pertaining to sector s that are shipped to country c at year t. Also, to avoid possible biases that might emerge from unobserved characteristics of sector that are invariant through time and destination countries, we included fixed effects dummies of each sector (D_s). Finally, we include an interaction of this dummies with the GDP index to capture the possible heterogeneity among sectors of the effect of higher external growth.

This means that we estimate an extended version of equation 1 as follows:

$$QX_{sct} = \beta_0 + \beta_1 GDP_{ct} + \sum_s \beta_s D_s GDP_{ct} + Z_c\alpha + Z_t\lambda + Z_{ct}\gamma + \sum_s \gamma_s D_s + \mu_{cs} + \varepsilon_{cst} \quad (5)$$

We estimate equation 5 with the whole sample using the panel FE and RE estimators. In Table 9 we compute the marginal effects of interest for each sector, where the standard errors are calculated using the delta method. The complete output of the estimation can be found in Appendix 7.9.

Table 9: Marginal effect of a variation in the logarithm of the GDP of trading partners on quantities exported per sector

Sector	Variable		FE	RE
Agricultural & Food	GDP Index	$\hat{\beta}_1$	1.206***	1.073***
			(0.344)	(0.337)
Mining (excl. Oil)	GDP Index	$\hat{\beta}_1 + \hat{\beta}_2$	2.890***	2.754***
			(0.847)	(0.342)
Oil	GDP Index	$\hat{\beta}_1 + \hat{\beta}_3$	4.789***	4.946***
			(1.289)	(0.459)
Chemical Manufacturing	GDP Index	$\hat{\beta}_1 + \hat{\beta}_4$	1.615***	1.582***
			(0.431)	(0.338)
Textiles & Footwear Manufacturing	GDP Index	$\hat{\beta}_1 + \hat{\beta}_5$	0.844*	0.783**
			(0.509)	(0.338)
Other Manufacturing	GDP Index	$\hat{\beta}_1 + \hat{\beta}_6$	1.776***	1.708***
			(0.346)	(0.338)
Observations			2,319	2,319
R-squared			0.448	
Number of countries and sectors			180	180

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To complement the results of Table 9, in Figure 6 we present a visual summary of the tests by pairs of sectors to statistically verify if there is evidence of a heterogeneous effect of the economic growth of trading partners on exports. The proper way to interpret this matrix is that in the cell marked by row i and column j there will be the marginal effect of the sector at position i in the rows minus the marginal effect of the sector j in the columns. As an example take oil in row 3 and chemical manufacturing in column 4. The register found at this position corresponds to the difference between the marginal effect of oil and of chemical manufacturing.

Results show that the quantities exported by the oil and mining sectors are the ones that respond the most to an increase of one percent of the GDP of trading partners, by increasing slightly below 5% and 3%, respectively. Note that this is higher than the effect for aggregate exports, which suggests that these two sectors, that have the highest participation within total exports, dominate in the aggregate and offset for the relative weak effect on others. For instance, sectors like textiles and agriculture and food industries that react the least to higher dynamism of economic activity abroad.

Regarding the heterogeneity, it can be seen that oil's effect is significantly higher (both statistically and in magnitude) than that of all manufacturing sectors, but not than that of other commodity-related sectors. Meanwhile, textiles and footwear have a significantly lower than any of the commodity sectors, especially relative to oil and other mining activities, while there is no statistical evidence to claim that it is different than any of the other manufacturing activities.

Figure 6: Pairwise statistical tests to verify the heterogeneity by sectors of the effect of the economic growth of trading partners on exports

	Agricultural & Food	Mining (excl Oil)	Oil	Chemical Manufacturing	Textiles & Footwear	Other Manufacturing
Agricultural & Food		-1,684	-3,583	-0,409	0,362*	-0,570
Mining (excl Oil)	1,684		-1,899	1,275	2,046**	1,114
Oil	3,583	1,899		3,174**	3,945***	3,013**
Chemical Manufacturing	0,409	-1,275	-3,174**		0,771	-0,161
Textiles & Footwear	-0,362*	-2,046**	-3,945***	-0,771		-0,932
Other Manufacturing	0,570	-1,114	-3,013**	0,161	0,932	

5 Conclusion

The objective of this paper was to quantify the effect of the economic growth of trading partners on the aggregate quantities of goods exported by a small open economy and to disentangle some of the factors behind this behavior. We did this by decomposing this effect on the extensive and intensive margin of the export decision. We find that there is a positive correlation between economic activity of trading and the quantities exported of both entering (extensive margin) and surviving firms (intensive margin). However, the flow of firms at both margins, namely the probability of entering, exiting and surviving within the export market seems not be affected by external demand.

Although we do not have a definite explanation for these results, we hypothetize that the costs of entering the export market, as in the models of Melitz (2003) and Roberts and Tybout (1997), generate hystheresis in the sense that firms base their decisions to exit, enter or remain on the export market on more structural factors, rather on cyclical indicators like foreign growth. Meanwhile, if firms happen to be fortunate enough to be in the export market (either because they entered that year or already were at previous one) at a period in which there is an economic boom abroad, they will take advantage of it by exporting more. If this were true, it still leaves ample field for further research on the topic, like trying to determine the factors explaining changes in the flow of firms in and out of the export market.

Additional to exploration of the intensive and extensive margins, we also found evidence of an heterogenous effect of international growth on exports by sectors. In particular, we observed that the volumes exported by the commodity sector, especially oil and derivatives, respond more to variations of the economic growth of trading partners than the manufacturing sector. Once again, we would like to posit some hypothesis that rationalize this behaviour in the hope to motivate further research on the subject.

One hypothesis is that commodities are exported to be used as intermediate goods in the early stage production of further products, while manufacturing products tend to be associated with the final stage of the production chain or directly with consumer or capital goods. Demand for intermediate goods might be more sensitive during economic booms depending on the type of intermediate good. Commodities, for instance, are fairly standard products. During economic booms the origin of commodities might not be as important, but in other periods it might be easier to switch providers.

On the other hand, storing commodities might be cheaper than other products. For example, if a firm exports coal and it owns the right to exploit a mine, it can store the coal freely by not exploiting the mine. This implies that this firm will be able to decrease its exports of coal more easily if demand falls. In contrast, manufacturing requires a relatively more elaborated and time consuming production process, which might make it less responsive in the short term to changes in demand.

A final hypothesis concerns the comparative advantage that Colombia might have in commodities. This is consistent with Eaton and Kortum (2002), for example. If Colombia has a comparative advantage in commodities, firms exporting these products will be able to increase their share of the market in an easier way than with other products.

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7 Appendix

7.1 List of main trading partners of Colombia and region classification for Figures

Country	Region	Country	Region
Australia	Asia & Pacific	Malaysia	Asia & Pacific
Austria	Eurozone	Malta	Eurozone
Belgium	Eurozone	Mexico	North America
Brazil	South America	Netherlands	Eurozone
Canada	North America	New Zealand	Asia & Pacific
Chile	South America	Norway	Rest of Europe
China	Asia & Pacific	Panama	Central America and the Caribbean
Costa Rica	Central America and the Caribbean	Peru	South America
Cyprus	Eurozone	Portugal	Eurozone
Denmark	Rest of Europe	Russian Federation	Rest of Europe
Ecuador	South America	Singapore	Asia & Pacific
Estonia	Eurozone	Slovakia	Eurozone
Finland	Eurozone	Slovenia	Eurozone
France	Eurozone	South Africa	Africa
Germany	Eurozone	South Korea	Asia & Pacific
Greece	Eurozone	Spain	Eurozone
India	Asia & Pacific	Sweden	Rest of Europe
Indonesia	Asia & Pacific	Switzerland	Rest of Europe
Ireland	Eurozone	Thailand	Asia & Pacific
Italy	Eurozone	Turkey	Rest of Europe
Japan	Asia & Pacific	United Kingdom	Rest of Europe
Latvia	Eurozone	United States	North America
Lithuania	Eurozone	Venezuela	South America

7.2 List of International Standard Industrial Classification of All Economic Activities (ISIC) 3 digit categories included in each sector

Sector	ISIC code	ISIC description
Agricultural and Food	011	Growing of non-perennial crops
Agricultural and Food	012	Growing of perennial crops
Agricultural and Food	013	Plant propagation
Agricultural and Food	014	Animal production
Agricultural and Food	031	Fishing
Agricultural and Food	032	Aquaculture
Agricultural and Food	101	Processing and preserving of meat
Agricultural and Food	102	Processing and preserving of fish, crustaceans and molluscs
Agricultural and Food	103	Processing and preserving of fruit and vegetables
Agricultural and Food	104	Manufacture of vegetable and animal oils and fats
Agricultural and Food	105	Manufacture of dairy products
Agricultural and Food	106	Manufacture of grain mill products, starches and starch products
Agricultural and Food	107	Manufacture of sugar
Agricultural and Food	108	Manufacture of other food products
Agricultural and Food	109	Manufacture of prepared animal feeds
Agricultural and Food	110	Manufacture of beverages
Mining (excl. oil)	051	Mining of hard coal
Mining (excl. oil)	052	Mining of lignite
Mining (excl. oil)	062	Extraction of natural gas
Mining (excl. oil)	071	Mining of iron ores
Mining (excl. oil)	072	Mining of non-ferrous metal ores
Mining (excl. oil)	081	Quarrying of stone, sand and clay
Mining (excl. oil)	082	Quarrying of esmeralds, precious and semi-precious stones
Mining (excl. oil)	089	Mining and quarrying n.e.c.
Mining (excl. oil)	191	Manufacture of coke oven products
Mining (excl. oil)	239	Manufacture of non-metallic mineral products n.e.c.
Mining (excl. oil)	241	Manufacture of basic iron and steel
Mining (excl. oil)	242	Manufacture of basic precious and other non-ferrous metals
Mining (excl. oil)	243	Casting of metals
Oil	061	Extraction of crude petroleum
Oil	192	Manufacture of refined petroleum products
Chemical Manufacturing	201	Manufacture of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms
Chemical Manufacturing	202	Manufacture of other chemical products
Chemical Manufacturing	203	Manufacture of man-made fibres
Chemical Manufacturing	210	Manufacture of pharmaceuticals, medicinal chemical and botanical products

List of International Standard Industrial Classification of All Economic Activities (ISIC) 3 digit categories included in each sector (continued)

Sector	ISIC code	ISIC description
Chemical Manufacturing	221	Manufacture of rubber products
Chemical Manufacturing	222	Manufacture of plastics products
Chemical Manufacturing	231	Manufacture of glass and glass products
Textile and Footwear Manufacturing	131	Spinning, weaving and finishing of textiles
Textile and Footwear Manufacturing	139	Manufacture of other textiles
Textile and Footwear Manufacturing	141	Manufacture of wearing apparel, except fur apparel
Textile and Footwear Manufacturing	142	Manufacture of articles of fur
Textile and Footwear Manufacturing	143	Manufacture of knitted and crocheted apparel
Textile and Footwear Manufacturing	151	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness; dressing and dyeing of fur
Textile and Footwear Manufacturing	152	Manufacture of footwear
Other Manufacturing	120	Manufacture of tobacco products
Other Manufacturing	251	Manufacture of structural metal products, tanks, reservoirs and steam generators
Other Manufacturing	252	Manufacture of weapons and ammunition
Other Manufacturing	259	Manufacture of other fabricated metal products
Other Manufacturing	261	Manufacture of electronic components and boards
Other Manufacturing	262	Manufacture of computers and peripheral equipment
Other Manufacturing	263	Manufacture of communication equipment
Other Manufacturing	264	Manufacture of consumer electronics
Other Manufacturing	265	Manufacture of measuring, testing, navigating and control equipment; watches and clocks
Other Manufacturing	266	Manufacture of irradiation, electromedical and electrotherapeutic equipment
Other Manufacturing	267	Manufacture of optical instruments and photographic equipment
Other Manufacturing	268	Manufacture of magnetic and optical media
Other Manufacturing	271	Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus
Other Manufacturing	272	Manufacture of batteries and accumulators
Other Manufacturing	273	Manufacture of wiring and wiring devices
Other Manufacturing	274	Manufacture of electric lighting equipment
Other Manufacturing	275	Manufacture of domestic appliances
Other Manufacturing	279	Manufacture of other electrical equipment
Other Manufacturing	281	Manufacture of general-purpose machinery
Other Manufacturing	282	Manufacture of special-purpose machinery
Other Manufacturing	291	Manufacture of motor vehicles

List of International Standard Industrial Classification of All Economic Activities (ISIC) 3 digit categories included in each sector (continued)

Sector	ISIC code	ISIC description
Other Manufacturing	292	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
Other Manufacturing	293	Manufacture of parts and accessories for motor vehicles
Other Manufacturing	301	Building of ships and boats
Other Manufacturing	302	Manufacture of railway locomotives and rolling stock
Other Manufacturing	303	Manufacture of air and spacecraft and related machinery
Other Manufacturing	304	Manufacture of military fighting vehicles
Other Manufacturing	309	Manufacture of transport equipment n.e.c.
Other Manufacturing	311	Manufacture of furniture
Other Manufacturing	312	Manufacture of matresses
Other Manufacturing	321	Manufacture of jewellery, bijouterie and related articles
Other Manufacturing	322	Manufacture of musical instruments
Other Manufacturing	323	Manufacture of sports goods
Other Manufacturing	324	Manufacture of games and toys
Other Manufacturing	325	Manufacture of medical and dental instruments and supplies
Other Manufacturing	329	Other manufacturing n.e.c.
Rest of exports	022	Logging
Rest of exports	161	Sawmilling and planing of wood
Rest of exports	162	Manufacture of products of wood, cork, straw and plaiting materials
Rest of exports	170	Manufacture of paper and paper products
Rest of exports	181	Printing and service activities related to printing
Rest of exports	351	Electric power generation, transmission and distribution
Rest of exports	370	Sewerage
Rest of exports	381	Waste collection
Rest of exports	383	Materials recovery
Rest of exports	581	Publishing of books, periodicals and other publishing activities
Rest of exports	591	Motion picture, video and television programme activities
Rest of exports	592	Sound recording and music publishing activities
Rest of exports	711	Architectural and engineering activities and related technical consultancy
Rest of exports	742	Photographic activities
Rest of exports	900	Creative, arts and entertainment activities
Rest of exports	910	Libraries, archives, museums and other cultural activities
Rest of exports	960	Other personal service activities

7.3 Results for equation 1 - Marginal effect of a variation in the logarithm of the GDP of trading partners on quantities exported (full sample)

	Pooled OLS	FE	RE
	QX	QX	QX
GDP Index	3.026***	3.089***	3.026***
	(0.569)	(0.571)	(0.569)
RER	0.0724	0.184	0.0724
	(0.365)	(0.368)	(0.365)
FTA	0.191	0.186	0.191
	(0.193)	(0.197)	(0.193)
VIX	-0.00117	-0.00102	-0.00117
	(0.00677)	(0.00675)	(0.00677)
dist	-0.000222***		-0.000222***
	(3.90e-05)		(3.90e-05)
ind_conf	0.000925	0.000543	0.000925
	(0.00397)	(0.00394)	(0.00397)
Constant	0.956	-1.987	0.956
	(3.494)	(3.598)	(3.494)
Observations	420	420	420
R-squared		0.448	
Number of countries	30	30	30

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7.4 Results for equation 1 - Marginal effect of a variation in the logarithm of the GDP of trading partners on quantities exported (sample including remaining firms only)

	Pooled OLS	FE	RE
	QX	QX	QX
GDP Index	1.738***	2.020***	1.738***
	(0.466)	(0.456)	(0.466)
RER	-0.211	0.375	-0.211
	(0.651)	(0.767)	(0.651)
FTA	0.379	0.297	0.379
	(0.312)	(0.290)	(0.312)
VIX	-0.0134	-0.0134	-0.0134
	(0.0214)	(0.0213)	(0.0214)
dist	-0.000306***		-0.000306***
	(4.25e-05)		(4.25e-05)
ind_conf	-0.00793	-0.0104	-0.00793
	(0.0193)	(0.0196)	(0.0193)
Constant	4.231	-2.446	4.231
	(4.480)	(4.899)	(4.480)
Observations	368	368	368
R-squared		0.053	
Number of panel_pais	30	30	30

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7.5 Results for equation 2 - Marginal effect of a variation in the logarithm of the GDP of trading partners on the probability to remain

	FE	RE	IV (2 year GDP lag)	IV (1 year GDP lead)
	P(remain)	P(remain)	P(remain)	P(remain)
GDP Index	3.823	4.264	2.090	5.327
	(11.15)	(8.335)	(7.072)	(6.749)
RER	-8.524	-6.907	-7.513	-8.222
	(12.08)	(6.716)	(5.528)	(5.609)
FTA	-0.964	-0.957	-2.447	0.731
	(4.848)	(4.238)	(4.492)	(4.389)
VIX	0.144	0.101	0.0800	-0.127
	(0.270)	(0.272)	(0.330)	(0.334)
dist		-0.000309	-0.000253	-0.000302
		(0.000454)	(0.000308)	(0.000291)
ind_conf	0.0489	-0.0167	-0.0542	-0.164
	(0.181)	(0.181)	(0.286)	(0.270)
Constant	60.38	54.11	68.22	60.83
	(92.72)	(54.48)	(47.45)	(45.87)
Observations	335	335	291	311
R-squared	0.006		0.013	0.016
Number of countries	30	30		

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7.6 Results for equation 1 - Marginal effect of a variation in the logarithm of the GDP of trading partners on quantities exported (sample including entering firms only)

	Pooled OLS	FE	RE
	QX	QX	QX
GDP Index	1.121*	1.398**	1.121*
	(0.581)	(0.570)	(0.581)
RER	-0.190	0.457	-0.190
	(0.435)	(0.495)	(0.435)
FTA	0.651***	0.582**	0.651***
	(0.247)	(0.245)	(0.247)
VIX	-0.00768	-0.00748	-0.00768
	(0.0213)	(0.0214)	(0.0213)
dist	-0.000275***		-0.000275***
	(3.68e-05)		(3.68e-05)
ind_conf	-0.0165	-0.0184	-0.0165
	(0.0147)	(0.0148)	(0.0147)
Constant	8.258**	1.393	8.258**
	(3.535)	(3.700)	(3.535)
Observations	408	408	408
R-squared		0.025	
Number of countries	30	30	30

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7.7 Results for equation 3 - Marginal effect of a variation in the logarithm of the GDP of trading partners on the probability to exit

	FE	RE	IV (2 year GDP lag)	IV (1 year GDP lead)
	P(exit)	P(exit)	P(exit)	P(exit)
GDP Index	-3.823	-4.264	-2.090	-5.327
	(11.15)	(8.335)	(7.072)	(6.749)
RER	8.524	6.907	7.513	8.222
	(12.08)	(6.716)	(5.528)	(5.609)
FTA	0.964	0.957	2.447	-0.731
	(4.848)	(4.238)	(4.492)	(4.389)
VIX	-0.144	-0.101	-0.0800	0.127
	(0.270)	(0.272)	(0.330)	(0.334)
dist		0.000309	0.000253	0.000302
		(0.000454)	(0.000308)	(0.000291)
ind_conf	-0.0489	0.0167	0.0542	0.164
	(0.181)	(0.181)	(0.286)	(0.270)
Constant	39.62	45.89	31.78	39.17
	(92.72)	(54.48)	(47.45)	(45.87)
Observations	335	335	291	311
R-squared	0.006		0.013	0.016
Number of countries	30	30		

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7.8 Results for equation 4 - Marginal effect of a variation in the logarithm of the GDP of trading partners on the probability to entry

	FE	RE
	P(entry)	P(entry)
GDP Index	3.632	2.697
	(2.692)	(1.731)
RER	0.0997	0.678
	(2.864)	(1.311)
FTA	-3.399	-1.217
	(2.856)	(1.460)
VIX	0.0452	0.0523
	(0.0796)	(0.0792)
dist		-7.82e-05
		(8.96e-05)
ind_conf	0.0539	0.0571
	(0.0633)	(0.0647)
Constant	-11.16	-9.082
	(20.56)	(9.128)
Observations	420	420
R-squared	0.020	
Number of countries	30	30

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7.9 Results for equation 5 - Marginal effect of a variation in the logarithm of the GDP of trading partners on quantities exported per sector

	FE	RE
GDP Index	1.206***	1.073***
	(0.344)	(0.337)
RER	0.536*	0.297*
	(0.285)	(0.171)
TLC	0.084	0.122
	(0.229)	(0.114)
VIX	-0.007	-0.007
	(0.006)	(0.006)
Dist	0.000	-0.000***
	(0.000)	(0.000)
Ind_conf	-0.005	-0.004
	(0.005)	(0.005)
$I(sector = 2) \times GDP$	1.684*	1.681***
	(0.885)	(0.473)
$I(sector = 3) \times GDP$	3.583***	3.873***
	(1.334)	(0.564)
$I(sector = 4) \times GDP$	0.408	0.509
	(0.535)	(0.471)
$I(sector = 5) \times GDP$	-0.362	-0.290
	(0.599)	(0.471)
$I(sector = 6) \times GDP$	0.570	0.635
	(0.469)	(0.471)
Observations	2,319	2,319
R-squared	0.448	
Number of countries and sectors	180	180

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1