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(*) The opinions and analyses are the responsibility of the authors and, therefore, do not necessarily coincide with those of the Banco de España or the Eurosystem.

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Abstract

This paper investigates the impact of trade protectionism in the form of tariff barriers on Spanish goods exports. The Spanish economy has signicantly increased its degree of openness, which improves potential economic growth, but also implies a higher exposure to the protectionist shift in the international environment observed in the last years. With the purpose of assessing exports sensitivity to tariff increases, we obtain a database combining annual tariffs applied to Spanish products over the years 1995-2019 from WITS and bilateral extra-EU Spanish goods exports from Eurostat, with a product disaggregation level at 6 digits. We estimate the effect of tariffs both on exporting probability (i.e. exports extensive margin) through a linear probability model and exports levels (i.e. exports intensive margin) through a gravity equation. The findings of this paper show that higher tariffs reduce exports levels through extensive an intensive margins. A 1% tariff increase reduces on average the probability of exporting to aspecic market by nearly 0.08 pp. and exported values by around 1%.

Keywords: protectionism, exports, tariffs.

JEL classification: E43, F41, N10, N30, N40.

Resumen

En este artículo se lleva a cabo una estimación del efecto de los aranceles sobre las exportaciones de bienes españolas. El notable incremento del grado de apertura de la economía española ha aumentado su crecimiento potencial, aunque también supone una mayor exposición al giro proteccionista acaecido en los últimos años. Con la finalidad de evaluar la elasticidad de las exportaciones nominales ante variaciones arancelarias, se construye una base de datos anual con desagregación por productos a 6 dígitos que contiene información procedente de WITS sobre aranceles soportados por los productos españoles en cada país entre 1995-2019 y de exportaciones de bienes extracomunitarias publicadas por Eurostat. Los resultados muestran que un incremento de los aranceles afecta negativamente tanto a las posibilidades de exportación como, de manera persistente, a los valores exportados. De acuerdo con las estimaciones realizadas, un aumento del 1 % de los aranceles a la importación impuestos por otro país para un producto español implica una caída de la probabilidad de exportar a ese mercado de 0,08 puntos porcentuales y una reducción de las exportaciones nominales de alrededor del 1 %.

Palabras clave: proteccionismo, exportaciones, aranceles.

Códigos JEL: F10, F13, F14.

1 Introduction

This paper investigates the impact of trade protectionism in the form of tariff barriers on Spanish goods exports using data for the period 1995-2019. The positive effects of trade liberalization on international trade have been widely studied in the literature (Cheong et al., 2018). In fact, during the period analysed in this paper, global tariffs have decreased significantly to reach historically low levels, contributing to international trade expansion. But protectionist actions have intensified during the Trump administration, whose political agenda promoted trade barriers, particularly against China, in order to reverse the US bilateral trade deficit against this country and to promote the domestic industry (Evenett, 2019).

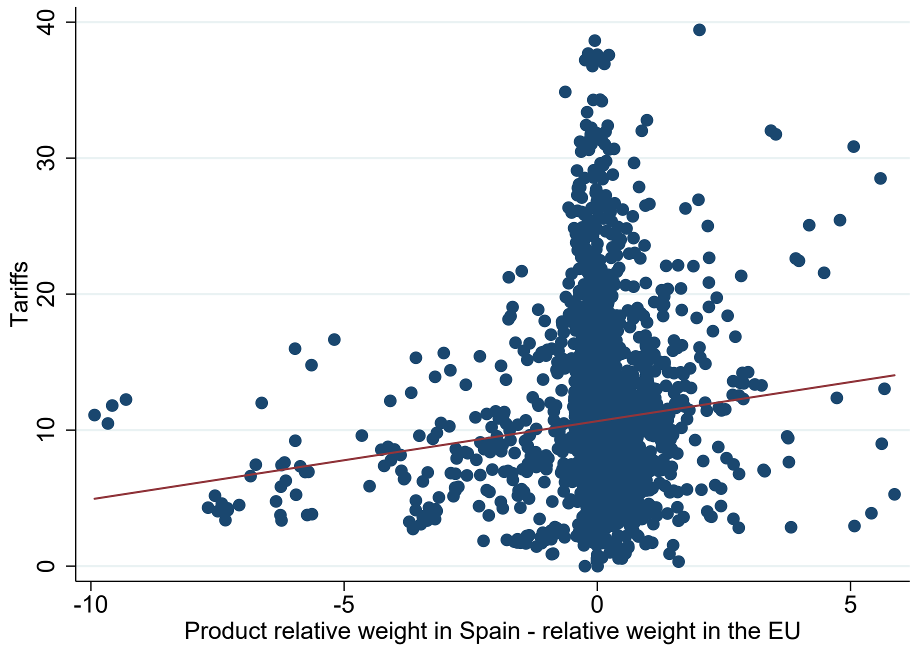
Specifically, Spain has benefited from a substantial tariff decrease since 1995, with tariffs dropping by 9 pp. This decline, mainly concentrated until 2007, has been more marked than that undergone by tariffs applied to global trade and to the EU (4 pp. and 5 pp. until 2018, respectively). However, the tariff applied to Spanish goods exports is still somewhat higher than the tariff applied to the EU (4.4% and 3.6%, respectively), since the composition of Spanish exports is skewed towards products with higher tariffs, like agricultural products and textiles (Figure 1).

The decrease observed in tariff levels, together with the advances in the European economic integration process, competitiveness gains accumulated since the 2008 crisis and the expansion in the number of goods exporting firms, have fostered an appreciable increase in the degree of openness of the Spanish economy. This process has been reflected in the rise of the relative weight of goods exports in the economy, which has increased by 9 pp. since 1995, reaching 24% of GDP. This higher openness improves potential economic growth, but also implies a higher exposure to a protectionist shift in the international environment. However, this vulnerability is partially offset as a result of the high relative weight of the EU in Spanish exports of goods (60%). Consequently, the effects of protectionist tensions in the last years on Spanish goods exports have so far been relatively modest. Protectionist policies affecting Spain have been implemented mainly through non-tariff measures, which have rather outnumbered tariff increases. Nevertheless, a limited share of Spanish exports has been directly affected by tariffs increases applied by Trump government. In October 2019, the US administration imposed a 25% and a 10% tariff for a year on a range of agricultural products (olives, wine, olive oil and cheese) and civilian aircraft that account in total for only 0.3% of Spanish goods exports.[1] The new Biden administration has removed recently this tariff increase. Another channel of impact is through tariffs imposed by the US on China, which indirectly affect Spanish exports via the global value chains. This impact is modest, as the exposure of the Spanish economy to China continues to be reduced even when global value chains are incorporated. Specifically, the Spanish value-added content in Chinese exports to the US is below 0.1% of GDP.

[1]The specific impact of these protectionist measures in the affected sectors is more significant, since US accounts for around 6.5% of the exports of these sectors.

Figure 1

Difference in the relative weight of product-disaggregated exports between Spain and the EU, and tariffs applied



Source: Own calculations, Eurostat and WITS.

In any case, it is very relevant to analyse the sensitivity of goods exports to tariff increases using specific data for Spain since the impact of tariff measures in a country may potentially depend on the product structure of exports and its sensitivity to price changes.

In order to assess exports elasticity to tariff changes, we combine annual tariff measures at the product-destination level over the years 1995-2019 from the WITS database with product-destination annual information on Spanish extra-EU goods exports, both in real and nominal terms, from Eurostat with 6-digit level disaggregation. Using a long time sample allows to obtain an average elasticity and to assess the reaction of Spanish exports to foreign tariffs changes between 1995 and 2019. We estimate the effect of tariffs on both exporting probability (i.e. exports extensive margin) by a linear probability model and exports levels (i.e. exports intensive margin). In the second case, we regress exports on tariffs levels by product-destination pairs, using a standard gravity equation, which allows the introduction of tariff barriers as exports transaction costs. Also, we decompose this effect in its volume and price components. The effect on the quantities exported can be cushioned if sellers partially reduce their price margins in order to compensate for the increase in tariff barriers. In all these regressions, we introduce a set of fixed and time varying effects by product and destination markets to enhance identification and to control for non-observable variables that explain export behavior. For example, including product-country fixed effects allows comparing exports of the same product to the same country before and after a change in tariffs. Alternatively, with product-year fixed effects, we compare exports of the same product in the same year to countries in which the product is differentially affected by tariffs. It should be noted that the regressions in this article provide a direct and reduced form estimate of the elasticity of exports to tariffs, so that the differential impact of other determinants of bilateral exports (such as distance or market size) cannot be identified, nor do they incorporate trade diversion effects caused by changes in tariff levels.

The findings of this paper show that higher tariffs reduce export levels in line with international empirical evidence (see Berthou and Stumpner (2020)). In terms of the extensive margin, a 1 pp. rise in tariffs decreases the probability of exporting to a specific market by nearly 0.08 pp. on average. Concerning exports levels, a 1 pp. tariff increase reduces exports by, at least, around 1% according to the regressions and this impact is persistent along time. The reduction is concentrated in exports volume, since price adjustment is not statistically significant. The impact of tariffs on real exports is somewhat higher than the long run exports price elasticity estimated with aggregate real goods exports data for the 1995-2013 period. García and Prades (2015) estimated that such elasticity is around 0.7. International empirical evidence on the recent US-China tariff war finds a limited exporters' price adjustment (Amiti et al. (2019), Fajgelbaum et al. (2020) and Berthou and Stumpner (2020)). Disaggregated data at the product level allow obtaining sectoral tariff elasticities, which differ appreciably depending on the characteristics of the industries. Our results are robust to alternative specifications employed in this paper to check the problems that usually affect disaggregated international trade data, in particular the absence of trade relations in some product-destination combinations, known in the literature as zero trade values. These zero trade values may reflect the existence of high tariffs that discourage exports and bias the estimates.

The present paper contributes to a better understanding of the potential effects of protectionism on Spanish international trade. The remainder of the paper is organized as follows. Section 2 describes the data. Section 3 explains the empirical strategy, then in Section 4 we present the baseline results at the product-destination level for extensive and intensive margins, and we also show evidence on the persistence of tariff impact on exporting probability and aggregate nominal exports. Section 5 disentangles the effects of tariffs between quantities and nominal values, and Section 6 disaggregates the results by sector of activity. Thereafter, Section 7 provides robustness checks focusing particularly in the existence of zero bilateral exports flows.

2 Data

This paper employs disaggregated data on Spanish exports by product and country against non-EU countries and the corresponding tariffs applied by such country-product pairs.[2] Specifically, bilateral merchandise exports are disaggregated at 6-digit level according to the Harmonized System nomenclature (HS) for the 1995-2019 period, and obtained from Eurostat.[3] Eurostat provides data

[2] In Customs data, exports are valued in FOB (Free on Board) terms and imports in CIF (Cost, Insurance and Freight) terms. In neither case are tariffs included to calculate the nominal value of trade transactions.

[3] Available at `http://epp.eurostat.ec.europa.eu/newxtweb/`.

of both nominal and quantity exports with a comprehensive coverage. These data are combined with information on tariffs provided by the World Bank at the same product disaggregation level.[4]

The World Bank provides data about the tariffs faced by Spanish exporters, combining information from UNCTAD Trade Analysis Information System (TRAINS), WTO Integrated Database (IDB) and Consolidated Tariff Schedules (CTS) database. Specifically, they provide data on Most Favored Nation and preferential tariffs imposed by each importer for each HS 6 digit product. So, exports and tariff disaggregated data by products are consistent since they are based on HS nomenclature. World Bank statistics are available for more than 160 countries and 5,300 products since 1988.

Thus, for each country member of the WTO, either the Most Favored Nation (MFN) or preferential tariffs are applied.

MFN tariffs are what countries promise to impose on imports from other members of the WTO, unless the country is part of a preferential trade agreement (such as a free trade area or customs union). This means that, in practice, MFN rates are the highest that WTO members charge one another. However, virtually all countries in the world belong to at least one preferential trade agreement, under which they promise to give another country's products preferential tariffs, lower than their MFN rate. In a customs union or a free trade area, the preferential tariff rate is zero on essentially all products.

Regardless the tariff type, each one can take several forms. The most common is an *ad valorem* tariff, which means that the customs duty is calculated as a percentage of the value of the product. But many countries' tariff schedules also include a variety of non *ad valorem* tariffs, which depend on the physical quantity of the good traded. Also, tariff rate quotas are made up of an initially low tariff rate and a high tariff rate on imports entering above that initial amount. World Bank database reports *ad valorem* rates equivalences of *non-ad valorem* tariffs, obtaining effectively applied rates, which are computed on an *ad valorem* basis for all country-product pairs.

Thus, in this paper we use effective tariff rates applied for each product-country pair at a 6-digit HS disaggregation to assess Spanish goods exports elasticity to tariffs increases. Regarding data on tariffs applied to Spanish exports, WITS coverage is not complete along the period 1995-2019, as there are gaps in the tariffs database for some product-country exporting relationships in specific years. In any case, tariff data coverage is reasonably wide, accounting for around 80% of Spanish extra-EU exports for 1995-2019 period.

Table 1 shows some descriptive statistics of this database, which is an unbalanced panel with more than 13 million observations. Average exports to a product destination were around 72 thousand euros with a maximum export to a market of 1,779 million euros, while average tariffs were around 8.6% per product-destination and median tariffs were 5%. Around 30% of tariff changes were protectionist and the rest liberalizing, being the mean reduction of almost 5 pp. and the median around 2.5 pp.

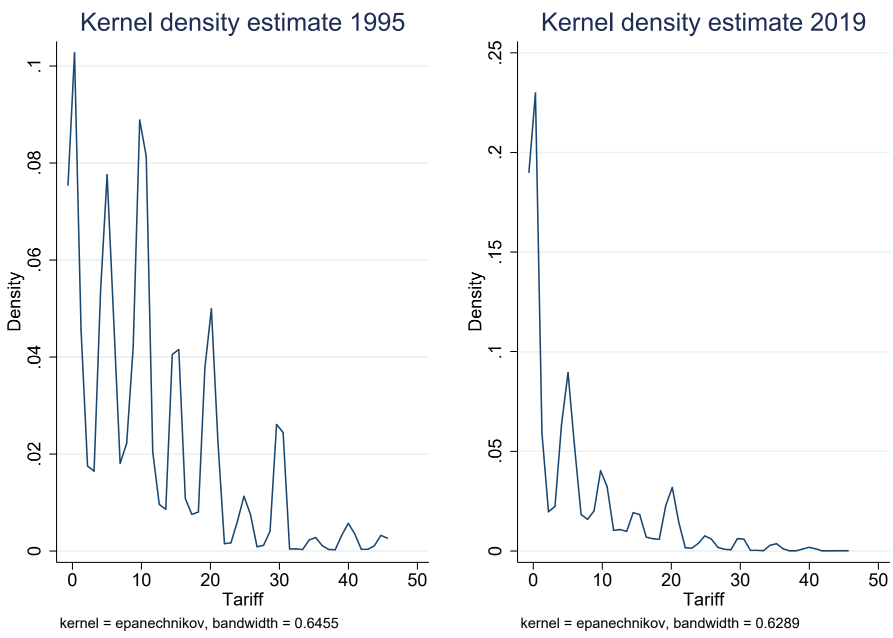
[4]Available at `https://wits.worldbank.org/default.aspx`.

During the 1995-2019 period, effective *ad valorem* applied tariffs have decreased significantly, consolidating previous trade liberalization. This reduction was generalized for all products, as reflected in Figure 2, which shows the distribution of tariffs at the product-country level in 1995 and 2019 in the left and right panels respectively. It can be observed that 2019 tariffs distribution is closer to zero than in 1995.

Table 1
Descriptive Statistics since 1995

	N	mean	sd	min	p50	max
Exports in 1000kg	13,306,002	53.97	4,115.15	0	0.00	2,994,672.25
Exports (thousand €)	13,306,002	71.74	2,353.01	0	0.00	1,778,865.97
Tariff	13,306,002	8.58	9.36	0	5.00	45.00
Tariff increases	372,465	5.76	5.99	0	4.23	45.00
Tariff reductions	992,510	-4.64	5.48	-45.00	-2.50	0.00

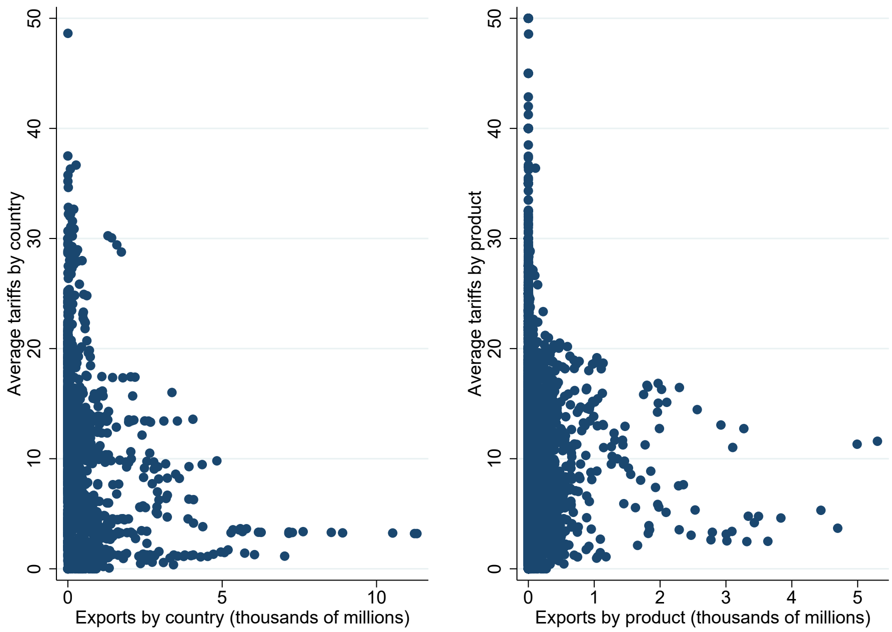
Figure 2
Kdensity Tariffs



Source: Own calculations and WITS. We exclude the percentiles 1 and 99 of the distribution of tariffs.

Figure 3

Exports and Tariffs by country and product



Source: Own calculations, Eurostat and WITS.

3 Empirical approach

This section describes the baseline methodology used to estimate the elasticity of goods exports to tariff changes. In line with the international empirical literature (Yotov et al., 2016), it is based on the conceptual framework provided by the export gravity equation, which is widely used to analyze the determinants of bilateral trade relations between a set of countries. In this sense, gravity equations have been used to estimate the effects of regional integration agreements on exports. In the specific case of Spanish exports, the gravity equation states that bilateral exports between Spain and a country d are proportional to the product of their gross domestic products,[5] but inversely proportional to distance. Distance refers to all the factors that might create trade resistance. Export costs can be classified into several categories: firstly, the bilateral geographical distance, which can be refined taking into account the existence of natural barriers and quality of infrastructure; secondly, trade policy measures that affect transactions, such as the existence of tariffs; and finally, costs associated with cultural or institutional remoteness. Therefore, exports elasticity to tariff changes can be estimated within the framework of gravity equations.

To the extent that we are only interested in identifying the impact of tariff barriers, the remaining determinants traditionally considered in the gravity equations can be subsumed within a broad set

[5]The importing country's GDP reflects its demand for goods and the exporting country's GDP approaches its export supply capacity.

of fixed and time-varying effects by country and product (see, for example, Fajgelbaum et al., 2020). Thus, the gravity equation would be as follows:

$$x_{pdt} = (1 + T_{pdt})^{\beta} \Delta_{pd} Z_{pt} A_{dt} E_{pdt} \tag{1}$$

where x_{pdt} denotes Spanish exports of product p to destination country d at year t. This bilateral flow depends on tariffs T_{pdt} applied by country d to Spanish exports of product p, time invariant characteristics of product-destination combinations (such as distance) captured through a fixed effects matrix (Δ_{pd}), as well as time varying sectoral factors common across regions (e.g. a sectoral productivity shock) and time varying variables related to the destination country (e.g. GDP or bilateral exchange rate) captured with Z_{pt} and A_{dt}. Lastly, the stochastic gravity equation includes a disturbance term statistically independent of the explanatory variables (E_{pdt}).

The set of fixed and time varying effects control for heterogeneities among countries and products both in cross section and time dimensions, and subsume all standard country and product level explanatory variables in gravity equations. Thus, this set of variables avoids endogeneity bias caused by omitted explanatory variables, which would arise if any export determinant omitted from the right hand side was correlated with tariffs. For example, a decrease in international production of a specific product or a consumption shock in the partner country could affect Spanish exports to a market and be correlated with tariffs for a product-country combination. However, note that in our setting these shocks would be captured by the product-time and destination-time fixed effects.[6] This set of controls also captures the potential impact of non-tariff protectionist measures implemented across countries since the 2008 global financial crisis, which according to empirical evidence have reduced global trade medium term growth.

The most prevalent approach to estimate the multiplicative gravity model is to use a log-transformation of the former equation (Krisztin and Fischer, 2015):

$$\ln x_{pdt} = \beta \ln(1 + T_{pdt}) + \delta_{pd} + \zeta_{pt} + \alpha_{dt} + \epsilon_{pdt} \tag{2}$$

This log-transformation allows to estimate the impact of tariffs on established trade relations (intensive margin) by least square (LS) methods, but it does not incorporate the impact on exporting probability, since the log-transformation removes zero trade values. In section 7, the potential biases in LS estimations that could be caused by these zero trade values are discussed and alternative estimation methods that avoid these problems are tested.

On the other hand, as observed in the international empirical evidence, there is a significant proportion of potential product-destination relationships with zero exports in the sample used in

[6] Another potential source of endogeneity is simultaneity bias, and this could happen if tariffs imposed by a country to specific Spanish products depended on exported values by Spain to that economy. In general terms, this bias may not be relevant, since tariffs on Spanish products are common to those applied to the Union as a whole, because Spain is a country member of the EU. Therefore, these tariffs would depend on the aggregate exports of all member countries, and not only on Spain, which constitutes a minor fraction of the total. However, note that for some products (for example for some agricultural goods) Spanish exports represent a significant proportion of total EU exports. In such cases, which anyway suppose a minor fraction of the range of exported products, tariffs imposed on the EU could potentially depend on Spanish exports levels.

this paper (around 85%). This result could be explained by very high tariff levels. In order to assess this possibility, we estimate the impact of tariffs on the probability that exports to specific product-country combination are positive (extensive margin). In any case, the obtained results do not fully identify the impact of tariffs on the number of exporting firms in each sector, as this would require information at the microeconomic level. Consequently, we regress a linear probability model in which the dependent variable is a dummy that takes a value of 1 if positive exports are reported to a product-destination and zero otherwise. It should be noted that the regression on exporting probability includes zero and non-zero trade relationships, which avoids the zero-trade values bias mentioned above for the intensive margin regressions. Explanatory variables for the extensive margin are, like in the gravity equation specification, tariffs and a set of fixed and time varying effects by products and countries that subsume potential explanatory variables different than tariffs in order to avoid omitted variable bias.

4 Main results

4.1 Extensive margin

This section describes the results obtained when estimating the basic specifications mentioned above. Starting with the impact of tariffs on exporting probability (i.e. extensive margin), Table 2 reports the effect of tariffs changes on the extensive margin of exports using different sets of control variables.

This impact is negative and significant across specifications that include different FE and time dummies for taking into account potential biases from omitted variables. So, column (1) includes the most exhaustive set, with product-destination (δ_{pd}), product-time (ζ_{pt}) and destination-time (α_{dt}) FE, column (2) excludes from (1) product-time FE, column (3) includes product-destination and product-time FE, column (4) includes product-time and destination-time FE, and, finally, column (5) identifies the impact of tariffs on exports by including product, destination and time FE separately.

The results obtained show that the impact of tariffs on exporting probability is negative and statistically significant at the 99% confidence level, regardless of the set of control variables used, although the magnitude of this effect changes substantially when the set of control variables used in the estimation varies. According to column (1), that includes the most exhaustive set of controls, a 10 pp. increase in tariffs reduces the probability of exporting by 0.8 pp. Removing different time FE by product or country, which account for transitory shocks in such dimensions, changes the magnitude of the impact on exporting probability. The impact also rises dramatically when the product-destination FE are removed from the regression.[7] Therefore, the probability of exporting depends on the interaction between the structural characteristics of the production sector and the destination market, captured through product-destination FE, as the transitory characteristics of

[7] According to international trade models, a given product will be exported to a specific country when there is a proportion of firms whose productivity exceeds a certain threshold, which depends on transaction costs incurred when operating in the country. These costs are determined by different factors including distance and cultural proximity.

these markets. So, in columns 2-5 a 10 pp. increase in tariffs diminishes exporting probability by almost 2 pp. The magnitude of the effects found in these regressions is lower than the evidence with international data that group emerging and advanced countries, but is relatively similar to the results shown by Cheong et al. (2018) for a subsample of developed countries over 1996-2010 disaggregated at 2-digit manufacturing sector level, who also report a high volatility of the coefficients depending on the set of control variables used.

TABLE 2
TARIFFS AND EXPORTS. EXTENSIVE MARGIN

	(1)	(2)	(3)	(4)	(5)
$\ln(1+T_{pdt})$	-0.0755***	-0.161***	-0.176***	-0.152***	-0.187***
(s.e.)	(0.00367)	(0.00405)	(0.00315)	(0.00311)	(0.00283)
# obs	13,136,371	13,141,157	13,136,372	13,187,845	13,192,409
R2	0.627	0.603	0.616	0.395	0.360
Fixed effects	pd, dt, pt	pd, dt	pd, pt	dt, pt	p, d, t

Notes. Dependent variable is export status. Standard errors are multi-clustered at the product and destination level. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

4.2 Intensive margin

Regarding the impact of tariffs on nominal export values (i.e. intensive margin), we regress equation 2 by LS method. The expected sign of the effect of tariffs on aggregate exports is negative, as a tariff increase implies higher transaction costs. This increase could lead to a rise in prices of affected products, with the consequent loss of price-competitiveness. Like in the linear probability regression of the previous section, we change the FE control set across regressions in order to assess the sensitivity of the results. Columns 1-5 of Table 3 have the same FE controls than the corresponding in Table 2 (see section 4.1).

Baseline gravity regression results also show a negative and statistically significant impact of tariffs on the intensive margin of exports in 1995-2019.[8] The negative sign of the coefficient remains, and also its statistical significance, when the set of control variables is changed. However, the magnitude of the impact of tariffs on exports is, again, sensitive to the FE variables included in each specification. According to column (1), which includes product-country, product-time and country-time FE, a 1 pp. tariff raise is expected to reduce exports by around 0.9%. Removing some FE controls increases exports tariff elasticity. So, when only product-country and country-time FE are included, the induced decrease reaches 1.1% (column 2). The negative effects of tariff increases on exports are even more substantial when country-time or product-country FE are excluded from the

[8]The bulk of the reduction in tariffs applied to Spanish exports observed between 1995 and 2019 was concentrated until 2007, in line with the evolution observed at the global level and in the EU. From 2008 onwards, the downward trend in tariffs is less marked. When the sample is divided into two sub-periods (1995-2007 and 2008-2019), it can be seen that, in the first of them, exports tariff elasticity remains negative and statistically significant, with a magnitude similar to that found for the whole period. However, from 2008 onwards, the coefficients are not significant, in a context of a marked reduction in the world trade growth rate despite the fact that in aggregate terms there has not been an appreciable change in tariffs.

regression,[9] as this elasticity rises to around 2% (columns 3-5). In comparison, recent studies using monthly United States data for 2017-2019 point to an export growth elasticity to tariffs of about 1 (see Berthou and Stumpner (2020) and Fajgelbaum et al. (2020)). Similarly, Fontagné et al. (2018), using French exports data at the product-destination level, estimate that a 1% increase in tariffs reduces exports by 1.2%. Finally, Cheong et al. (2018) find an elasticity of around 2 for 149 countries in 1997-2010, obtaining a higher coefficient for developing economies.

Lastly, it should be taken into account that in baseline regressions of this and next subsection, exports are in logs. Thus, zero values for exports are not included in the regressions and the tariffs coefficient refers to specific country-product combinations in which there is at least one firm already exporting. The potential biases that arise from not taking into account zero trade values are discussed and contrasted in Section 7, which also analyzes the potential endogeneity arising from previous Spanish export levels for a specific product-country combination (see footnote 7).

TABLE 3
TARIFFS AND EXPORTS. INTENSIVE MARGIN

	(1)	(2)	(3)	(4)	(5)
$\ln(1 + T_{pdt})$	-0.864***	-1.102***	-2.225***	-1.959***	-2.165***
(s.e.)	(0.0636)	(0.0712)	(0.0503)	(0.0573)	(0.0482)
# obs	1,962,160	1,973,779	1,962,186	2,050,554	2,059,751
R2	0.713	0.656	0.704	0.460	0.384
Fixed effects	pd, dt, pt	pd, dt	pd, pt	dt, pt	p, d, t

Notes. Dependent variable is ln(exports). Standard errors are multi-clustered at the product and destination level. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

4.3 Lag effects

Tariffs negative impact on exports could remain in the long term, since a tariff raise for a specific product by a country increases transaction costs for exporting firms to that product-country combination. According to micro founded international trade theories (Melitz, 2003), a fraction of less efficient exporters will eventually leave that market, since their costs including tariffs are above the new exports equilibrium price. In consequence, exporters base diminishes, in line with Dutt et al. (2013), who show that the extensive margin decreases with a raise in trade costs. Concerning the intensive margin of exports, increasing tariffs implies a rise in the variable trade costs, leading to a decrease of demand at the new effective price level, reducing firm level exports. However, the exit from the export market of competitors with smaller productivity could augment exports of surviving exporters (Melitz, 2003). Table 4 provides LS estimates for lagged effects on both margins, which are consistent with the channels outlined above. The set of control variables is exhaustive, in order to account for all factors that can potentially affect exports. So, regressions reported in Table 4 include

[9] Country-time dummies have a strong explanatory power on the intensive margin of exports, capturing transitory shocks or international trade explanatory factors that change over time, like economic growth, market size or globalization. Comparatively, starting an export relationship (approximated by the extensive margin) depends relatively more on the productivity of the companies operating in the sector compared to the costs of exporting, which in a relevant proportion relate to persistent characteristics (such as distance and cultural proximity).

product-destination (δ_{pd}), product-time (ζ_{pt}) and destination-time (α_{dt}) FE.

Starting with exporting probability, the contemporaneous effect is higher than the effect of past tariff increases (columns 1-4). While the contemporaneous impact is a decrease in the exporting probability to a specific country-product pair of -0.08 pp., lagged effects remain between -0.06 pp. and -0.08 pp. According to these results, the reduction of the exporters base as a result of an increase in tariffs would be concentrated in the initial stages of its implementation, since the least efficient firms are pushed out of the market. In the case of exported values, the impact is also negative and statistically significant, in line with Baier et al. (2014). Moreover, our estimates show that the effects of an increase in tariffs on aggregate exports are persistent over time: as can be seen in columns 5-8, a 1% tariff increase implies a fall of exported values of 0.9% in the same year, and this magnitude increases when we consider lagged tariff raises between one and three years before. This result suggests that firms scale down swiftly their exports in response to a tariff increase. Moreover, a tariff rise leads to additional nominal exports falls in subsequent periods against a background of worsening price-competitiveness.

These lagged effects of tariff increases point in the same direction as international empirical evidence, which suggests that the impact on the probability of exporting is largely concentrated in the initial periods of implementation of protectionist measures, while the intensive margin is more persistent. When comparing the magnitude of the coefficients with international evidence, it should be borne in mind that the regressions carried out in this paper include the most comprehensive set of fixed effects, which means that exports are less sensitive to tariffs than when fixed effects controlling for importing countries sectoral characteristics are excluded, as noted above in sections 4.1 and 4.2. As shown in the Annex (Table A.1), including current and lagged tariff levels does not change qualitatively the results. We find a reduction of the contemporaneous effect of tariff changes on exported values (i.e. intensive margin), while the impact increases gradually over time as pointed above. With respect to the extensive margin of trade, the overall effect of tariffs remains practically unchanged.

Table 4

Tariffs and exports. Lag Effects

	Extensive Margin				Intensive Margin			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(1+T_{pdt})$	-0.0755***				-0.864***			
(s.e.)	(0.00367)				(0.0636)			
$\ln(1+T_{pdt-1})$		-0.0657***				-1.000***		
(s.e.)		(0.00452)				(0.0688)		
$\ln(1+T_{pdt-2})$			-0.0790***				-0.955***	
(s.e.)			(0.00484)				(0.0707)	
$\ln(1+T_{pdt-3})$				-0.0803***				-0.933***
(s.e.)				(0.00487)				(0.0716)
# obs	13,136,371	10,424,754	9,607,599	9,010,209	1,962,160	1,682,047	1,598,712	1,528,984
R2	0.627	0.638	0.642	0.646	0.713	0.725	0.730	0.736
Fixed effects	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt

Notes. Dependent variable is an export dummy in columns 1-4 and ln(exports) in columns 5-8. Standard errors are multi-clustered at the product and destination level. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

5 Channels

The potential negative effect of higher tariffs on exported real volumes could be partially offset by exporting firms lowering the pre-tariff prices that they charge for these goods. An *ad valorem* tariff on Spanish exports of product p implemented by country d raises the cost of the exported good in the foreign market from price p_0 (before tariff raise) to p_1 (p_1=$p_0(1 + T_{pd})$), if we assume a complete pass-through. As a result, although prices received by exporters do not change (remain at p_0), there is a wedge between the prices charged by domestic producers and the prices paid by foreign consumers. This wedge equals the per-unit tariff being collected by Customs (p_0T_{pd}). We can also use this framework when a pre-existing tariff is augmented. The new market equilibrium price in the foreign country after a tariff raise will depend on the elasticities of supply and demand. For example, when exports are supplied perfectly elastically, prices charged by exporters do not change and, therefore, tariff pass-through is complete. As a result, prices in the foreign market will rise by a magnitude that equals the *ad valorem* tariff increase, as mentioned above. In this case, the fall in real exports volume is higher than in the case of a positive slope supply curve, since then there is an incomplete tariff pass-through to the foreign market, in other words $p_1< p_0(1 + T_{pd})$. Thus, export prices after a tariff increase are below previous prices.

To be more concrete, we can assess the pass-through degree using exports unit values, defined as the ratio between nominal and real exports, as a proxy of prices charged by exporters (Amiti et al., 2019). Unit exports values are an indirect measure of prices received by Spanish exporters and can show if there is a price response due to tariffs changes. So, when exports supply is horizontal, unit values will not change due to a tariff increase, but they will decrease when exports supply slope is positive.

The aim of this section is to explore the degree of tariff pass-through of Spanish exporters during 1995-2019 period. For that purpose, we decompose the tariff impact on nominal exports between quantity and price channels using exports quantities reported also by Eurostat and computing the ratio between nominal and exports quantities as a proxy for bilateral exports unit values at 6-digit level disaggregation. Then, we regress by LS real exports and unit values on tariffs and a set of control variables that includes product-destination (δ_{pd}), product-time (ζ_{pt}) and destination-time (α_{dt}) FE with the aim of avoiding omitted variables bias, like in the previous regressions. We also include lagged tariffs to measure the persistence of tariffs pass-through.

As can be seen in Table 5, tariffs impact is concentrated on exported quantities, since the price adjustment is not statistically significant. Specifically, we see in columns 1-3 that a 10 pp. increase in tariffs leads to a reduction of nominal exports of 9%, with almost an 8% volume reduction. This result is in line with the evidence on 2018 US-China trade war, which points that exports prices had a very limited sensitivity to tariff increases (Amiti et al. (2019), Berthou and Stumpner (2020) and Fajgelbaum et al. (2020)). In addition, the impact of tariffs on real exports is higher than the long run exports price elasticity estimated with aggregate real goods exports data for the 1995-2013 period

(García and Prades, 2015). They found that such elasticity is around 0.7. Concerning persistence, the results show that the impact of tariff lags on volumes and hence on values is persistent over time. These results do not change in a significant way when we include both current and lagged tariff levels (Table A.2).

TABLE 5

TARIFFS AND EXPORTS. CHANNELS

	Tariff			Tariff(t-1)			Tariff(t-2)		
	Value (1)	Volume (2)	Unit Value (3)	Value (4)	Volume (5)	Unit Value (6)	Value (7)	Volume (8)	Unit Value (9)
$\ln(1+T_{pdt})$	-0.864***	-0.785***	0.000904						
(s.e.)	(0.0636)	(0.0712)	(0.0313)						
$\ln(1+T_{pdt-1})$				-1.000***	-0.928***	0.00481			
(s.e.)				(0.0688)	(0.0775)	(0.0346)			
$\ln(1+T_{pdt-2})$							-0.955***	-0.865***	-0.0274
(s.e.)							(0.0707)	(0.0798)	(0.0359)
# obs	1,962,160	1,850,827	1,849,616	1,682,047	1,590,567	1,589,498	1,598,712	1,515,482	1,514,472
R2	0.713	0.772	0.795	0.725	0.780	0.800	0.730	0.782	0.800
Fixed effects	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt

Notes. Dependent variables are in ln terms. Standard errors are multi-clustered at the product and destination level. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

6 Heterogeneity by sector

Although we use exports data disaggregated by products at 6-digit level, the results presented as far are average effects over all products and therefore cannot reveal any potential heterogeneous effects across sectors. For easing the interpretation of results, we aggregate the 5,300 product categories in 8 sectors (food, prepared foodstuff, chemicals, materials, textile, machinery, vehicles and rest). Although tariffs vary significantly across products, as shown in Figure 2, there has been a generalized tariff reduction along the sample period, as described in the introduction of this paper. Once these product groups have been defined, we conduct group-by-group LS estimations of tariff impact on nominal exports, including product-destination (δ_{pd}), product-time (ζ_{pt}) and destination-time (α_{dt}) FE. We can control for FE as the group estimations are still conducted using 6-digit level data. International evidence points to the fact that the impact of a tariff increase can be heterogeneous in terms of the sector. Thus, the potential boost to international trade associated with the adoption of a free trade agreement varies significantly across products.

The estimation results for the intensive margin for each of these 8 groups are presented in Table 6. It can be seen that there is a great heterogeneity across groups. According to the estimates, tariff increases significantly reduce nominal exports for vehicles, food, machinery, chemicals, textiles and materials. Thus, a 1 pp. tariff increase would reduce vehicle exports by 1.4% and those of food, machinery, chemicals, textiles and materials by 1.1%, 0.7%, 0.7%, 0.5% and 0.5%. On the contrary, estimated coefficient for prepared foodstuffs is non-significant, in line with the results obtained by previous papers (Cheong et al., 2018). Thus, the elasticity is highest in the case of the automotive sector, which is structured through large multinational groups, whose location decisions have been, at least partially, conditioned in past decades by tariff policies. Furthermore, the global value chain of this industry is one of the most fragmented, hence making it easier for its enterprises to substitute markets in response to any shock. Overall, we observe acute differences in sectoral responses to trade protectionism. Analyzing the differences between sectors could be of interest to assess the specific impact of protectionism on individual sectors and therefore for future research agenda.

TABLE 6
TARIFFS AND EXPORTS BY SECTOR

	Food (1)	Prep. Food (2)	Chemicals (3)	Materials (4)	Textiles (5)	Machinery (6)	Vehicles (7)	Rest (8)
$\ln(1 + T_{pdt})$	-1.061***	-0.186	-0.651***	-0.450***	-0.529***	-0.736***	-1.390***	-0.265
(s.e.)	(0.271)	(0.359)	(0.242)	(0.137)	(0.159)	(0.163)	(0.430)	(0.221)
# obs	108,905	60,962	256,398	534,557	324,794	443,358	55,015	177,040
R2	0.775	0.756	0.741	0.708	0.747	0.656	0.735	0.698
Fixed effects	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt pt	pd, dt, pt	pd, dt, pt	pd, dt, pt

Notes. Dependent variable is ln(exports). Standard errors are multi-clustered at the product and destination level. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

7 Robustness

Baseline results presented previously are potentially subject to some biases that may affect their reliability. This section describes some robustness checks performed to corroborate the results described above, in particular in Section 4.2.

First of all, baseline intensive margin estimations do not include zero bilateral trade flows, as the logarithm of zero is undefined. Our database contains more than 85% of country-product combinations without exports (zero trade values), in line with international empirical evidence when highly disaggregated data are employed (Helpman et al., 2008). By disregarding countries that do not trade with each other, regressions which do not account for zero trade values exclude important information and generate biased estimates, since zero trade values are not randomly distributed. In fact, they are the consequence of some characteristics of the bilateral trade relationship, like a high level of tariffs that prevents firms from exporting (Santos Silva and Tenreyro, 2006).

Several methods have been suggested to deal with the zero flows problem. One approach modifies the dependent variable adding a small number to accommodate the log transformation (e. g. $\ln(x_{pdt}+1)$). This transformation yields generally inconsistent estimates, depending the severity of such inconsistency on the model and the specific characteristics of the sample used (Raballand, 2003). A solution for this problem is to estimate the gravity model directly from its multiplicative form (as expressed previously in equation 1), which allows zero trade values. The multiplicative gravity relationship can be written as the exponential function of equation 2:

$$exp(\ln x_{pdt}) = exp(\beta \ln(1 + T_{pdt}) + \delta_{pd} + \zeta_{pt} + \alpha_{dt} + \epsilon_{pdt}) \quad (3)$$

The coefficients of specification 3 can be interpreted as elasticities. One way to estimate the multiplicative gravity equation is based on the Poisson probability model specification. Santos Silva and Tenreyro (2006) propose the Poisson pseudo maximum likelihood (PPML) estimator introduced by Gourieroux et al. (1984), since this estimator does not need that the data generating the process is a Poisson function. As a result, a significant number of empirical trade papers have used the PPML estimator (for example, Westerlund and Wilhelmsson (2011) and Timini and Conesa (2018)).

As previously mentioned, another potential source of concern is simultaneity bias, that occurs when the tariffs applied to a specific product depend on the magnitude of imports of that good. In the case of Spain, it is not plausible that this potential bias was relevant, since Spain belongs to a free trade area and participates in the WTO through the EU.

Table 7 tests the robustness of the estimates presented in the previous sections, summarized in column 1. Specifically, column 2 shows the results of the regression using the PPML estimator, column 3 includes the lag of Spanish exports in order to contrast the existence of simultaneity bias, and column 4 excludes countries that joined in the EU during the sample period. In all cases, the regressions incorporate product-destination, product-time and destination-time FE. Using the PPML estimator, tariff coefficient reaches 1.3 and remains statistically significantly, in line with empirical evidence, as described above in the paper. Concerning the simultaneity bias, the estimates remain practically unchanged when we include exports lag in the baseline regression (column 3). In addition, it could be argued that EU countries that became members after 1995 could be biasing our estimates, since the data period used in the paper is 1995-2019. In order to avoid that potential issue, we exclude in column 4 the 13 members that joined in the EU after 1995 from the regressions. Again, estimated coefficients are not altered.

TABLE 7

TARIFFS AND EXPORTS. ROBUSTNESS

	Baseline (1)	P-poisson (2)	Lagged Exports (3)	Exc. EU13 (4)
$\ln(1+T_{pdt})$	-0.864***	-1.252***	-0.714***	-0.858***
(s.e.)	(0.0636)	(0.0659)	(0.209)	(0.0651)
$\ln x_{pdt-1}$			0.255***	
(s.e.)			(0.002)	
# obs	1,962,160	5,166,376	1,229,356	1,890,675
R2	0.713		0.712	0.652
Fixed effects	pd, pt, dt	pd, pt, dt	pd, pt, dt	pd, pt, dt

Notes. Dependent variables are in ln terms in columns 1,3 and 4; and in levels in column 2. Standard errors are multi-clustered at the product and destination level. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

8 Concluding remarks

The trade agenda of Trump administration implied an increase of protectionist concerns. Spanish exports were affected very moderately, both directly by the tariff increases imposed by the US and also indirectly by the effects through global value chains of the tariffs imposed by the US on Chinese exports. Nevertheless, it is necessary to analyse the sensitivity of Spanish exports to eventual tariff increases, due to hypothetical increases in tariffs on EU products in a context of higher trade policy uncertainty.

This paper provides evidence that tariffs rises persistently reduce Spanish goods sales abroad. For that purpose, we combine tariff and Spanish extra-EU goods exports data at the product-country level over the years 1995-2019. The paper uses tariffs and exports data disaggregated at 6-digit level. A set of fixed and time varying dummies for each product and country control for non-observable variables. Thus, the regressions in this article provide a direct and reduced form estimate of the elasticity of exports to tariffs, so that the differential impact of other determinants of bilateral exports (such as distance or market size) cannot be identified, nor do they explicitly incorporate trade diversion effects caused by changes in tariff levels. According to our results, tariffs affect negatively both exporting probability (i.e. extensive margin) and exports values (i.e. intensive margin). Results show that a 1% tariff increase leads to, at least, a 1% fall in exports levels. This negative impact is concentrated on export quantities. Exports sensitivity to tariff increases varies across products, depending on the characteristics of each industry. The results shown in this paper are robust once potential biases that usually affect disaggregated international trade data are taken into account, in particular the absence of trade relations in some product-destination combinations, known in the literature as zero trade values. These zero trade values may reflect the existence of high tariffs that discourage exports and could bias the estimates.

The findings obtained underline that the Spanish export sector, which has been a crucial growth lever during the last expansionary phase and has made it possible to reconcile sustained growth with the correction of the external imbalance, can face up persistent potential losses in the event of protectionist measures.

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A Additional results

Table A.1
Tariffs and exports. Lag Effects

	Extensive Margin				Intensive Margin			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(1 + T_{pdt})$	-0.0755***	-0.0495***	-0.0446***	-0.0476***	-0.864***	-0.424***	-0.314***	-0.273***
(s.e.)	(0.00367)	(0.00481)	(0.00594)	(0.00702)	(0.0636)	(0.0754)	(0.0846)	(0.0918)
$\ln(1 + T_{pdt-1})$		-0.0343***	-0.0178***	-0.0184***		-0.718***	-0.408***	-0.432***
(s.e.)		(0.00451)	(0.00572)	(0.00674)		(0.0718)	(0.0853)	(0.0949)
$\ln(1 + T_{pdt-2})$			-0.0494***	-0.0186***			-0.605***	-0.402***
(s.e.)			(0.00531)	(0.00650)			(0.0783)	(0.0905)
$\ln(1 + T_{pdt-3})$				-0.0551***				-0.473***
(s.e.)				(0.00607)				(0.0853)
# obs	13,136,371	10,424,754	8,702,546	7,345,320	1,962,160	1,682,047	1,484,376	1,318,555
R2	0.627	0.639	0.648	0.655	0.713	0.725	0.736	0.747
Fixed effects	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt

Notes. Dependent variable is an export dummy in columns 1-4 and ln(exports) in columns 5-8. Standard errors are multi-clustered at the product and destination level. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Table A.2
Tariffs and exports. Channels

	Tariff			Tariff(t-1)			Tariff(t-2)		
	Value (1)	Volume (2)	Unit Value (3)	Value (4)	Volume (5)	Unit Value (6)	Value (7)	Volume (8)	Unit Value (9)
$\ln(1 + T_{pdt})$	-0.864***	-0.785***	0.000904	-0.424***	-0.335***	0.0302	-0.314***	-0.297***	0.0750
(s.e.)	(0.0636)	(0.0712)	(0.0313)	(0.0754)	(0.0848)	(0.0419)	(0.0846)	(0.0954)	(0.0479)
$\ln(1 + T_{pdt-1})$				-0.718***	-0.706***	-0.0152	-0.408***	-0.338***	-0.0198
				(0.0718)	(0.0806)	(0.0398)	(0.0853)	(0.0955)	(0.0499)
$\ln(1 + T_{pdt-2})$							-0.605***	-0.575***	-0.0453
(s.e.)							(0.0783)	(0.0877)	(0.0434)
# obs	1,962,160	1,850,827	1,849,616	1,682,047	1,590,567	1,589,498	1,484,376	1,406,029	1,405,081
R2	0.713	0.772	0.795	0.725	0.780	0.800	0.736	0.787	0.804
Fixed effects	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt	pd, dt, pt

Notes. Dependent variables are in ln terms. Standard errors are multi-clustered at the product and destination level. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

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