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# Impact of Covid-19 containment measures on trade☆

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ABSTRACT

Combining Spanish firm-level monthly trade data with country-level Covid-19 containment measures over February–July 2020, we show that the value of exports decreased more in destinations that introduced strict containment measures, whereas the value of imports remained unaffected. Strict containment measures in a partner country increased the probability of a firm ceasing to trade with it. Negative effects were concentrated between March and May 2020. The detrimental effect of containment on exports was larger in destinations where the share of jobs that could be done remotely was low, for goods consumed outside the household, for wholesalers and retailers, and for manufacturers not participating in global value chains.

## 1. Introduction

Owing to the rapid spread and mortality of Covid-19, many countries adopted strict containment measures to protect their populations. Schools and factories were closed, and people were confined at home. The fear of contracting the virus also led many people to voluntarily adopt social distancing measures. The health crisis had a large negative impact on economic activity and international trade flows. The International Monetary Fund reported an 8.4% decrease in global trade volume for 2020, the second largest year-to-year drop of the last decades (IMF, 2021).

This paper analyzes the impact on trade of government-imposed containment measures used to arrest the spread of Covid-19. As the virus propagated from China to the rest of the world, countries adopted protective measures at different points in time. There were also differences in the scope of those measures, their stringency levels, and duration. Those differences enable us to explore whether trade flows decreased more in countries that adopted more stringent containment measures than in those applying softer ones, and whether some containment measures had a stronger negative impact on trade than did others.

We incorporate mandatory and voluntary social distancing measures into a Chaney's (2008) model of international trade with heterogeneous firms and identify the channels through which the Covid-19 crisis may have affected exports and imports at the firm level. The model demonstrates that containment measures may affect the share of income spent in a product, total income,

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trade costs, the overall price index, and the productivity of exporters and importers. The model also shows that containment measures adopted by export-destination countries mostly affect exports through demand channels (i.e., the fall in consumption and investment), while containment measures adopted by import-origin countries affect imports through supply channels (i.e., the disruption in production processes caused by workplace closures).

We derive econometric specifications from the model and test them using Spanish monthly firm-level export and import data disaggregated by product and partner. We examine the impact of containment measures on the value of trade and the probability of ceasing a trade relationship. Furthermore, we analyze whether containment measures affected exports and imports differently to help determine whether the decrease in trade flows was motivated by demand factors or a supply crisis. Finally, we explore whether containment measures had a larger effect on particular countries, goods, and firms. Because containment measures adopted by Spanish trading partners were exogenous to Spanish firms, we can give a causal interpretation to our regression results.

We find that the value of Spanish exports decreased more in destinations that adopted strict containment measures. For example, if the US had adopted the containment measures taken by China in February 2020, a month during which containment measures were very strict in China but light in the US, the value of Spanish firms' exports to the US in that month would have decreased by 9%. Our estimates also show that the value of Spanish exports between February and July 2020 decreased by 8% relative to a situation without the Covid-19 crisis. Up to 88% of the drop in exports was accounted by mandatory measures and about 12% by voluntary social distancing measures. Contrarily, the containment measures adopted by countries where Spanish imports originated had no effect on the value of goods imported by Spanish firms.

We further find that containment measures increased the probability of a firm ceasing to export (import) a product to (from) a country. For example, if the US had adopted the containment measures taken by China in February 2020, the probability of a Spanish firm ceasing to export a product to the US would have increased by 8 percentage points. This represents a 20% increase over the unconditional probability of ceasing an export relationship. The probability of ceasing an import relationship would have increased by 3 percentage points, which represents a 7% increase over the unconditional probability of ceasing an import relationship. The negative effects of containment measures on trade concentrated between March and May 2020.

We also examine whether containment measures had a differential impact by country, type of good, firm economic activity, and firm participation in global value chains (GVC). First, we find that the negative effect of containment measures on exports was attenuated in destinations that could perform a large share of jobs from home. Second, we build a list of goods that are mostly consumed outside the household, which we denote as "outdoor goods". We find that containment measures had a very large negative effect on the value of exports for outdoor goods and no significant effect for the remainder of consumption goods. The probability of a firm ceasing to export a good to a destination that adopted containment measures was three-times larger than if the traded good was consumed outdoors. Contrarily, containment measures adopted by the countries where Spanish imports originated had similar effects on all types of consumption goods. Third, we find that confinement measures had a lower negative impact on the value of exports and on the probability of ceasing an export relationship for manufacturers than wholesalers and retailers. Fourth, among manufacturers, the negative effect was further reduced if the firm participated in GVCs. These results indicate that the stickiness of inter-firm relationships, that tend to be stronger for manufacturers participating in GVCs, made exports more resilient to a health crisis.

Our paper has important implications. Because exports were negatively affected by containment measures, their relaxation should lead to a rise in the value of exports and a recovery of the trade relationships that disappeared during the crisis, as long as the pandemic does not prolong. Contrarily, if containment measures are re-introduced owing to an outburst in the number of infections, trade will be negatively affected again. The apparent mitigation of the negative effects of containment measures on trade from June 2020 onward suggests that firms might have learned how to manage the additional trade costs imposed by the health crisis. We also find that the negative effect of containment measures is larger on exports than on imports, suggesting that a drop in demand, rather than a supply crisis, was the main contributor to the reduction of trade flows. Finally, policy-makers should account for the negative effect of containment measures being heterogeneous across countries, products, and firms.

Our paper relates to the literature that analyzes the impact of Covid-19 on trade.[1] Friedt and Zhang (2020), using Chinese provinces monthly exports data, concluded that production disruption in the countries supplying intermediate inputs to Chinese exporters was the most important explanation for the drop in Chinese imports during the pandemic. Meier and Pinto (2020) found that during March and April of 2020 imports from China decreased more in US industries that were more exposed to Chinese inputs before Covid-19. They attributed this decline to disruptions in the supply chain. Bonadio et al. (2020) showed that disruptions to global value chains could explain one-third of the Covid-19-induced slump. Demir and Javorcik (2020) found that export transactions backed by letters of credit and documentary collection were more resilient to the Covid-19 crisis than were those using open accounts or cash in advance. Vidya and Prabheesh (2020) found that trade interconnectedness among countries fell drastically after the Covid-19 outbreak. Using data aggregated by product-group and partner, Büchel et al. (2020) conclude that Swiss exports were negatively correlated with trading partners' Covid-19 infection rates and uncorrelated with the stringency index of their containment measures. Contrarily, Swiss imports were negatively correlated with the intensity of trading partners' compulsory and voluntary social-distancing measures. Similar to our paper, Liu et al. (2021) find that demand factors and government-imposed containment measures were more important than supply factors and voluntary measures in explaining the trade-reduction effect of Covid-19. We contribute to this literature by estimating the effect of Covid-19 containment measures on trade and doing it using firm-level data, which enables us to control for all firm, product, and month-specific factors that may also correlate with the value of exports

[1] For a survey of the literature on the economic impact of Covid-19 see Padhan and Prabheesh (2021).

and imports. We also augment previous analyses by showing that firms selling to destinations where the share of jobs that could be done at home was large, exporters of non-outdoor goods, and manufacturers participating in GVCs were more resilient to the negative impact of the pandemic on exports.

Our paper also relates to Fernandes and Tang (2020), who used firm-level data to analyze the impact of the 2003 SARS epidemic, an antecedent to Covid-19, on Chinese exports and imports. They found that trade grew less in Chinese regions affected by the epidemic than in unaffected regions. We extend their analysis by exploring the effect of a worldwide epidemic on trade.[2] (Benguria, 2021) finds that the drop in Colombian trade during the Covid-19 crisis was concentrated on the intensive margin. Similar to our results, he concludes that multinational affiliates, which are more likely to participate in GVCs, had a better export performance. Finally, our paper also contributes to the literature analyzing how Covid-19 affects global trade flows (Baldwin & Tomiura, 2020; Felbermayr & Görg, 2020), the interplay between globalization and pandemics (Antràs et al., 2020), and to a wider literature that studies the effect of recessions on trade (Behrens et al., 2013; Bricongne et al., 2012; Chor & Manova, 2012; Eaton et al., 2016; Levchenko et al., 2010).

The remainder of the paper is structured as follows. Section 2 develops the conceptual framework, identifies the channels through which the Covid-19 crisis may have affected trade flows, and derives the econometric specifications. Section 3 introduces the data we use for the empirical analysis and Section 4 presents the regression results. The last section concludes.

## 2. Conceptual framework

To guide our analysis on the effect of the Covid-19 crisis on firms' trade, we use Chaney's (2008) model of international trade with heterogeneous firms. In this model, firms produce horizontally-differentiated varieties within an industry and are heterogeneous in productivity, labor is the only production factor, and the preferences of a representative consumer are given by a constant elasticity of substitution (CES) utility function. A firm will export if it makes profits in the foreign market. This will occur if the firm has a productivity enabling her to generate enough revenue to cover the extra costs of exporting. In that case, industry $k$ exports by firm $i$ to country $j$ in period $t$ will be determined by the following equation:

$$x_{ijkt} = \beta_{jkt} Y_{jt} (P_{jkt})^{\sigma-1} \left( \frac{\sigma}{\sigma - 1} \frac{\tau_{jkt} w_t}{z_{ikt}} \right)^{-\sigma} \tag{1}$$

where $\beta_{jkt}$ is the share of income ($Y_{jt}$) that country $j$ devotes to industry $k$. $P_{jkt}$ is the price index of industry $k$ varieties in country $j$; $\sigma$ is the elasticity of substitution across varieties, which is common across industries; $\tau_{jkt}$ is an iceberg-type trade cost, denoting the units of an industry $k$ variety that should be sent from the country in which firm $i$ is located to country $j$ to ensure that one unit arrives; $w_t$ is the wage that firm $i$ has to pay to its workers; and, $z_{ikt}$ the productivity of firm $i$ in producing industry $k$ goods.

The Covid-19 crisis could have affected firm $i$'s exports to country $j$ through different channels. First, country $j$ could have changed the share of expenditure devoted to industry $k$. For example, stay-at-home restrictions may provoke changes in consumption (e.g., playing golf is forbidden, so golf balls are not purchased). Second, the Covid-19 crisis could have reduced consumption and investment in $j$, generating an economic slump in this country. Third, the Covid-19 crisis could have increased the costs of trading due to a reduction in the availability and frequency of transport means. Fourth, containment measures in the domestic market could have affected firm $i$'s productivity. For example, it could have led to temporary shutdowns of $i$'s production facilities or to operate with fewer workers due to social distancing measures. Productivity could also be affected by a lack of intermediate inputs due to production shutdowns of local and foreign suppliers. The reduction in domestic demand could also have forced firms to leave some productive capacity idle, decreasing productivity. However, if firms previously had capacity limitations to expand their sales abroad, the spare capacity could have reduced the marginal costs of producing for foreign markets and led to an increase in exports (Almunia et al., 2021). Fifth, all the Covid-19-related changes explained above could have altered $k$ varieties' overall price index in $j$.

To capture the changes that the Covid-19 crisis could have introduced in country $j$-related variables ($\beta_{jkt}$, $Y_{jt}$, $P_{jkt}$, and $\tau_{jkt}$), we assume that they are determined by a time-invariant and a Covid-19-related component. We further divide this latter component into government-imposed containment measures ($g$) and voluntary social distancing measures ($\upsilon$). For example, as mentioned previously, during the Covid-19 crisis some countries introduced measures that limited the time for outdoor activities. The government measures could have led to a reduction in the share of income devoted to outdoor goods. However, individuals may have further reduced that share if they voluntarily decided to stay-at-home permanently.

Applying this decomposition to all $j$-related variables, we have:

$$\begin{aligned} \beta_{jkt} &= e^{g1_{jkt} + \upsilon 1_{jkt}} \beta_{jk} \\ Y_{jt} &= e^{g2_{jt} + \upsilon 2_{jt}} Y_j \\ (P_{jkt})^{\sigma-1} &= e^{g3_{jkt} + \upsilon 3_{jkt}} (P_{jk})^{\sigma-1} \\ (\tau_{jkt})^{-\sigma} &= e^{g4_{jkt} + \upsilon 4_{jkt}} (\tau_{jk})^{-\sigma} \end{aligned} \tag{2}$$

Substituting (2) in (1) and taking logs in (1), we get:

$$\ln x_{ijkt} = g_{jkt} + \upsilon_{jkt} + f_{jk} - \sigma \ln \frac{\sigma}{\sigma - 1} - \sigma \ln \left( \frac{w_t}{z_{ikt}} \right) \tag{3}$$

[2] Gu et al. (2020) exploit daily electricity usage data at the firm level to identify the economic activities most negatively affected by the Covid-19 pandemic in China.

where,

$$\begin{aligned} g_{jkt} &= g1_{jkt} + g2_{jt} + g3_{jkt} + g4_{jkt} \\ \upsilon_{jkt} &= \upsilon1_{jkt} + \upsilon2_{jt} + \upsilon3_{jkt} + \upsilon4_{jkt} \\ f_{jk} &= \ln \beta_{jk} + \ln Y_j + (\sigma - 1)\ln P_{jk} - \sigma \ln \tau_{jk} \end{aligned} \quad (4)$$

Note that $g_{jkt}$ and $\upsilon_{jkt}$ capture the net effect of containment measures and voluntary social distancing measures on the value of $i$ exports to $j$, respectively. On the other hand, $f_{jk}$ captures the net effect of the time-invariant components on the value of $i$ exports to $j$.

We also explore the effect of the Covid-19 crisis on the probability that a firm ceases to export an industry $k$ variety to $j$. A firm will stop exporting ($Exit_{ijkt} = 1$) if its productivity drops below the minimum productivity required to get profits in $j$ ($\underline{z}_{ijk}$)

$$Exit_{ijkt} = \begin{cases} 1 \text{ if } z_{ikt} < \underline{z}_{ijk} \\ 0 \text{ otherwise,} \end{cases} \quad (5)$$

where,

$$\underline{z}_{ijkt} = \left( \frac{F_{jkt}}{\lambda \beta_{jkt} Y_{jt}} \right)^{(1/\sigma-1)} \left( \frac{w_t \tau_{jkt}}{P_{jkt}} \right) \quad (6)$$

where $\lambda = (\sigma-1)^{\sigma-1}\sigma^{-\sigma}$. Note that Eq. (6) incorporates a new variable, $F_{jkt}$, which denotes the fixed costs of exporting to $j$.

As for the intensive margin of exports, we decompose the $j$-related variables into a Covid-19 and a time-invariant component. We further decompose the Covid-19 component into containment measures and voluntary social distancing measures.

We also use Chaney's (2008) model to guide our analysis on the effect that the Covid-19-crisis had on firm-level imports. Appendix B explains how we derive the regression equations for the value of imports and the termination of an import relationship. A key point of this analysis is that the $g_{jkt}$ and $\upsilon_{jkt}$ variables in imports only comprise the effect of the Covid-19-crisis on $p_{jkt}$ and $\tau_{jkt}$. These latter variables are related to supply conditions in the trading partner. Contrarily, for exports, the $g_{jkt}$ and $\upsilon_{jkt}$ variables comprised the share of income that $j$ devotes to industry $k$ varieties, its total income, price index, and trade costs. These variables are mostly related to demand conditions in the trading partner. We will take advantage of these differences to make inferences on the relative contributions of supply and demand variables to the changes in trade provoked by the Covid-19 crisis. Specifically, if the point value of the $g_{jkt}$ and $\upsilon_{jkt}$ variables' coefficients are higher for imports than exports, it will indicate that supply factors are more important than demand factors in explaining changes in trade. Contrarily, if the point value of the estimated coefficients are larger for exports than imports, it will indicate than demand factors are more important than supply factors in explaining changes in trade.

## 3. Data

Our empirical analysis combines a firm-level trade database, a country-level containment measure database, and a list of goods that were mostly consumed outside the household.

*A. Firm-level trade data*

Monthly data on Spanish trade in goods were from the Customs and Excise Department of the Spanish Tax Agency and included the universe of Spanish exporters and importers. The dataset contained a firm identifier, export destination or import origin, the product's combined-nomenclature eight-digit classification, the value of the flow, and the traded quantities.[3] These destinations accounted for 95% and 97% of the value of Spanish exports and imports, respectively. We also removed Andorra and Gibraltar from the list of destinations, because owing to their locations, trade with those territories was similar to domestic sales for Spanish firms.

In January 2020 there was only one country (i.e., China) that reported Covid-19-related deaths. There were another 17 countries that also reported Covid-19 cases, but the number of infected individuals was very small. Since most governments began to implement COVID stringency measures at the end of January and there is missing data on the number of Covid-19-related infection cases and deaths for the first weeks of this month, we start our analysis in February. Our sample ends in July 2020, the latest month available in our database when writing this study. Our identification strategy demanded a sample of firms that traded a product with at least two partners in a month. These firms accounted for 81% and 61% of the Spanish exports and imports, respectively, during the February–July 2020 period. Table A.1 in the Appendix provides summary statistics for our trade data. The number of exporters and importers included in the sample was 19,109 and 18,370, respectively. The median firm exported to six destinations and imported from three different countries. The median exporter and importer only traded one good. The median firm exported and imported 14,389 and 17,637 euros, respectively, of a product with a partner in a given month.

*B. Containment measures and new Covid-19 cases*

[3] We excluded trade transactions having values lower than 1,500 euros. To match the firm-level trade data with the list of outdoor consumption goods, we collapsed the former at the harmonized system (HS) six-digit classification. To avoid the effect of outliers, we restricted the sample to the top-80 destinations (origins) of Spanish exports (imports) in 2019, although the final sample was reduced to 79 export destinations and 78 import origins due to the lack of containment measures data for some countries.

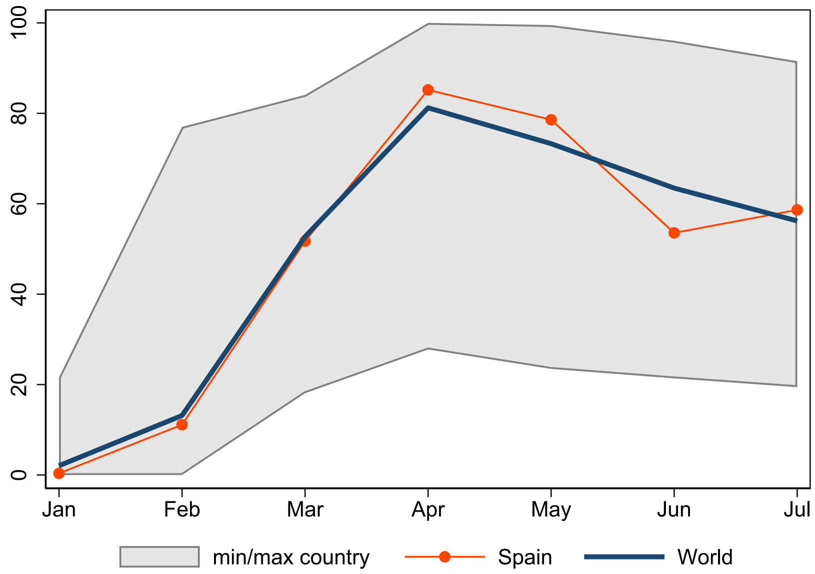


**Fig. 1.** Stringency index. Note: The monthly stringency index is the simple average of daily values. Authors' own elaboration based on Hale et al. (2021).

International data on confinement and closure indicators of government response to Covid-19 and number of individuals infected by Covid-19 came from Hale et al. (2021). We used the daily information of eight specific containment measures and an overall stringency index. The containment measures included school closings, workplace closings, canceled public events, restrictions on gatherings, closed public transports, stay-at-home requirements, restrictions on internal movements, and international travel controls. The overall stringency index was calculated as an average of containment measures' stringency level as well as one health policy indicator (i.e., public information campaigns). The value of the index was the average of the nine indicators and took a value between 0 and 100. We used monthly averages of the containment measures in concordance with the frequency of our trade data. The number of new Covid-19 cases was the monthly average of the per-capita daily number of new individuals that contracted Covid-19. Results were robust to measuring variables at the first day of the month.

Fig. 1 describes the evolution of the overall stringency index in the world from January to July 2020.[4] The index was constructed as a weighted average of the top-80 trading partners of Spain in 2019. In January, the toughness of the restrictions on personal mobility was almost zero on average. However, some countries (e.g., China) had already implemented restraint measures. In April, Spain and its trading partners implemented severe restraints to people's mobility, and the world stringency index reached its maximum. Nonetheless, the strictness of the confinement and closure measures exhibited a huge variation across trading partners.[5] Taiwan, Japan, and Sweden had light containment measures, whereas The Philippines, India, and Serbia had very strict ones. From May to July 2020, the restrictions affecting people's mobility were relaxed gradually, although the overall stringency indicator remained very high and the variation in the stringency measures across trading partners remained large.

Panel (a) of Fig. 2 shows the correlation between the year-to-year growth rate of Spanish exports, the stringency index and new Covid-19 cases in the destination of Spanish exports.[6] Year-to-year growth is the change in the export value between a month in 2020 and the same month in 2019. The stringency index (number of new cases) is the average of the stringency indices (number of new cases) of the destination of Spanish exports, weighted by the share of each destination in Spanish exports in 2019. We transformed the stringency index into a negative number, so than an increase in stringency and a decrease in exports growth would follow the same direction in the graph. We transformed the number of new cases into an index, where the minimum was zero and the maximum 100. Next, we multiplied the index by (−1), so an increase in the number of new Covid-19 cases would follow the same direction as a decrease in trade.

Although the first news about Covid-19 appeared in January 2020, and some Spanish exports' destinations had already begun to adopt containment measures by then, exports grew in January and February relative to the same months in 2019. From March 2020 onward, there was a correlation between the stringency index, the number of new cases, and the drop in Spanish exports. Imports were lower in January, but higher in February, relative to 2019 (Panel (b) of Fig. 2). From March 2020 onward, the evolution of imports correlated with the stringency index and the number of new cases in the origin of Spanish imports. However, the correlation was weaker than in exports.

[4] Interested readers can visit Our World in Data website to see the evolution on the stringency index in a world map.

[5] Table A.2 in the Appendix presents the value of the stringency index for the five countries having the strictest containment measures and the five countries having the least strict containment measures in each month over the January–July period.

[6] Hale et al. (2021) examined correlations between the stringency index and new Covid-19 cases country by country.

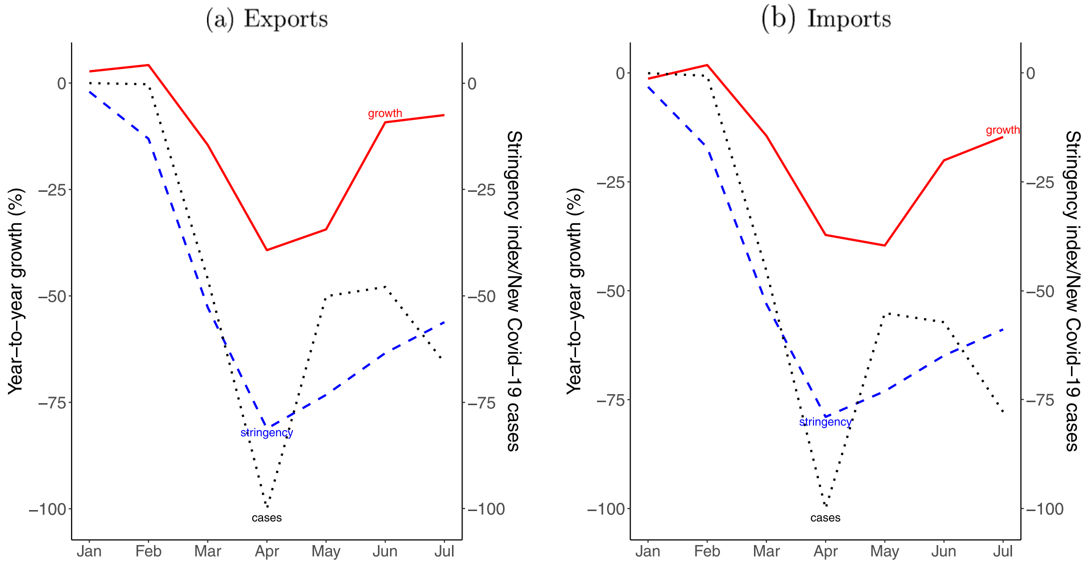


**Fig. 2.** Correlation between the year-to-year growth in trade, the stringency index of containment measures, and new Covid-19 cases.
Note: The year-to-year growth is the relative change in the trade between a month in 2020 and the same month in 2019. The stringency index for exports was calculated as the average stringency index of Spanish export destinations, weighted by the share of each destination in Spanish exports in 2019. The stringency index for imports was calculated as the average stringency index of Spanish import origins, weighted by the share of each origin in Spanish imports in 2019. New Covid-19 cases is the monthly average of the per-capita daily number of new individuals that contracted Covid-19. It is calculated as the average of cases in Spanish trading partners weighted by the share of each partner in Spanish trade. We calculate one average for exports and another for imports. We transformed the number of new cases into an index, where the maximum was −100.

Panel (a) of Fig. 2 suggests that the strict containment measures adopted by the destinations of Spanish exports reduced the economic activity in those countries, negatively affecting the demand for Spanish goods. However, the reduction in economic activity could also be explained by voluntary social distancing measures adopted by the population in response to the increase of Covid-19 cases. Panel (b) suggests that stricter compulsory and voluntary social distancing measures at the origins of Spanish imports led to a reduction in their supply capacity, which translated into fewer Spanish imports from those countries. However, looking at Fig. 1, we can see that the evolution of the stringency index in Spain was very similar to the world average. Therefore, it is possible that strict containment measures in Spain precluded firms from supplying their foreign customers. On the other hand, the reduction in demand in Spain, rather than supply-capacity problems in foreign countries, could explain the decrease in imports. The regression equations explained in the next section enable us to control for these confounding factors and estimate the causal effect that containment measures had on Spanish firms' trade flows.

*C. List of outdoor consumption goods*

We are interested in measuring the heterogeneous impact on trade of containment measures by type of products, particularly on goods consumed outdoor. For that purpose, we elaborated a list of "outdoor" consumption products. Our criterion for classifying a product as "outdoor" was whether it is mostly consumed outside the household. For example, ski-boots are consumed outside the household. Thus, we included them in the list of outdoor goods. Contrarily, slippers are mostly consumed inside the household. Thus, we excluded them from the list of outdoor goods. We focused on consumption goods, because they enabled us to determine, in a relatively straightforward way, whether they were mostly consumed outdoors. We selected categories that were classified as consumption goods in the Classification of Broad Economic Categories (BEC) Revision 4.[7] These included BEC-112: Food and beverages, primary, mainly for household consumption; BEC-122: Food and beverages, processed, mainly for household consumption; BEC-522: Other non-industrial transport equipment; and BEC-6: Consumer goods not elsewhere specified. We matched the BEC codes with the 2017 HS six-digit product classification codes using the United Nation's correspondence table to link the list of outdoor goods with firm-level trade data.[8]

To determine whether food and beverages were outdoor goods, we used the Annual Food Consumption Report published by the Spanish Ministry of Agriculture, Fishery, and Feeding (Ministerio de Agricultura, Pesca y Alimentación, 2020). For a wide range of food and beverages, the report provided the per-capita consumption inside and outside the household. We classified a foodstuff or beverage as "outdoor" if the per capita consumption outside the household was greater than in the household. According to this criterion, all foods were indoor consumption goods, whereas all beverages, except for wine, were outdoor consumption goods. It is

[7] BEC Rev. 4 classification, which includes the correspondence with the basic class of goods, can be downloaded from https://ec.europa.eu/eurostat/ramon/other_documents/bec/BEC_Rev_4.pdf.

[8] The correspondence table can be downloaded at https://unstats.un.org/unsd/trade/classifications/correspondence-tables.aspURL.

important to note that this classification has limitations, because it is based on Spanish households' consumption habits, which may differ from those in other countries.

For the remaining consumption goods, first, we classified as "non-outdoor" the products whose description included the term "household" (e.g., HS-691190; Household and toilet articles of porcelain or china). Second, we listed all non-industrial transport equipment as "outdoor". This category included motorcycles, bicycles, yachts, and other vessels for pleasure or sport. In the broad category of "other consumer goods" (BEC-6), third, we classified the wear of apparel as "outdoor" except for some specific products, such as nightdresses or pajamas, which are mainly consumed inside the household. We further classified footwear, jewelry, cosmetics, and most of sport equipment as "outdoor". For the remaining products, we analyzed them one-by-one to determine their status. For example, we classified binoculars, suitcases, sunglasses, or camping goods as "outdoor" whereas we excluded carpets, cooking appliances, and washing machines from the list of outdoor goods.[9]

## 4. Regression results

We divide this section in four parts. First, we explain the specifications used in the empirical analyses. Second, we present the estimations of the Covid-19 crisis on the value of exports and imports and the probability of terminating a trade relationship. Third, we show the month-by-month effects of containment measures on trade. Fourth, we explore whether containment measures had a heterogeneous impact by country, type of good, firm economic activity, and firm participation in GVCs.

### 4.1. Specifications

To estimate Eq. (3), we proxy containment measures by an stringency index of the containment measures taken by governments ($Containment_{jt}$). Similar to IMF (2020), we assume that voluntary social distancing measures will be larger the greater the number of new per-capita Covid-19 cases ($Cases_{jt}$). The permanent term $f_{jk}$ is captured by a country × product fixed effect ($\gamma_{jk}$). The $\sigma \ln \frac{\sigma}{\sigma-1}$ term is captured by a constant term ($\mu$). Finally, the $\sigma \ln(\frac{w_t}{z_{ikt}})$ term is captured by a firm × product × period fixed effect ($\gamma_{ikt}$),

$$\ln x_{ijkt} = \mu + \alpha Containment_{jt} + \beta Cases_{jt} + \gamma_{jk} + \gamma_{ikt} + \epsilon_{ijkt} \tag{7}$$

where $\epsilon_{ijkt}$ is the disturbance term. Note that $Contaiment_{jt}$ and $Cases_{jt}$ are defined at the destination × period level and, therefore, do not vary across industries. Thus, they capture the average effect that containment measures and voluntary social distancing measures in $j$ have on the value of $i$ exports to that country.[10]

Our identification strategy is based on the correlation between the variation of a firm exports of a product in a given period across countries and the differences in the stringency level of the containment measures adopted by those countries. Because the containment measures adopted by foreign governments were exogenous to Spanish exporters, the $\alpha$ coefficient captures the causal effect of containment measures on trade. Likewise, $\beta$ captures the causal effect of voluntary social distancing measures on trade.

To analyze the effect of containment measures on the extensive margin of trade, we use a regression equation that comprises the same independent variables as (7)

$$Exit_{ijkt} = \mu + \alpha Containment_{jt} + \beta Cases_{jt} + \gamma_{jk} + \gamma_{ikt} + \epsilon_{ijkt} \tag{8}$$

where $Exit_{ijkt}$ turns one if firm $i$ ceases to export product $k$ to destination $j$ at month $t$.

### 4.2. Baseline results

Table 1 presents the estimations of the impact of containment measures on trade. We transformed the explanatory variables into standardized scores (with mean zero and standard deviation of one) to compare the magnitude of the coefficients. Panel A presents the estimates when $Cases_{jt}$ is excluded from the regression equation and panel B reports the estimates when it is included. Columns 1 to 4 report the estimates for exports and Columns 5 to 8 for imports.

Containment measures have a significant negative effect on the value exported by Spanish firms (Column 1). The absolute point value of the coefficient is larger in Panel A than in B, indicating that the coefficient estimated in the former was capturing the negative effect that voluntary social distancing measures had on export value. The number of cases also has a negative effect on the value of exports. However, its impact on the value of exports is much smaller than that of containment measures. Specifically, the negative impact of a one-standard-deviation increase in containment measures is three-times larger than that of Covid-19 cases. Columns 2 and 3 decompose the negative impact of containment measures on the value of exports in its quantity and price components.[11] The negative effect concentrates on the quantity of exports.

We use the stringency-index coefficient reported in Column 1 of Panel B to quantify the effects of containment measures on the value of exports. In February 2020, the stringency index in China was 2.3 standard deviations higher than that in the US. If the

[9] The list of all HS 6-digit consumption goods with the outdoor identification can be downloaded from http://paginaspersonales.deusto.es/aminondo/Research.htm.

[10] Notice that our regression estimates the net effect that containment measures and voluntary social distancing measures have on the value of exports and, thus, we cannot disentangle the individual effect of each of the channels identified in Section 2.

[11] Prices are unit values, calculated as the value divided by quantity (kg).

**Table 1**
Impact of Covid-19 containment measures on Spanish trade.

| | Exports | | | | Imports | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Value | (2) Quantity | (3) Price | (4) Exit | (5) Value | (6) Quantity | (7) Price | (8) Exit |
| Panel A | | | | | | | | |
| Stringency index | −0.050*** | −0.049*** | −0.001 | 0.036*** | −0.008 | −0.000 | −0.007 | 0.016*** |
| | (0.012) | (0.013) | (0.003) | (0.005) | (0.011) | (0.015) | (0.007) | (0.003) |
| Observations | 880,273 | 880,273 | 880,273 | 1,099,009 | 474,933 | 474,933 | 474,933 | 652,865 |
| Adj. R-squared | 0.542 | 0.792 | 0.913 | 0.275 | 0.487 | 0.726 | 0.825 | 0.227 |
| Firms | 19,109 | 19,109 | 19,109 | 22,369 | 18,370 | 18370 | 18370 | 22757 |
| Countries | 79 | 79 | 79 | 79 | 78 | 78 | 78 | 78 |
| Products | 3797 | 3797 | 3797 | 3966 | 3721 | 3721 | 3721 | 3966 |
| Panel B | | | | | | | | |
| Stringency index | −0.043*** | −0.042*** | −0.002 | 0.034*** | −0.001 | 0.006 | −0.007 | 0.014*** |
| | (0.013) | (0.014) | (0.003) | (0.005) | (0.013) | (0.017) | (0.007) | (0.004) |
| Cases | −0.014** | −0.016** | 0.002 | 0.002 | −0.019* | −0.018 | −0.001 | 0.006* |
| | (0.007) | (0.007) | (0.002) | (0.002) | (0.010) | (0.012) | (0.005) | (0.003) |
| Observations | 880,273 | 880,273 | 880,273 | 1,099,009 | 474,933 | 474,933 | 474,933 | 652,865 |
| Adj. R-squared | 0.542 | 0.792 | 0.913 | 0.275 | 0.487 | 0.726 | 0.825 | 0.227 |
| Firms | 19,109 | 19,109 | 19,109 | 22,369 | 18,370 | 18,370 | 18,370 | 22,757 |
| Countries | 79 | 79 | 79 | 79 | 78 | 78 | 78 | 78 |
| Products | 3797 | 3797 | 3797 | 3966 | 3721 | 3721 | 3721 | 3966 |

Note: In Columns 1 and 5, the dependent variable is the (log) value of exports and imports, respectively. In Columns 2 and 6, the dependent variable is the (log) quantity of exports and imports, respectively. In Columns 3 and 7, the dependent variable is the (log) price of exports and imports, respectively. In Column 4, the dependent variable turns one if a firm ceases to export a product to a destination in a given month. In Column 8, the dependent variable turns one if a firm ceases to import a product from a destination in a given month. All estimations include a firm × product × month fixed effect, a destination × product fixed effect, and a constant. Standard errors clustered at destination × month level are in parentheses. ***, **, and *: statistically significant at 1%, 5%, and 10%, respectively.

US had adopted the same containment measures as China, the value of Spanish exports to the US in February 2020 would have been 9% lower ((1-(exp(2.3*(−0.043))))*100). We also compute the average increase in the stringency-index and cases during the February–July period, and find that containment measures and voluntary social distancing measures led to an 8% reduction in the value of Spanish exports.[12] 88% of this reduction was accounted by containment measures and 12% by voluntary social distancing measures. Our estimates render a decrease in the value of exports which represents 47% of the actual decrease in the value of exports between February and July 2020 and the same period of 2019 (17.2%).

To estimate the effect of containment measures on exit, we substituted the dependent variable in Eqs. (7) and (A.5), the (log) value of exports or imports, with a dummy variable that turns one if the firm ceased to export (import) a product to (from) a country in a given month. Because the specification had high-dimensional fixed effects, we estimated it with a linear probability model. Column 4 shows that strict containment measures increased the probability that a firm ceased to export a good to a country in a given month. For example, if the US containment measures had been the same as those in China in February 2020, the probability of exit of Spanish firms exporting to the US would have increased by 8 percentage points (2.3*0.034). Because the unconditional probability of exit was 41% in February 2020, this increase represents a 20% growth in the probability of exit.

Column 5 of Table 1 shows that containment measures had no effect on the value of imports. That is, differences in the stringency of the containment measures adopted by countries where Spanish imports originated had no effect on the value imported by a Spanish firm. Containment effects had no effect either on the quantity or price of imports (Columns 6 and 7). However, containment measures increased the probability of a firm ceasing to import a product from a country in a given month (Column 8). Using the same example as before, if the US had adopted in February 2020 the containment measures taken by China, the probability of a Spanish firm ceasing to import a product from the US would have increased by 3 percentage points (2.3 * 0.014). Because the unconditional probability of exit was 40% in February 2020, this increase represents a 7% growth in the probability of exit.

Estimates on the impact of containment measures on imports should be taken with care because imports are recorded when they arrive to the border. Therefore, there may be a synchronization problem between the containment measures and the registration of imports. To test the robustness of our results, we re-estimate the import-related coefficients with a sample composed by European Union (EU) countries only. We expect the synchronization distortion to be smaller among these import origins because all of them are, at maximum, at a five-day lorry distance from Spain. Furthermore, EU countries account for 56% of Spanish imports. As Table A.3 in the Appendix shows, imports values were not affected by containment measures. We do not observe that containment measures reduced the probability of ceasing an import relationship either.

Our estimates indicate that containment measures had a larger negative effect on exports than imports. This result suggests that a reduction in demand caused by a slump in consumption and investment in export destinations, rather than firms' difficulties to

[12] The emergence of the health crisis increased containment and voluntary measures by 1.7 and 0.8 standard deviations, respectively. The decrease in the value of exports is computed as $1 - \exp[(1.7 * (-0.043)) + (0.8 * (-0.014))]$.

**Table 2**
Impact of individual containment measures on Spanish trade.

| | Exports | | Imports | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Value | Exit | Value | Exit |
| School closing | −0.026*** | 0.013*** | −0.007 | 0.005** |
| | (0.010) | (0.004) | (0.008) | (0.003) |
| Workplace closing | −0.037*** | 0.022*** | −0.001 | 0.011*** |
| | (0.009) | (0.004) | (0.011) | (0.003) |
| Cancel public events | −0.003 | 0.011*** | 0.002 | 0.006* |
| | (0.010) | (0.004) | (0.008) | (0.003) |
| Restrictions on gatherings | −0.017* | 0.012*** | 0.003 | 0.007** |
| | (0.009) | (0.003) | (0.008) | (0.003) |
| Close public transport | −0.030*** | 0.019*** | 0.001 | 0.008*** |
| | (0.008) | (0.003) | (0.008) | (0.002) |
| Stay at home requirements | −0.016 | 0.015*** | 0.003 | 0.007*** |
| | (0.010) | (0.004) | (0.007) | (0.002) |
| Restrictions on internal mov | −0.006 | 0.009*** | 0.002 | 0.005** |
| | (0.008) | (0.003) | (0.007) | (0.002) |
| International travel controls | 0.000 | 0.008*** | −0.001 | −0.004 |
| | (0.012) | (0.003) | (0.008) | (0.003) |
| Observations | 880,285 | 1,099,009 | 474,945 | 652,865 |
| Firms | 19,109 | 22,369 | 18,370 | 22,757 |
| Countries | 79 | 79 | 78 | 78 |
| Products | 3797 | 3966 | 3721 | 3966 |

Note: We ran individual regressions for each trade and containment measure (32 regressions total). We report the $\alpha$ coefficient of each regression only. In Columns 1 and 2, the dependent variable is the (log) value of exports and imports, respectively. In Column 3, the dependent variable turns one if a firm ceases to export a product to a destination in a given month. In Column 4, the dependent variable turns one if a firm ceases to import a product from a destination in a given month. All estimations include a firm × product × month fixed effect, a destination × product fixed effect, and a constant. Standard errors clustered at destination × month level are in parentheses. ***, **, and *: statistically significant at 1%, 5%, and 10%, respectively.

operate because of workplace closure measures in the countries of origin of imports, was the main contributor to the decrease in trade flows.

To further test the robustness of our results, first, we substituted the number of new Covid-19 cases by the number of new deaths (per capita) related to Covid-19 to proxy for voluntary social distancing measures. Second, we re-estimated the model with first-day-of-the-month stringency levels and new Covid-19 cases. Panels A and B of Table A.4 in the Appendix show that results are quantitatively and qualitatively similar to those reported in Table 1.

Table 2 presents the estimates for each individual containment measure. Although the coefficients of all containment measures are presented in one column, they were estimated using individual regressions that included one containment measure, the number of Covid-19 cases, and fixed effects as independent variables. We normalized all containment measures to compare coefficients' point values. Column 1 shows that all individual containment measures, except for international travel controls, had a negative effect on the value of exports. However, only four measures had a statistically significant negative effect on the value of exports: school closing, workplace closing, restrictions on gatherings, and close public transport. Among these, workplace closing was the measure having the largest negative impact on the value of exports. Column 2 reports that all containment measures increased the probability that a firm ceased to export a good to a country in a given month. Furthermore, all coefficients were statistically significant. The coefficient having the largest point value corresponded to workplace closing.

No containment measure had a significant effect on the value of imports (Column 3). Even the coefficient for workplace closing, the containment measure most closely related with a disruption in supply, was zero. Column 4 shows that most containment measures increased the probability of a firm ceasing to import a product from a country in a given month. The impact was especially strong for workplace closing.

### *4.3. Month-by-month estimates*

In this subsection, we analyze whether the sensitivity of trade values and exit to containment measures changed over the pandemic. We estimated the following regression equation

$$\ln x_{ijkt} = \alpha_{Feb} d_{Feb} Containment_{jt} + \cdots + \alpha_{Jul} d_{Jul} Containment_{jt} + \beta_{Feb} d_{Feb} Cases_{jt} + \cdots + \alpha_{Jul} d_{Jul} Cases_{jt} + \gamma_{ikt} + \gamma_{jk} + \epsilon_{ijkt} \quad (9)$$

where the $\alpha$ and $\beta$ coefficients are month-specific and $d_{Feb}$ ($d_{Jul}$) turns one if $m$ is February (July).

The upper-left quadrant of Fig. 3 plots the point values and the 95% confidence intervals of monthly stringency index coefficients when the dependent variable was the value of exports. The point value followed a V-shape, becoming more negative between February and April and less negative afterward. Containment measures had a 95% significant negative effect on the value of exports

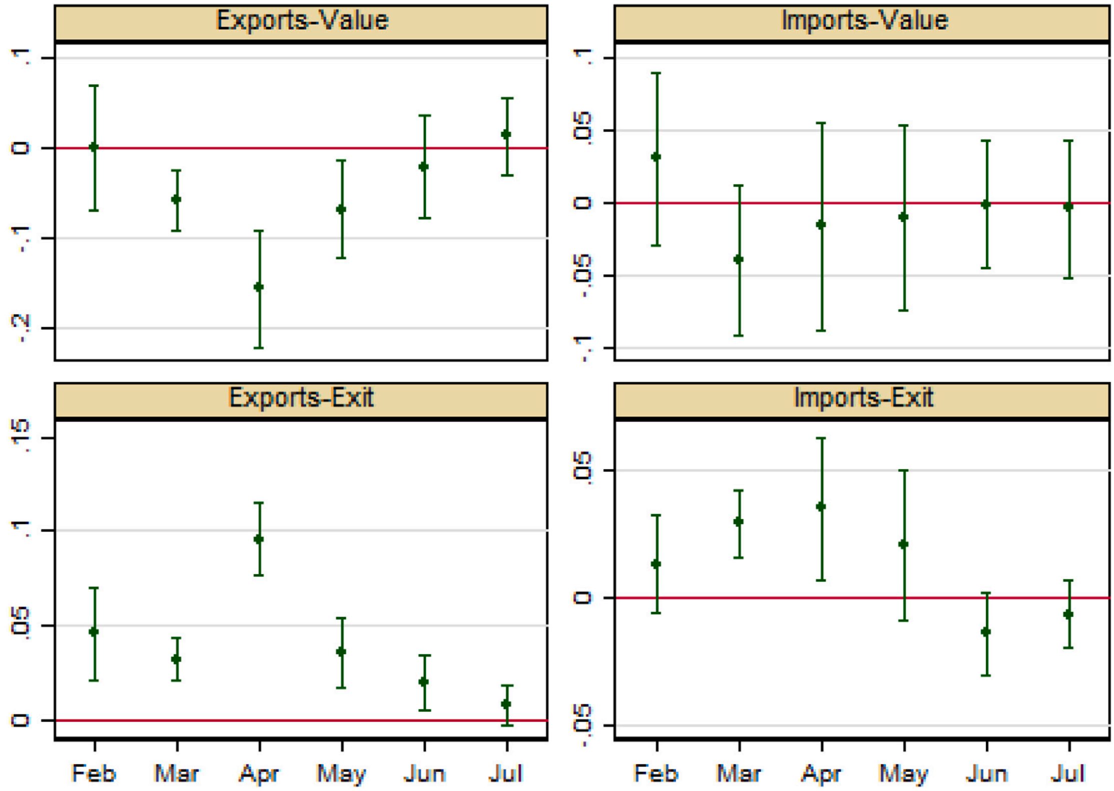


**Fig. 3.** Stringency index. Regression coefficients month by month.
Note: The figure plots the regression coefficients and the 95% confidence intervals for the stringency index estimated with Eq. (9). All estimations include a firm × product × month fixed effect and a destination fixed effect.

from March to May. The stringency index coefficients for the value of imports were very close to zero over the whole period (upper-right quadrant). Containment measures had a significant negative effect on the probability of ceasing an export trade relationship in all months, except July. The sensitivity of ceasing an export trade relationship to containment measures was especially high in April. Containment effects significantly increased the probability that a firm ceased to import a good in March and April.

As a general trend, the negative effect of containment measures rose between February and April and declined afterward. At least, two reasons can explain why. First, firms may have learned how to manage the additional trade costs introduced by containment measures. For example, at the beginning of the pandemic, if a country introduced strict containment measures, delivering goods to that country became more expensive (e.g., the frequency of cargo travel was reduced), reducing the value of exports or making the export flow uncompetitive. Later, firms could have found alternative and cheaper transport modes for sending their products to the destination, thus reducing the sensitivity of exports to strict containment measures.

Second, at the beginning of the pandemic, there was high uncertainty about the extent and duration of the impact of Covid-19 on economic activity. This could have led firms to overreact to the introduction of containment measures, strongly reducing their demand for foreign goods. After firms had better information to evaluate the impact and duration of Covid-19, they could have adjusted their demand for foreign goods upward.

### *4.4. Heterogeneity by country, product, firm activity, and participation in GVCs*

We analyzed whether the effects of containment measures on trade varied across countries, products, firm main activity, and the participation of manufacturing firms in GVCs. First, Dingel and Neiman (2020) showed that there were large differences across countries in the number of jobs that could be done at home. If a country introduced a workplace closing measure, but most of jobs could be done at home, the impact of containment on economic activity and trade would be lower than if fewer jobs could be done at home. We augmented the regression equations with a variable that interacts the stringency index with a dummy that turns one if the country has a share of jobs that can be done at home above the median.[13] Panel A of Table 3 reports that export values were less affected by containment measures in destinations where a large share of jobs could be done at home. Export relationships were

[13] Data on the share of jobs that can be done at home are from Dingel and Neiman (2020).

**Table 3**
Heterogeneity by country, product, activity, and participation in GVCs.

| | Exports | | | | Imports | | | |
|---|---|---|---|---|---|---|---|---|
| | Value | | Exit | | Value | | Exit | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| A. Country | | | | | | | | |
| Cases | −0.022** | −0.022* | 0.003 | 0.005 | −0.017 | −0.014 | 0.006 | 0.003 |
| | (0.011) | (0.013) | (0.003) | (0.004) | (0.011) | (0.012) | (0.004) | (0.004) |
| Stringency index | −0.029 | −0.092** | 0.026*** | 0.048*** | 0.002 | 0.028 | 0.010* | −0.010 |
| | (0.019) | (0.044) | (0.004) | (0.012) | (0.016) | (0.050) | (0.006) | (0.018) |
| Stringency index * Telework | | 0.184* | | −0.065* | | −0.060 | | 0.054 |
| | | (0.107) | | (0.034) | | (0.135) | | (0.047) |
| Observations | 629,979 | 628,963 | 756,159 | 755,325 | 246,541 | 246,085 | 330,346 | 330,035 |
| Adj. R-squared | 0.562 | 0.568 | 0.301 | 0.307 | 0.499 | 0.506 | 0.254 | 0.251 |
| Firms | 14,762 | 14,762 | 16,332 | 16,332 | 12,170 | 12,170 | 14,383 | 14,383 |
| Countries | 45 | 45 | 45 | 45 | 42 | 42 | 42 | 42 |
| Products | 3537 | 3537 | 3674 | 3674 | 3241 | 3241 | 3498 | 3498 |
| B. Product | | | | | | | | |
| Cases | −0.022** | −0.022** | 0.005 | 0.005 | −0.049** | −0.048** | 0.011* | 0.011 |
| | (0.010) | (0.010) | (0.004) | (0.004) | (0.023) | (0.022) | (0.007) | (0.006) |
| Stringency index | −0.060*** | −0.014 | 0.042*** | 0.025*** | 0.027 | 0.023 | −0.003 | 0.002 |
| | (0.020) | (0.013) | (0.008) | (0.005) | (0.031) | (0.019) | (0.008) | (0.007) |
| Stringency * Outdoor | | −0.112*** | | 0.043*** | | 0.007 | | −0.008 |
| | | (0.035) | | (0.012) | | (0.041) | | (0.012) |
| Observations | 333,799 | 333,799 | 411,252 | 411,252 | 125,561 | 125,561 | 171,652 | 171,652 |
| Adj. R-squared | 0.536 | 0.536 | 0.314 | 0.314 | 0.516 | 0.516 | 0.284 | 0.284 |
| Firms | 7698 | 7698 | 8858 | 8858 | 5252 | 5252 | 6641 | 6641 |
| Countries | 79 | 79 | 79 | 79 | 75 | 75 | 75 | 75 |
| Products | 892 | 892 | 908 | 908 | 864 | 864 | 886 | 886 |
| C. Activity | | | | | | | | |
| Cases | −0.016** | −0.017** | 0.001 | 0.001 | −0.015 | −0.014 | 0.005 | 0.006 |
| | (0.008) | (0.008) | (0.002) | (0.002) | (0.010) | (0.010) | (0.004) | (0.004) |
| Stringency index | −0.051*** | −0.101*** | 0.038*** | 0.051*** | 0.007 | 0.025 | 0.017*** | 0.017*** |
| | (0.014) | (0.027) | (0.005) | (0.010) | (0.016) | (0.023) | (0.004) | (0.006) |
| Stringency * Manuf.firm | | 0.071*** | | −0.018** | | −0.038 | | −0.002 |
| | | (0.022) | | (0.008) | | (0.027) | | (0.007) |
| Observations | 674,088 | 663,510 | 834,241 | 826,269 | 319,340 | 313,653 | 432,218 | 427,589 |
| Adj. R-squared | 0.565 | 0.585 | 0.285 | 0.294 | 0.504 | 0.536 | 0.236 | 0.251 |
| Firms | 10,108 | 10,108 | 10,912 | 10,912 | 9120 | 9120 | 10,340 | 10,340 |
| Countries | 79 | 79 | 79 | 79 | 78 | 78 | 78 | 78 |
| Products | 3564 | 3564 | 3727 | 3727 | 3465 | 3465 | 3712 | 3712 |
| D. Global value chains | | | | | | | | |
| Cases | −0.013* | −0.012* | −0.000 | −0.001 | −0.012 | −0.011 | 0.005 | 0.004 |
| | (0.007) | (0.007) | (0.002) | (0.002) | (0.013) | (0.013) | (0.004) | (0.005) |
| Stringency index | −0.032*** | −0.071*** | 0.034*** | 0.046*** | −0.014 | 0.163* | 0.016*** | −0.042 |
| | (0.011) | (0.020) | (0.005) | (0.009) | (0.017) | (0.095) | (0.005) | (0.027) |
| Stringency * GVC | | 0.040** | | −0.013 | | −0.180* | | 0.058** |
| | | (0.019) | | (0.008) | | (0.096) | | (0.028) |
| Observations | 418,896 | 416,178 | 520,582 | 518,365 | 157,953 | 152,771 | 217,132 | 209,913 |
| Adj. R-squared | 0.571 | 0.578 | 0.254 | 0.257 | 0.531 | 0.534 | 0.238 | 0.239 |
| Firms | 6834 | 6834 | 7285 | 7285 | 5065 | 5065 | 5708 | 5708 |
| Countries | 79 | 79 | 79 | 79 | 78 | 78 | 78 | 78 |
| Products | 3084 | 3084 | 3259 | 3259 | 2772 | 2772 | 3073 | 3073 |

Note: In Columns 1–2 and 3–4 the dependent variable is the (log) value of exports and imports, respectively. In Columns 5–6 the dependent variable turns one if a firm ceases to export a product to a destination in a given month. In Columns 7–8 the dependent variable turns one if a firm ceases to import a product from a destination in a given month. All estimations include a firm × product × month fixed effect, a country × product fixed effect, and a constant. In Columns 2, 4, 6 and 8 in panel A we interact the firm × product × month fixed effect with the telework dummy. In Columns 2, 4, 6 and 8 in panel C we interact the destination × product fixed effect with the manufacturer dummy. In Columns 2, 4, 6 and 8 in panel D we interact the destination × product fixed effect with the participation-in-a-GVC dummy. Standard errors clustered at destination × month level are in parentheses. ***, **, and *: statistically significant at 1%, 5%, and 10%, respectively.

also less likely to cease in destinations were workers could perform their tasks remotely. The effect of containment measures on imports was similar for low and high-teleworking countries.

Second, some containment measures, such as the requirement to stay-at-home, could have a larger negative effect on goods that were mostly consumed outside the household than the rest of consumption goods. We used the list presented in Section 3 to create a dummy variable that turns one if the product is consumed outdoors. We augmented the regression equations interacting the stringency index with the outdoor dummy variable. Column 1 of panel B in Table 3 shows that Spanish exports of consumption goods decreased more in destinations that adopted strict containment measures. In Column 2, we introduced the interaction variable. As expected, it was negative and significant. Whereas containment measures had no significant effect on non-outdoor goods, a one-standard-deviation increase in the stringency index of containment measures led to a 10.6% decrease in the exported value of outdoor goods. Column 3 shows that strict containment measures increased the probability of exit for consumption goods and it became much larger if the product was consumed outdoors (Column 4). Specifically, containment measures had 2.7 times larger effect on outdoor than the rest of consumption goods. Finally, containment measures adopted by countries where Spanish imports originated had a similar impact on outdoor goods and the remainder of consumption goods (Columns 5–8 of panel B).

The negative effect of Covid-19 on the export of outdoor goods should be particularly sensitive to the introduction of stay-at-home requirements in trading partners. We substituted the stringency index by the stay-at-home confinement measure and interacted this latter variable with the outdoor goods dummy. To facilitate the reading of results, we created a new stay-at-home dummy variable that turns one if the stay-at-home requirement had few or no exceptions.[14] Table A.5 in the Appendix reports these results. The difference of the impact of containment on exports between outdoor goods and the remainder of consumption goods was magnified for the value of exports.

Third, we explored whether the impact of containment measures was similar for manufacturers relative to wholesalers and retailers.[15] Our expectation was that manufacturers had closer ties with their foreign customers and suppliers than did wholesalers. Therefore, we expected trade relations to be more resilient to a crisis among manufacturers than wholesalers and retailers. Column 2 of panel C shows that the negative effect of containment measures on the value of exports was smaller if the firm participating in the flow was a manufacturer. The probability of ceasing an export relationship was also smaller for manufacturers (Column 4). We found that the effect of containment measures on the value of imports (Column 6) and the probability of ceasing an import relationship (Column 8) was similar for manufacturers and wholesalers and retailers.

Fourth, we examined whether participation in a GVC affected the impact of containment measures on trade. We determined that a firm participated in a GVC if it imported intermediate inputs to elaborate an output to be exported.[16] We expected the stickiness of inter-firm relationships to be larger when firms participated in a GVC. Production in GVCs depends heavily on firms supplying their inputs at the right time and with the required quality. Therefore, firms invest heavily in finding suppliers that will meet their production schedules and standards. This sunk cost makes the replacement of suppliers in GVCs less likely than in other inter-firm relationships (The World Bank, 2020).

Panel D presents the results. Because we defined participants in GVCs as firms that imported intermediates inputs to elaborate an output to be exported, we focused our analysis on manufacturers.[17] We created a variable that turns one if a firm participated in a GVC. We interacted this variable with the stringency index to capture whether the impact of containment measures on trade was lower for firms participating in GVCs. Column 2 of panel D shows that containment measures had a lower impact on the value of exports for manufacturers participating in GVCs. We also found that manufacturers participating in GVCs had a lower probability of ceasing an export relationship. However, the coefficient was statistically insignificant.

The results for imports without including the interaction term (Columns 5 and 7 of panel D) are in line with the estimates presented in previous panels. However, when the interaction term is included, the regressions render unexpected results. Column 6 of panel D shows that the stringency index had a positive effect on the value imported by manufacturers not participating in GVCs, while it had a very negative impact on manufacturers participating in GVCs. On the other hand, Column 8 shows that containment measures reduced the risk of terminating an import relationship for manufacturers not participating in GVCs, while they increased it for manufacturers participating in GVCs. These unexpected results are explained by the small number of firms, 172 (2333 observations), that only import in panel D's sample. This is because the dataset generated after linking the Customs database with the SABI database contains a very small number of firms that only import. Table A.6 in the Appendix reports the results when separate regressions are estimated for manufacturers not participating in GVCs and manufacturers participating in GVCs. They confirm that the unexpected results are explained by the very small sample of firms that do not participate in GVCs (i.e., only import).

## 5. Conclusion

This paper shows that the containment measures adopted by countries to arrest the spread of Covid-19 had a negative effect on Spanish exports. For example, if the US had adopted the containment measures taken by China in February 2020, a month during which containment measures were very strict in China (i.e., confinement at home and workplace closing) but light in the US, the value of Spanish firms' exports to the US in that month would have decreased by 9% and the probability of ceasing an export relationship would have increased by 20%. Containment measures had no negative effect on the value of imports. Instead, they raised the probability of ceasing an import relationship. The larger negative effect of containment measures on exports than imports suggests that demand factors, rather that supply ones, explained the decrease in trade flows during the pandemic. Containment

[14] The dummy variable is zero if there was no stay-at-home requirement or if it was only a recommendation.

[15] We merged the customs database with the SABI database from Bureau Van Dijk using the correspondence explained in de Lucio et al. (2018). We used the four-digit NACE code provided by SABI to classify firms as manufacturers (NACE 1000-3399) or wholesalers and retailers (excluding motor vehicle and motorcycle retailers) (NACE 4611-4799).

[16] This definition is similar to the backward GVC participation concept, which denotes a country's exports that embody imported intermediate inputs (Koopman et al., 2014).

[17] We used BEC to identify intermediate goods.

measures had a significant effect on trade between March and May 2020. From June 2020 onward the negative effect mitigated and became statistically insignificant. We also showed that the negative effect of containment measures on the value of exports was much larger for goods that were mostly consumed outside the household than for the rest of consumption goods. We further found that containment measures had a smaller negative effect on exports in destinations where the share of jobs that could be done remotely was high and for manufacturing firms participating in GVCs.

Our analysis suggests that the value of exports should recover after containment measures are relaxed in destination countries. The export and import relationships that were lost because of the pandemic should also recover as long as containment measures do not last long. However, our results also indicate that trade could be negatively affected again if governments have to re-introduce strict containment measures in response to an outburst in Covid-19 cases. Finally, policy makers should consider that the negative effect of containment measures on trade was heterogeneous across countries, products, and firms.

## Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.iref.2022.02.051.

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