From Macro to Micro: Heterogeneous Exporters in the Pandemic*

Jean-Charles Bricongne[†,1], Juan Carluccio[‡,1,4], Lionel Fontagné[§,1,2,3], Guillaume Gaulier[1,2], and Sebastian Stumpner[1]

[1]Bank of France
[2]CEPII
[3]Paris School of Economics
[4]University of Surrey

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Abstract

We use firm-level data to dissect the variation in aggregate French exports and imports of 2020. We establish three main facts. First, almost all of the adjustment has been through the firm intensive margin, in spite of a one-quarter decline in the number of exporters. Second, the fall in aggregate exports was predominantly driven by the largest traders. One hundred companies, the largest 0.1% of French exporters, are responsible for 57% of the decline registered in April-May 2020, while they accounted for 41% of exports pre-crisis. Among these, the top 10 firms alone explain 32% of the aggregate collapse, while their pre-crisis share was 19%. Similar figures are obtained on the import side. Last, we exploit plausible exogenous variation in sanitary measures across countries and find that heterogeneous responses to lockdowns in destination markets contributed to differences in growth rates across exporters of different sizes, an outcome absent for the largest importers. Our results suggest that firm heterogeneity and specific patterns of "superstar" exporters are key features for understanding the response of trade to the Covid shock.

Keywords: exports; firm-level trade data; COVID crisis; lock-down stringency.
JEL Classification: F14

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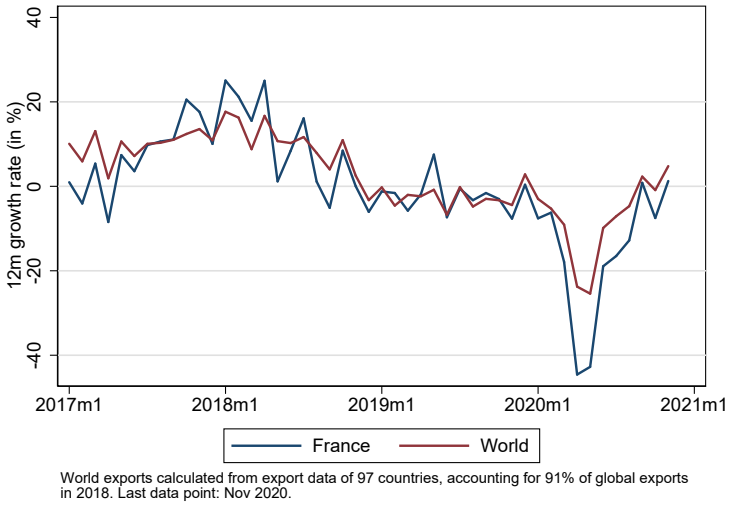
Introduction

The Covid-19 crisis generated a sharp and sizeable drop in international trade flows during the first semester of 2020. The value of world exports fell by around 22% in April 2020 with respect to April 2019, while the collapse in French exports was even higher, reaching 42%. Such movements were unprecedented in terms of suddenness and depth, surpassing the fall recorded in early 2009 at the onset of the Great Financial Crisis.

Figure 1: Evolution of World and French Exports



Source: Trade Data Monitor, Author's calculation.

Understanding the microeconomic mechanisms driving the evolution of aggregate exports is key to the comprehension of the macro reaction of trade to the Pandemic. A natural starting point is to focus on individual exporters. The trade literature of the past 20 years, starting with the seminal work of Melitz (2003), has established firm heterogeneity as a main driver of aggregate exports, and a key ingredient in modern trade models. Only a small portion of firms export and, among those, exports are very concentrated and shaped by a handful of "superstar exporters", that have been the focus of a recent literature starting with Freund and Pierola (2015). Does the skewness of the size distribution of exporters matter for the aggregate response of exports to exceptional shocks?

In this paper we use detailed firm-level and transaction level export data to dissect the large fall in

aggregate exports that took place during the first semester of 2020.[1] Two main facts stand out. First, almost the entirety of the adjustment happened through the firm intensive margin, in spite of a large drop in the number of exporters (around one quarter). Second, the fall in aggregate exports was predominantly driven by the largest exporters. The top 0.1% exporters (roughly 100 firms) were responsible for 57% of the fall recorded in April-May 2020, while they accounted for 41% of pre-crisis exports. The top 0.01% exporters (10 firms) explain 32% of the aggregate collapse, while their pre-crisis share was about 19%. These findings are robust to controlling for compositional effects with a full set of product and country fixed effects. Using data for 2006-2009 we document that similar patterns took place during the trade collapse of the Great Financial Crisis.

Having dissected exports at the firm level, we examine the role played by the specificity of the Covid crisis, namely the restrictions on consumption, production, and movement resulting from the imposition of sanitary measures worldwide. Our estimation strategy exploits plausibly exogenous variation in lockdown measures in destination countries. We regress growth rates of exports at the firm-product-destination level on the index of lockdown stringency of Hale et al. (2021), using different combinations of fixed effects that control for firm- and firm-product specific demand and supply shocks. To account for the large number of exits and entries at such disaggregated level, we use the mid-point growth rate of exports as dependent variable.[2] Beyond the expected negative and significant effect of lockdown stringency on export growth, we also show that heterogeneity matters: the elasticity of exports with respect to the stringency of the lockdown at destination increases with firm size and is greatest for superstar exporters.

The simple decompositions we performed, together with the econometric evidence of an heterogeneous impact of lockdowns, suggest that the skewness of the size distribution of exporters coupled with heterogeneous reactions to common shocks lead to rich adjustment patterns at the macro level. We thus contribute to the recent strand of papers that apply the insights by Gabaix (2011) to international trade and show that the distribution of exporters is fat-tailed, that idiosyncratic shocks to firms contribute to shape the overall trade patterns of a country (Eaton et al., 2012; Gaubert and Itskhoki, 2021) and that large firms are significantly more sensitive to foreign GDP growth (Di Giovanni et al., 2020). All of these contributions has focused on the role of large exporters along the business cycle. Our results

[1] For intra-European exports, we observe the identity of the client at each date.
[2] See Davis and Haltiwanger (1992) on the desirable properties of this metric and use in other contexts.

are to be taken as a first systematic evidence that such market structure matters for the adjustment to abnormally large shocks.

We perform a similar analysis on French importers and confirm that adjustment took place mostly at the intensive margin and that the top importers contributed more than their pre-Covid share in exports to the collapse of imports. Differently from exporters however, the top importers were not more affected than the average exporter by the lockdowns in the origin country of their imports.

The role of the different margins in explaining aggregate trade has been the focus of recent studies, starting with Bernard et al. (2009). Fernandes et al. (2019) use firm-level data for 50 countries over an average of 10 years and show that 40% of the variation in exports between country pairs (demeaned of origin-time and destination-time fixed effects) is explained by the change in the average export value per firms. The slope of this simple regression, defined as the intensive margin elasticity, in increasing in the percentile of firm size.[3] Firm size correlates with many firm-level attributes that are plausibly relevant for determining the firm-level response to shocks. Notably, large firms tend to be engaged in complex and more globalized value chains (Antràs, 2020) which might be one reasons behind the size effects we document, as suggested by early evidence focusing on the Fukushima disaster (Carvalho et al., 2016; Boehm et al., 2019). We are currently looking into the role of Global Value Chains (GVCs) in driving (at least partly) our results.[4]

We also add to the literature on the impact of the Covid crisis on trade (Bonadio et al., 2020; Antràs et al., 2020; Antràs, 2021; Antras and Chor, 2021). Using product-level data, Crozet et al. (2021) also focus on the trade collapse of april/may 2020 and show that product less-dependent in letters of credit resisted better to the collapse, contrary to "normal" times.[5] There is also an empirical literature quantifying the impact of sanitary measures using aggregate data: Kejzar and Velic (2020) for EU member states, Hayakawa et al. (2020) for 26 reporting countries and 186 trade partners, Espitia et al. (2021) for 28 countries using Google mobility data for 132 countries, Berthou and Stumpner (2021) for 31 countries. Closest to our approach are papers that document the adjustment of exporters and importers to the

[3] As opposed to the focus on superstars in the present paper, this elasticity is increasing steadily from the middle of the distribution in Fernandes et al. (2019) which leaves room for an explanation beyond granularity. There is nevertheless a jump in the elasticity at the last percentile. A caveat is that with the exception of China, the sample is made of developing countries where the role of superstar exporters might be more pronounced than for our sample.

[4] Along these lines, Espitia et al. (2021) shows that participation in global value chains increased exporters' vulnerability to foreign shocks in the early phases of the Covid crisis, but that it reduced vulnerability to domestic shocks.

[5] Demir and Javorcik (2020) provide further evidence along the same lines.

Covid using transactional data. Using firm-level data for monthly Spanish exports Minondo (2021) shows that the intensive margin accounts for 95% of the decrease in aggregate exports during the Covid crisis. As expected, de Lucio et al. (2020) show that the value of firm-level exports decreased by more in destinations with stricter containment measures. Lockdowns in sourcing countries have also impacted importers: Heise (2020) shows in a post that US imports from China declined in February-March 2020 by 50% at the through of the pandemic compared to the same months in 2019, which was partly compensated by increased shipments from other Asian suppliers.[6] Using the same data as us, Lafrogne-Roussier et al. (2021) use the Covid shock as a case study of disruption of the supply chains involving China. They show that importers exposed to the early Chinese lockdown experienced a 7% larger drop in their imports, which translated into a 5% drop in their imports, relative to non exposed exporters. We add to these works by dissecting the aggregate collapse of French exports and exploiting exporters' heterogeneity to identify a different reaction of firms of different size to a common exceptional shock. We show that the contribution of superstar exporters to the collapse goes beyond what the skewness of the distribution of their sizes would suggest.

This paper is also related to the literature on the trade collapse associated with the GFC (Levchenko et al., 2010; Claessens et al., 2012; Bricongne et al., 2012), where the contribution of large firms was also instrumental to the collapse, although the origin of the crisis was indeed different. We contrast the adjustment during the two global crises.

The remainder of the paper is organized as follows. Section 1 presents the data, shows how to dissect the different margins of trade and explores the contribution of big players to the overall adjustment. Section 2 studies the role of destinations and of lockdown stringency. It shows the results of our econometric estimations of the impact of Covid at destination (origin) on the export (import) performance of firms at different points in the size distribution. Section 3 concludes.

[6]The quarantine in the province of Hubei started the 23 January and has been progressively phased out from the 11 March on, but it takes at least 15 days to ship containers to the West-Coast (Shanghai-Los Angeles) and twice as much to the East-Coast (Shanghai-New-York). Concerning French imports, it takes 29 days for a vessel to ship containers from Ningbo to Le Havre, to which 7 days must be added for the Closing Freight Station before the estimated time of departure, and another 5 days for unloading the ship, store the container in the entrepot, unload the container and deliver its content by truck. This is a total shipping time of 41 days(data provided by CMA-CGM for a shipment with the "Laperouse".

1 Dissecting the trade collapse during Covid

This section presents the detailed on exports mobilized for our analysis, explains how the contributions of the trade margins can be computed. It addresses the heterogeneity of adjustments along the size distribution of exporters in order to shed light on the peculiar role of superstars. It finally shows how the metric of growth rates must be adapted to accommodate such high frequency data.

1.1 The firm-level data

We use firm-level trade data from the French Customs office, recorded at a monthly frequency for the period from January 2019 to June 2020. For each firm, uniquely identified by a 9-digit firm identifier called Siren, the data contain the value of exports and imports in current euros, quantities (in kilos or units depending on the product), product code, and country of destination/origin. Information on units and kilos combined with value of the transaction gives the unit value, an usual proxy for unobserved export prices. For intra-European flows, the exporter is matched with the client, which authorizes to dissect one more trade margin, namely the number of contractual relationships per exporter. Products are classified at the 8-digit level of the European Combined Nomenclature (CN), which comprises around 10,000 products.[7] The data are exhaustive in the case of extra-EU flows. For intra-UE trade, exporters are required to declare *the detail* of their transactions (*inter alia* code of the product and destination) only if they exceed a yearly value of 460,000 euros. Exporters below this threshold might file their records anyway. We show in Table A2 in the Appendix that the number of exporting firms subject to no-filing is limited and stable. Since reporting the detail needed for our analysis (product and destination on the top of export value) is not mandatory below the threshold, we disregard these declarations. On the import side, the declaration is mandatory if the firm has imported more than 460,000 euros the preceding year or as soon as this threshold is reached in the current year.

Our unit of observation is a firm-product-country-month combination. Our baseline dataset contains all the firms in the Customs files after dropping invalid firm identifiers, invalid country codes, and invalid product codes. The value of total exports in our dataset represent 98% of the total value of exports

[7] The first six digits of each product code correspond to the 2017 version of the Harmonised System (HS) at the six-digit level.

published in public statistics as shown in Figure A1 in the Appendix.[8]

1.2 Firm-level export distributions

Let us begin by expressing X_t as total French exports in month t, summed across firms, products and destinations, as the product of the number of active exporters, N_t times average export value per active firm f, $\bar{x}_{f,t}$:

$$X_t = N_t \bar{x}_{f,t} \tag{1}$$

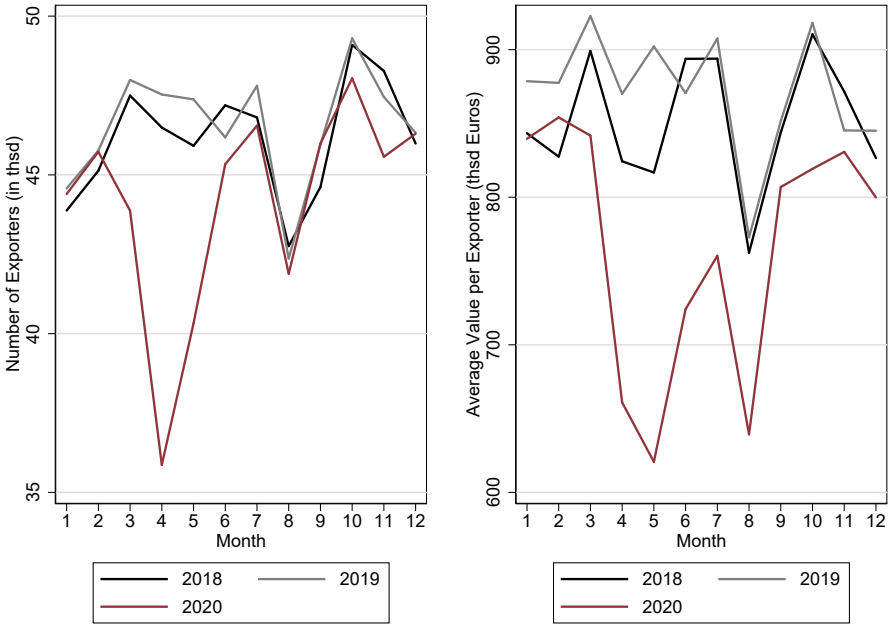
Figure 2 plots the evolution of $\bar{x}_{ft}$ and N_t for the period starting in January 2018 to December 2020, the last point in our data. So doing we can observe the monthly variation of these two export margins in 2020 and in the two previous years. There are strong seasonal patterns in French exports, which call for comparing each month with the same month the year before.[9] Both metrics recorded a large drop from March to May 2020, and a rather fast rebound as well. The number of firms with positive exports in April 2020 was roughly 36,000 against 47,000 one year before, a fall of a quarter. Similarly, the average value per firm in April 2020 was around 75% of that recorded the previous April. This is the largest fall in the number of French exporters in a given month recorded since 1994, the first year with firm-level data available. Notice that both margins were also strongly reduced with respect to the beginning of the year 2020, thus pointing unambiguously to an effect of the Pandemic.

A related, but more detailed, approach to capturing the changes in firm-level exports that resulted from the onset of the pandemic is to compare the size distribution of exports before and after the shock. Figure 3 provides the distribution of firm-level exports during the months of April and May in 2019 and 2020, in red and grey bars respectively, grouping firms into bins according to their exports in both months together. The Y-axis shows the frequency of occurrence of each bin. A visual comparison of both distributions shows that, for all bins, the number of firms is lower in 2020, which can result from the combination of firm exit and from reduction in the intensive margin. Interestingly, the grey distribution has a fatter tail than the red one, showing the reduction of exported values by the top exporters, to which we will come back later.

[8] Details concerning the construction and of previous contributions that rely on these data are provided in Bergounhon et al. (2018).

[9] Such seasonality explains the fall in both metrics in August 2019, which is not unusual.

Figure 2: Number of exporters (left) and average value per exporter (right)



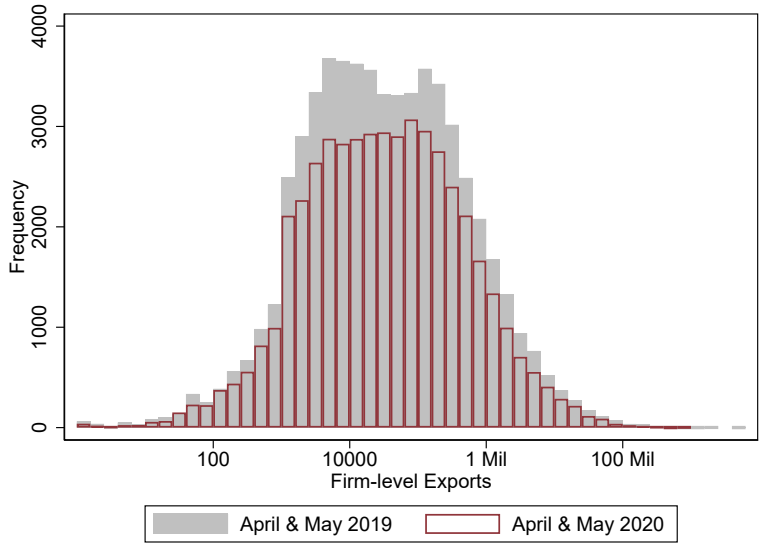
Note: *Source*: French customs, Authors' calculations.

Exiters are typically small firms. Such size differences are documented in the left panel of Figure 4 which shows the distribution of firm-level exports in April-May 2019 both for all firms, in grey, and for exiters in red. Exiters are defined as firms that reported positive exports in either April or May 2019 but did not export in either April or May 2020. The average export value of exiters is clearly lower than that of the average firm. Interestingly, though, the red distribution contains some firms with very large values (over 100 million euro). Overall, the figure suggests a limited role for firm exit in driving the aggregate export reduction.

The right panel of Figure 4 compares instead the size distribution of continuing firms. As expected, the size distribution in 2020 is moved to the left as compared with that of 2019, which is another way of showing a reduction in the firm intensive margin that Figure 2 documented. The Figure shows also the difference in the right tails of both distributions, pointing to a role for reductions in the very large exporters as a driver of the overall collapse.

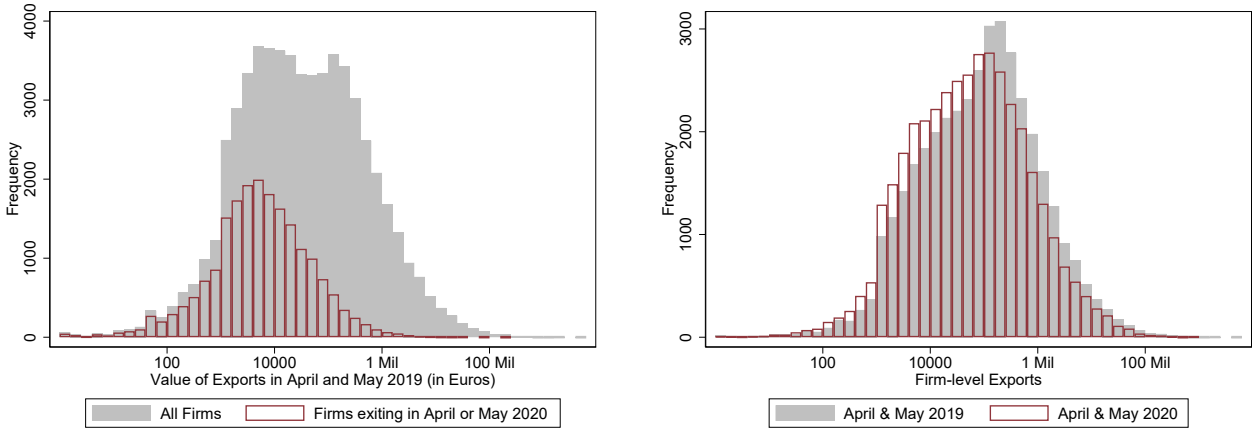
The first take home of the dissection of the exports collapse during the first months of the Covid is

Figure 3: Firm-level export distributions: Apr-May '19 vs Apr-May '20



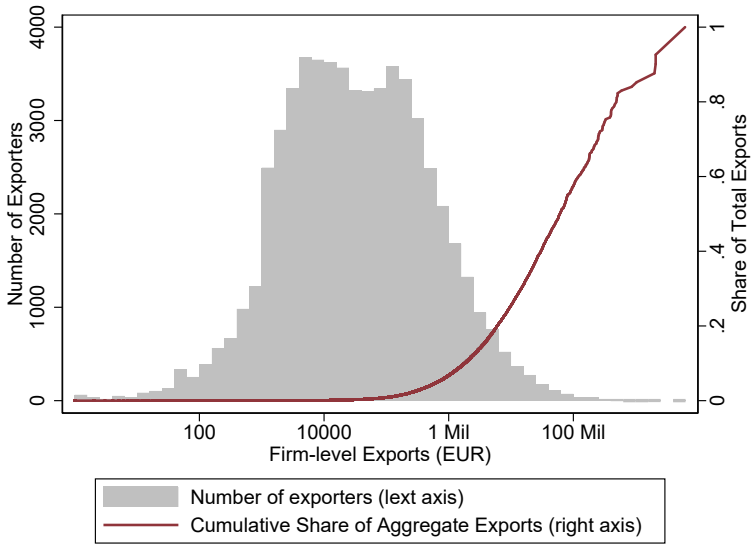
Note: Vertical axis: number of exporters. Horizontal axis: export value in thousand euro.
Source: French customs, Authors' calculations.

Figure 4: Firm-level export distributions of exiters *vs* continuing exporters: Apr-May '19 vs Apr-May '20



Note: left panel: all firms versus exiters; right panel: continuing exporters.
Source: French customs, Authors' calculations.

Figure 5: Number of exporters and their cumulative share of total exports (April & May 2019)



therefore that large firms contributed massively to the contraction of exports, provided that exiters were small. The number of exporters fell substantially (-25% in April 2020), but exiters are very small on average: their average exports in April-May 2019 was 64k Euros which accounts for 4.5% of the average of all exporters. This raises two questions that we need now to explore. First, what are the respective contributions of the extensive and intensive margins to the collapse of exports – we expect the extensive margin to play a minor role given the size of exiters. Second, is the contribution of the largest exporters to the decline in exports consistent with their pre-crisis size? The size distribution of continuing exporters moved to the left during the crisis but it is difficult to see which firms were driving the decline because the size distribution is very skewed as shown in Figure 5. Or is it more than that? We will now examine these issues in the next two sections.

1.3 Firm-intensive and Firm-extensive margins during the Covid crisis

We now want to systematize the assessment of the respective contributions of the extensive and intensive margins to the collapse of exports. To quantify these contributions, we apply the following decomposition to the aggregate export growth rate, with S_t the set of continuing firms, E_t the set of entrants and L_t the set of exiters, such that $\Delta N_t = E_t - L_t$:

$$\frac{\Delta X_t}{X_{t-1}} = \frac{\sum_{f \in S_t} \Delta x_{f,t}}{X_{t-1}} + \frac{\sum_{f \in E_t} x_{f,t} - \sum_{f \in L_t} x_{f,t-1}}{X_{t-1}} \tag{2}$$

The first term gives the contribution of the change in exports of continuing firms, that is, the contribution of the firm intensive margin, while the second terms gives the net contribution of the firm extensive margin, which includes entrants and exiters.

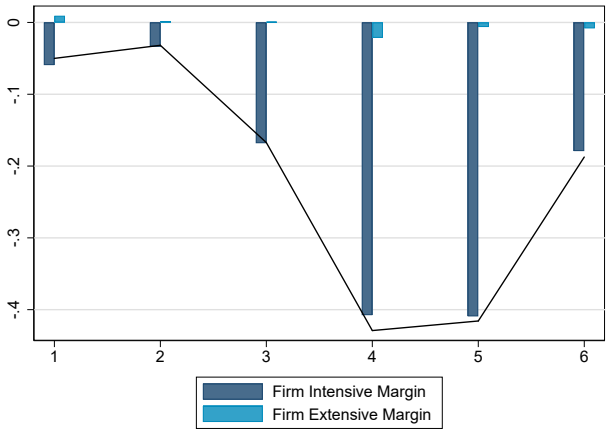
The decomposition is provided in Figure 6 where $\frac{\Delta X_t}{X_{t-1}}$ is given by the black solid curve, the firm intensive margin in dark blue, and the firm extensive margin in light blue. The firm intensive margin accounts for almost all of the monthly variation of aggregate exports. In spite of the very strong reduction in the number of exporters, the firm extensive margin plays a negligible role in the aggregate export drop. Interestingly, the firm extensive margin contributed positively during January and February 2020, to turn negative from April onwards. But the take home is indeed that the largest contribution to the export collapse is the firm intensive margin.

For the subset of intra-European transactions, our data allows to identify the partner in the commercial transaction (its VAT number). We can therefore verify whether the number of connections has been affected by the Covid crisis. We now dissect further the adjustment of exports by distinguishing between the number of partners $z_{f,t}$ and the average value per partner $\bar{x}_{fzt}$, at each date. To proceed, we focus on intra-EU exports, and the intensive margin of transactions, and we use the following decomposition in Figure 7:

$$\Delta \log(X_{f,t}) = \Delta \log(z_{f,t}) + \Delta \log(\bar{x}_{fz,t}) \mid f \in S_t \tag{3}$$

This decomposition shows that the large decrease in the intensive margin is not driven by a breakup of

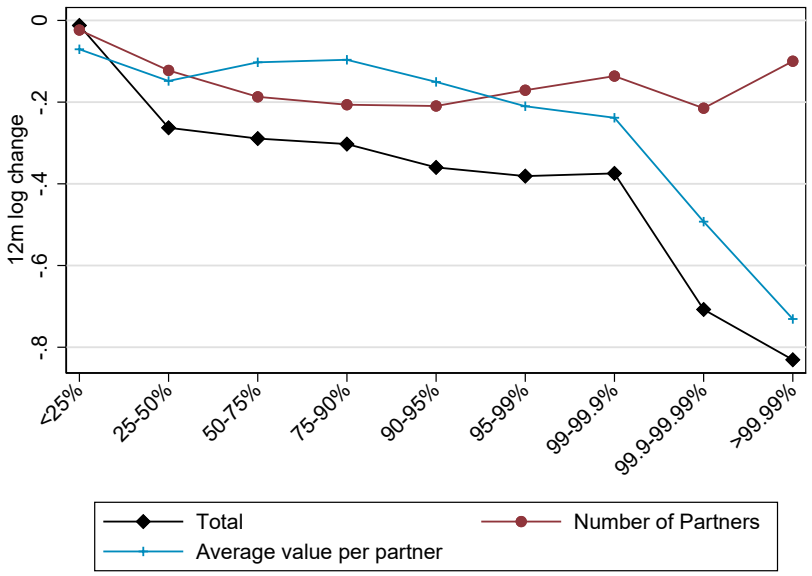
Figure 6: Contributions of the firm extensive and intensive margins



Notes: Horizontal axis, January is month 1; vertical axis: -.1 stands for a contribution of -10 % of the monthly variation of aggregate exports. *Source*: French customs, Authors' calculations.

connections with more clients. Instead, average exports per client fall by more for top exporters, pointing here again to the specific role of the largest exporters.

Figure 7: Number of Partners vs Avg Value per partner

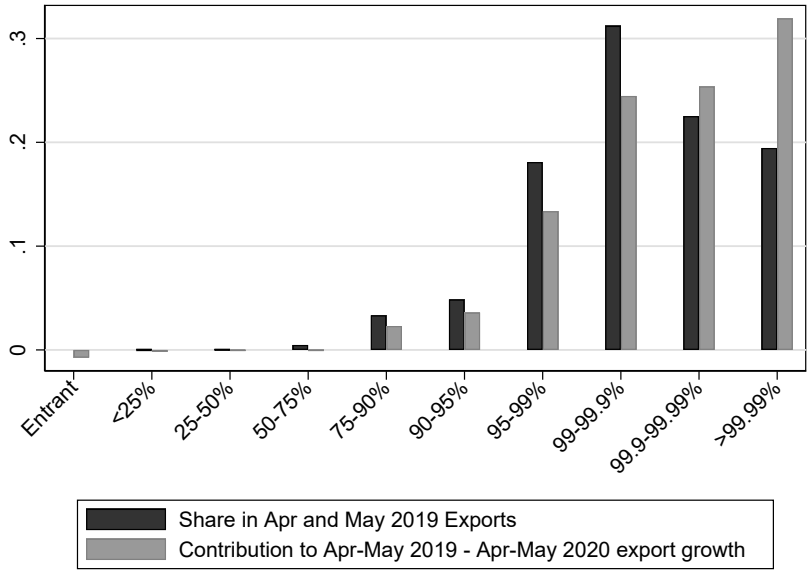


1.4 The role of top exporters

Having established a prominent role for the firm intensive margin in driving the collapse, we now seek for heterogeneity of adjustments along the size distribution. The black bars in Figure 8 show the pre-crisis distribution of firm-level exports as given by exports recorded in April-May 2019, by plotting the share of each percentile in aggregate exports. Unsurprisingly, the distribution is highly skewed: the highest 5% of exporters account for over 90% of total exports. Within the top 5%, heterogeneity is very large. The granularity of exports is better illustrated by zooming in the 1% largest exporters, then the 0.1% and the 0.01%. The top 0.1% (roughly 100 firms) accounted for 41% of exports pre-crisis and the top 0.01% (10 firms) for 19%.

The grey bars in the same figure show the contribution to total export growth by each percentile. If the contribution of any given bin to the collapse would had been proportional to their share in pre-crisis exports, then the grey and dark bars would be equal. This is not the case for any bin. In particular, most of the continuing firms adjusted *less* than what their share of pre-crisis exports would predict. Even firms lying between the percentiles 95 and 99 of the distribution accounted for 18% of total exports in 2019 (the black bar), and for 13% of the change in aggregate exports between April-May 2019 and April-May 2020. The opposite pattern holds for the very large exporters. The 101 firms in the range

Figure 8: Export share *before* Covid and contribution *during* Covid, by size bin



Source: French customs, Authors' calculations.

top 0.1% account for 57% of the fall in exports and the top 10 firms contributed respectively 32% of the overall fall. The very large exporters' contribution to the trade collapse was larger than their share of exports in normal times. Top exporters registered negative growth rates that were larger in absolute values than the rest of firms.

Monthly export data at the firm-product-destination level are, from the perspective of international trade, high-frequency data. These are characterized by a large number of zeros, which requires a particular treatment of growth rates that we develop in the next section.

1.5 Growth rates with high-frequency detailed export data

In order to cope with the large number of zeros, we now calculate year-on-year mid-point growth rates for each firm-product-country combination in the trade data. The main advantage of this indicator is to accommodate entry and exit, which is important given the high level of detail where a transaction is a triplet firm-by-product-by-destination. For small values it is similar to the usual log derivative as shown

in Figure A3 in the Appendix.[10]

Specifically, the mid-point growth rate writes:

$$g_{fjk,t} = \frac{x_{fjk,t} - x_{fjk,t-12}}{\frac{1}{2}(x_{fjk,t} + x_{fjk,t-12})} \tag{4}$$

where x denotes exported values (in euros), f indexes firms, j destination countries, p CN8 products and t time periods defined at the year- and month- level (e.g. April 2020). For each month in 2020, we compute year-on-year growth rates using the value in each month in 2020 and that in the same month of 2019. Mid-point growth rates are informative because they encompass both margins for each transaction into one single measure, thereby extracting the valuable information provided by the large number of zeros in the disaggregated trade data. The interpretation is straightforward. For continuing flows, g_{fjpt} gives the percentage variation between two time periods (defined with a 12 months lag). For exiting flows, it takes the value of -2, whereas for new flows it takes the value of +2.

Relying on such metric, another illustration of the role played by the adjustment of the largest exporters during the covid crisis is provided in Figure 9. The gray line plots the midpoint growth rates of individual firms' export values by size bin of exporters during the first two months of 2020. The black line repeats this exercise, but for the months of April-May.[11] The comparison of these two lines nicely describes an adjustment that occurred mainly at the top of the distribution. Moreover, this is in the last bin, corresponding to the top 0.01% largest firms, that the adjustment was more pronounced.

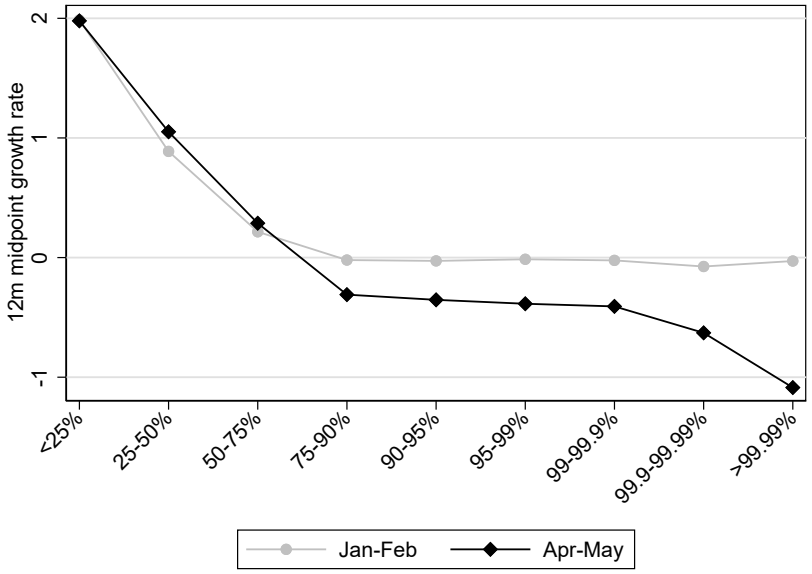
Such over-representation of large exporters in the adjustment might be driven by sector characteristics, or more subtly by sector-destination characteristics, as suggested by the extreme concentration of French exports on individual firms for certain industries. In order to provide a more systematic evidence of the role of the adjustment of big firms during the crisis, we now estimate the following regression at the most disaggregated level in the data, to control for potential sector and country composition effects:

$$g_{fjk,t} = \alpha_{b(f)t} + \beta_{s(f)t} + \epsilon_{fjk,t} \tag{5}$$

[10] Mid-point growth rates are frequently used in settings where entry/exit is important, e.g. Haltiwanger et al. (2013) on job creation by establishments.

[11] March is considered here as a transition period.

Figure 9: Export share *before* Covid and contribution *during* Covid, by size bin



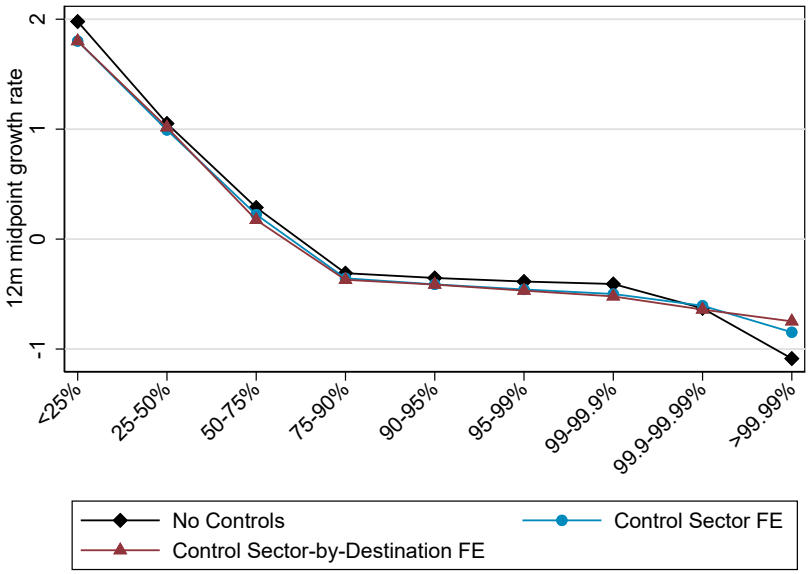
Source: French customs, Authors' calculations.

with $g_{fjk,t}$ the year-on-year mid-point growth rate as defined above and x the exported values (in euros). Recall that f indexes firms, j destination countries, k CN8 products and t time periods defined at the year- and month- level. $\alpha_{b(f)}$ is a vector of dummies indexing the location of firm f in the 2019 size distribution as shown in Figure 3, while $\beta_{s(f))}$ controls for the sector of the firm.

Results are shown in Figure 10 for the period covering the peak of the Covid crisis (April and May). Up to the 0.1% bin, we can conclude that the magnified impact on large exporters is robust to controlling for unobserved industry or industry-destinations characteristics. In the top 0.01% bin, part of the explanation pertains to industry characteristics, either concentration or type of products. But the over-representation of the largest exporters remains visible, although attenuated.[12]

[12]The results of magnified effects for biggest firms are confirmed for firms with the highest number of employees coming from the SIRENE database (the French business registry). Indeed, the magnitude of the coefficient for stringency index, using different fixed effects for products or product-time, with or without firm or firm-time or firm-product-time fixed effects, is higher for the sample of biggest firms than for the one with all firms.

Figure 10: Mid-point growth rates of exports by size bin during Covid, controlling for industry and industry-destination characteristics



Source: French customs, Authors' calculations.

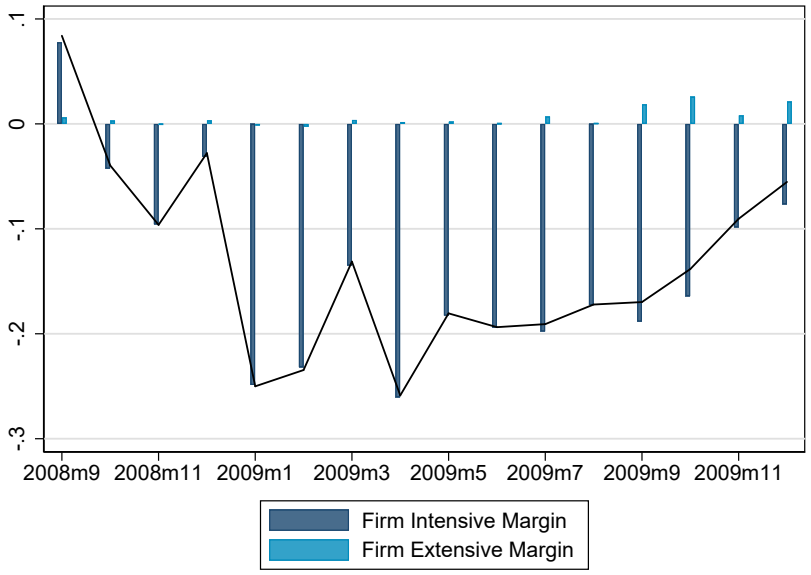
1.6 Similar patterns for exporters during the trade collapse of the GFC

We must now ask whether the patterns described in the previous section are specific to the Covid shock, or conversely whether what we observed is a more systematic pattern also present in other crisis periods, independently from their origin. The best candidate to explore this question is indeed the Global Financial Crisis. In this section, we proceed with a similar decomposition of aggregate exports using firm level data, but now during the Great Trade Collapse. Our conclusion is that despite evident differences in the determinants of the two crises and in their mechanisms of transmission, there are commonalities in the observed adjustment. Such conclusion is suggestive of specific characteristics of the largest exporters, beyond their size *stricto sensu*, making them more prone to adjust sharply in the "bad days".

Considering the adjustment of exporters during the GFC, we start by dissecting total exports, in each month, into firm participation (the firm-extensive margin) and the average value of exports per firm (resp. the intensive margin). We then compute the mid-point growth rate, as previously defined. The result shown in Figure 11 is clear-cut: most of the action is at the intensive margin during the months

of the trade collapse (the first semester of 2009). This evidence is echoing the conclusions of Bricongne et al. (2012) This is the first commonality with the adjustment of exports during the Covid crisis.

Figure 11: Mid-point growth rates during the GFC, by export margin

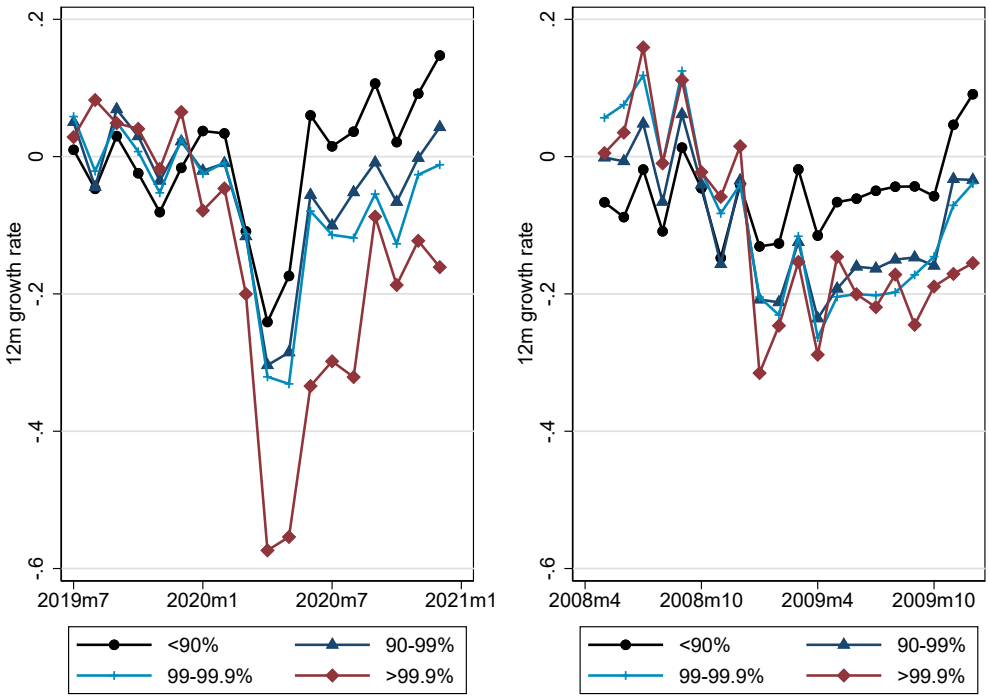


Source: French customs, Authors' calculations.

Provided that most of the adjustment of exports during the GFC crisis took place at the intensive margin, the question is: what is the contribution of the largest exporters to this pattern? Do we observe during the first semester of 2009 the same magnified effect for the export champions as during the Covid crisis? This comparison is presented in Figure 12.

The pattern is indeed more contrasted for the Covid crisis, and we can check that adjustments that took place for most of the bins were more pronounced during the Covid crisis. But the striking difference is for the top 0.01% firms. Although export champions were relatively more affected during the two crises than other exporters, the toll of the crisis on these firms has been much more pronounced during Covid. Recall that we double-checked in the previous section that such outcome is not driven (or not primarily driven) by industry or industry-destination characteristics. This suggests that beyond the systematic drop in exports induced by the Covid, there is something specific for the largest firms this time: the list of suspects matches recent developments of the literature – their involvement in GVCs, the complexity of business networks, etc. Confirming this intuitions is ongoing work. A first step in this direction is to

Figure 12: Growth rates of exports during the Covid and GFC crises, by size bin



Note: Left panel: Covid crisis; right panel: GFC crisis. *Source*: French customs, Authors' calculations.

examine the trade collapse during the Covid crisis from the importers point of view. We proceed to this comparison in the next section.

1.7 Large importers also more impacted by the Covid crisis

We ask in this section what is the respective contribution of the extensive and intensive margins to the import collapse at the peak of the Covid crisis, and whether top importing firms contributed more than their share to this collapse. The procedure is identical to what has been presented for exporters: we consider the universe of French importers in each month, and observe the value of imports, the product, the origin. Different from the export data, we do not have information on the partner firm for intra-EU imports. Importantly, we do not restrict imports to the population of exporters: we do have importers only.

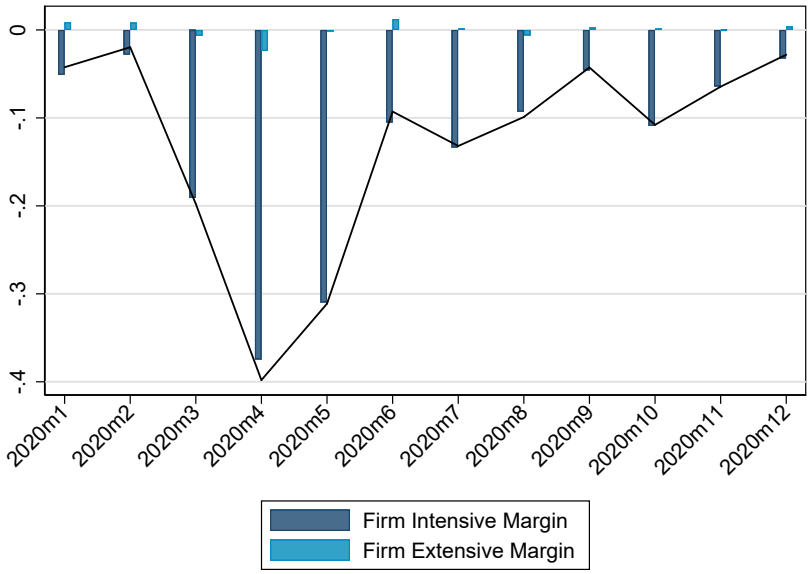
Figure 13 shows the contribution of the extensive and intensive margins to the collapse of French imports at the peak of the Covid crisis. This confirms what has been observed on the export side: the adjustment took place at the intensive margin rather exclusively. Exits of small importers do not show up in the aggregate given their limited size.

The next question is whether top importers also contributed more than their share to the collapse. We adopt the same strategy as for exports in Figure 14 and get a similar outcome, suggesting that large firms adjustments are pro-cyclical.

But are we considering the same population of firms? To what extent do large exporters overlap with large importers? Table 1 shows that only 40% of the exporters in the top 0.1% are ranked among the top 0.1% importers. Thus the match is highly imperfect. Out of the 10 largest exporters (the top 0.01%), 2 are also among the top 0.01% importers, 5 are among the next 0.1% largest importers, and 3 do not import.[13] Out of the next 0.1% largest exporters (91 firms), 4 are among the 10 largest importers, 29 among the 100 next importers; 37 also import but in bins grouping importers of smaller size, and 21 do not import. Such highly imperfect match is indeed also observable on the importer side. Considering the top 0.1% importers (118 firms), out of the 11 importers in the 0.01%, 2 are also in the top 0.01%

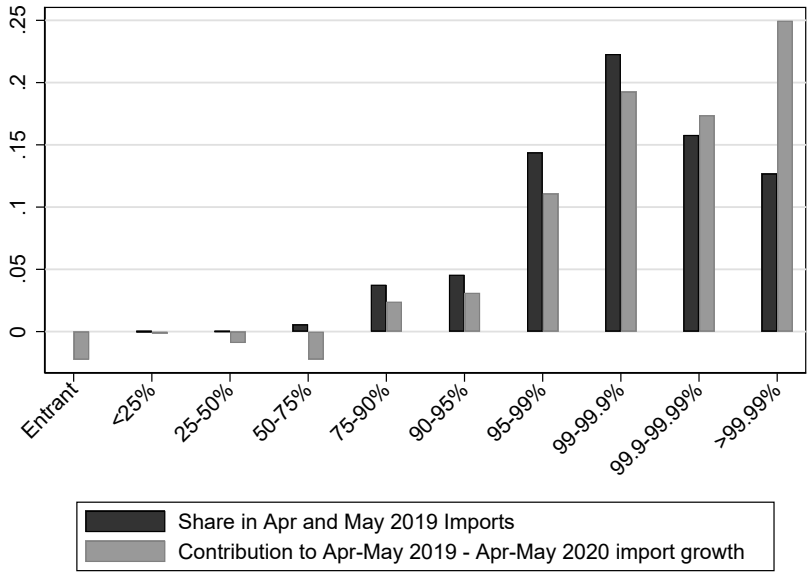
[13]Notice that the data is not consolidated by group: the same group may import through a different legal unit with a different identifier.

Figure 13: Contributions to imports of the firm extensive and intensive margins



Note: Horizontal axis, January is month 1; vertical axis: -.1 stands for a contribution of -10% of the monthly variation of aggregate exports.
Source: French customs, Authors' calculations

Figure 14: Import share *before* Covid and contribution *during* Covid, by size bin, controlling for industry and industry-destination characteristics



Note: Source: French customs, Authors' calculations

Table 1: Ranking of the top 0.1% exporters by export and import size

		Exporter		
		Top 0.1 %	Top 0.01 %	Total
Importer	Absent	21	3	24
	Below 0.1%	37	0	37
	Top 0.1 %	29	5	34
	Top 0.01 %	4	2	6
	Total	91	10	101

Note: Source: French customs, Authors' calculations

exporters, and 34 importers out of the remaining 107 firms in the top 0.1% exporters 34 are also in the top 1% exporters, as already said.

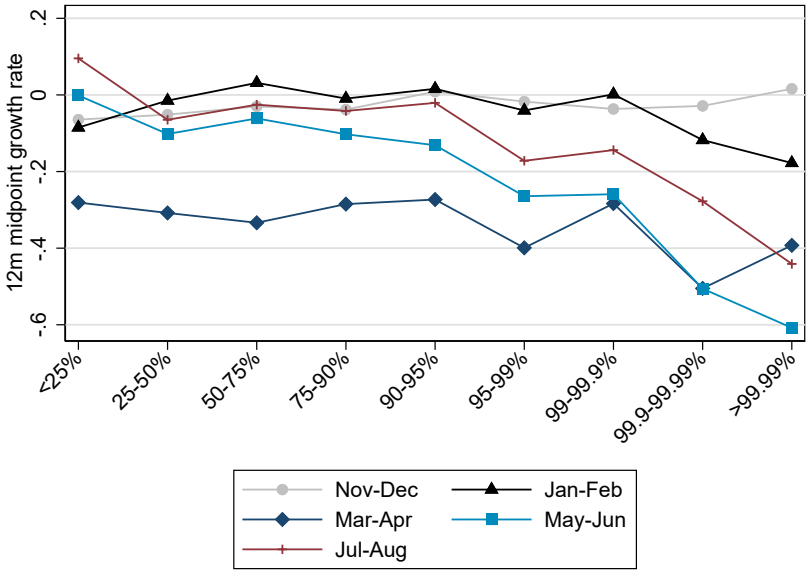
Such imperfect match between exporters and importers suggests that the determinants of the magnified adjustment of large traders may differ. We restrict in the next section our sample of importers to firms that exported at least three times during the 2019-20 period. This will provide descriptive evidence on the nexus between exports in imports in Global Value Chains.

1.8 Exporters' imports during the Covid crisis

We now match the database of exporters and importers, keeping only firms that exported at least twice over the period 2019-20. Importantly, the size bins are defined on exports. We plot in Figure 15 imports of exporters during the period November-December 2019 to July-August 2020). We notice a drop in imports already in January-February for the 0.1%largest exporters. Given the delays in shipping products, this probably reflects the effect at the end of February of the very first sanitary restrictions in Asia from the end of January (Bangladesh, China, Indonesia, Japan, Malaysia, Nepal, Taiwan). The trough in imports was reached in March-April for exporters of all sizes, except the top bin (the 0.01% top exporters) for which may-June is worse. Last, the recovery was even more difficult for the largest exporters in July-August.

We now compare in Figure 16 the change in exports and imports by size bin of exporters in January-February with April-May 2020. The two are aligned in terms of magnitude and regarding the over-adjustment of the largest exporters (recall that the bins in the two panels comprise the same exporters). We conclude from this comparison that the largest exporters have been more affected by the Covid than

Figure 15: Exporter's imports during the Covid crisis (Nov.-Dec. 2019 to July-Aug. 2020)



Note: Source: French customs, Authors' calculations

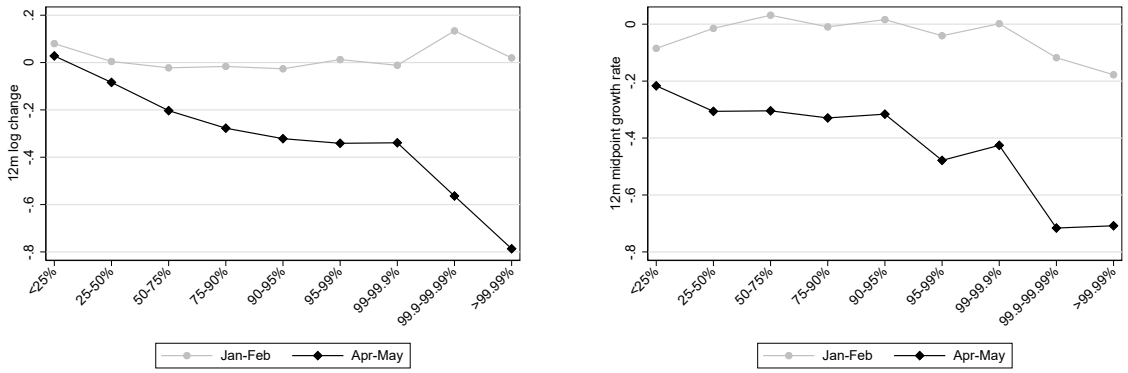
the average on their destination and at the origin of their imports.

Lastly we ask whether such over-shooting of large exporters' imports to the Covid shock is firstly a matter of origin of imports (e.g. a concentration of imports on China where the lockdown took place early), a matter of sector (e.g. bottlenecks in the electronic industries), or not. We proceed in Figure 17 as before, purging the variations of imports with origin and sector fixed effects. The take home is that the differential drop in imports of the largest exporters is not washed out by the sector-by-destination fixed effects.

2 The role of lockdown stringency at destination of exports and origin of imports

In this section we firstly dissect the firm intensive margin and show that this margin captures the adding/dropping of destinations – and to a lesser extent products – within firm. This raises an issue when computing growth rates at the firm-product-destination level that we tackle using the mid-point

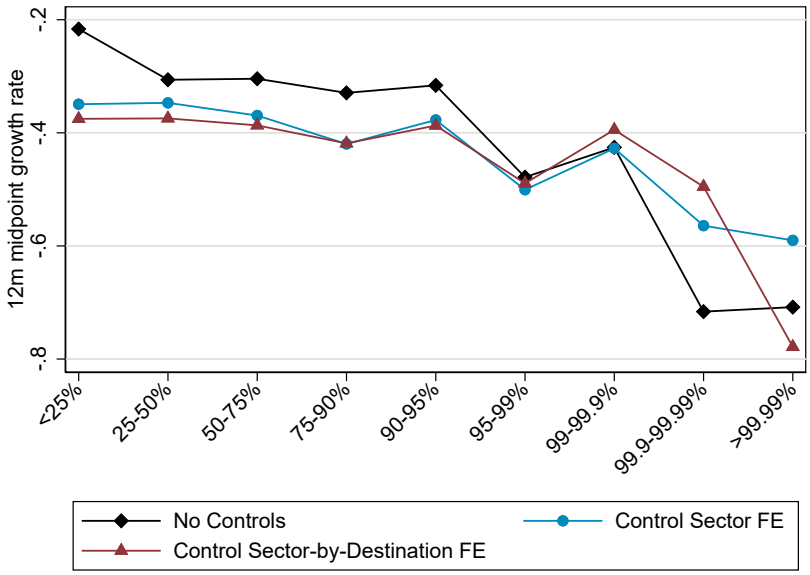
Figure 16: Change in exports and imports by size bin of exporters (April-May *versus* January-February)



(a) Exports (b) Imports

Note: Source: French customs, Authors' calculations

Figure 17: Exporter's imports during the Covid crisis (Nov.-Dec. 2019 to July-Aug. 2020), controlling for sector and destination



Note: Source: French customs, Authors' calculations

growth rate. We next develop an econometric analysis that exploits plausible variation in lockdown measures by trade partners. We explore to what extent the lockdown at destination of exports – a demand shock – contributes to the collapse of the firm-product-destination exports, and whether firms of different size were affected differently by this demand shock. Eventually, we perform the latter analysis on the import side, exploiting the variation in the stringency of lockdown in the origin countries as a shock affecting importers: we therefore quantify the impact on imports of the largely publicized supply disruptions, with again a focus on the heterogenous impact across importers of different size.

We find that lockdown stringency in a given destination reduced on average export growth to that destination. The negative effect of stringency reaches a maximum for the top exporters. In contrast, larger importers do *not* react differently from the average to the lock-down in the countries they import from. This series of results suggests that there is some specific channel having impacted exporters during the Covid crisis.

2.1 Dissecting the firm intensive margin

The firm intensive margin can be further decomposed into a firm-product-destination intensive margin, and two extensive margins capturing the adding/dropping of products and destinations within firm. This is done with the following decomposition, that follows Bernard et al. (2009):

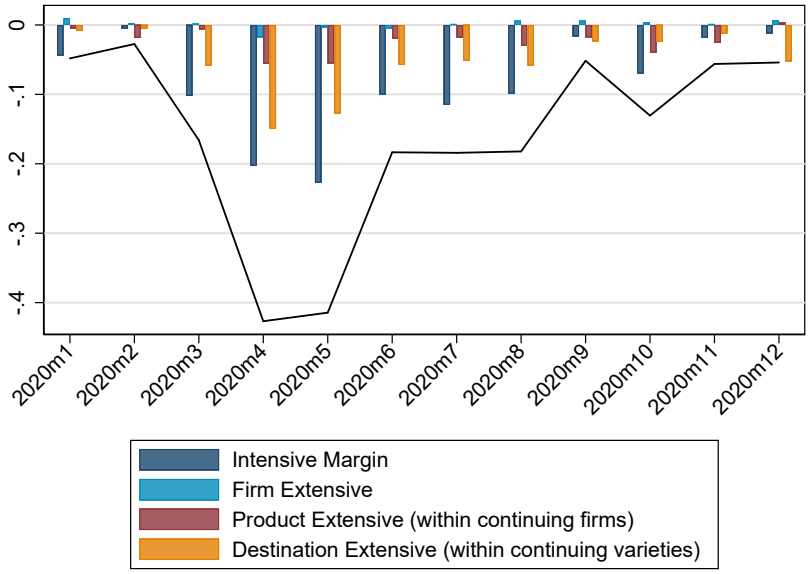
$$\frac{\Delta X_t}{X_{t-1}} = \underbrace{\frac{\sum_{f\in N} x_{f,t} - \sum_{f\in L} x_{f,t-1}}{X_{t-1}}}_{\text{Firm Extensive}} + \underbrace{\frac{\sum_{f\in S}\sum_{k\in S_f}\sum_{j\in S_{fk}} \Delta x_{fkj,t}}{X_{t-1}}}_{\text{Firm-Product-Destination Intensive}} + \underbrace{\frac{\sum_{f\in S}(\sum_{k\in N_f} x_{fk,t} - \sum_{k\in L_f} x_{fk,t-1})}{X_{t-1}}}_{\text{Product Extensive}} + \underbrace{\frac{\sum_{f\in S}\sum_{k\in S}(\sum_{j\in N_{fk}} x_{fkj,t} - \sum_{j\in L_{fk}} x_{fkj,t-1})}{X_{t-1}}}_{\text{Destination Extensive}} \quad (6)$$

The product extensive margin captures the adding/dropping of CN8 products within continuing firms, while the destination extensive margin measures the contribution of adding/dropping destinations within continuing firm-product-combinations (*varieties*).[14] This decomposition is implemented in Figure 18. It

[14]This decomposition depends on the order by which the extensive margin of products and destinations is introduced. In an alternative decomposition we introduce first destination and then the product extensive margin. This decomposition delivers similar results to the ones presented here.

shows that there was substantial dropping of destinations and products within continuing exporters, and that the destination extensive margin was more important than the product extensive margin. After taking out these extensive margins, roughly half of the decline in aggregate exports is explained by lower exports within firm-product-destination combinations.

Figure 18: Further decomposing the firm intensive margin



Notes: Vertical axis: -.1 stands for a contribution of -10 % of the monthly variation of aggregate exports. *Source*: French customs, Authors' calculations.

We now want to identify the impact on French exporters of lockdowns at destination. We are interested in the adjustment of exporters. We will accordingly consider the growth rate of exports by a given firm of a given product to a given destination during a given month. Given that the destination country dimension seems to have affected not only the intensive, but also the extensive margin, in what follows we use the mid-point growth rate as a dependent variable. Our first question is what is *average* impact of lockdowns on this growth rate, controlling for time-independent unobserved characteristics of the destinations, unobserved shocks to the exporter, and unobserved demand or supply shocks specific to the exported product but common to all French exporters. The second question is whether this impact differs for exporters of different size, and here we will interact our proxy of the Covid shock with the bins previously defined. Last, we will replicate this exercises for the French importers with estimations considering the stringency of lockdowns in the country of origin of French imports.

2.2 The impact of lockdowns in foreign markets

Our main measure of the intensity of lockdown measures is the Oxford Stringency index constructed by the University of Oxford (Hale et al. (2021)) for around 180 countries and updated on a daily basis. It is based on 20 indicators with information on several different common policy responses, which are aggregated into a set of four common indices ranging from 0 to 100 and increasing in the measures' stringency: an overall government response index, a containment and health index, an economic support index and the original stringency index. We use as a baseline the composite index that aggregates these four indices. The main indicator – "Stringency index" – is a composite indicator of school closures, workplace closures, cancellation of public events, public transport closures, public information campaigns, stay at home, restrictions on gatherings, restrictions on internal movement and international travel controls.

Our identification strategy takes advantage of the heterogeneous responses of destination countries to the Covid crisis in terms of timing and intensity of lockdown measures. Such heterogeneous response implies that $Lockdown\ Stringency_{j,t}$ varies both across trade partners and across time, providing us with large variation to identify α. We estimate the following baseline equation:

$$g_{fjk,t} = \alpha Lockdown\ Stringency_{j,t} + \beta_{ft} + \gamma_j + \delta_{kt} + \epsilon_{fjk,t} \tag{7}$$

where $g_{fjk,t}$ is the mid-point growth rate of exports by firm f of product k to destination country j during month t, as defined above. $Lockdown\ Stringency_{j,t}$ is the value taken by the Oxford Index of stringency in destination j, divided by 100 so that it takes values in the range [0,1]. Unobservable shocks to the firm i are captured by a firm-time fixed effect β_{ft}. Time-invariant origin-destination unobserved characteristics (France is indeed the origin of all exporters) are captured by a vector of destinations fixed effect γ_j, and δ_{kt} a product-time fixed effect capturing any unobserved product-level shock common to all destinations and exporting firms. Results are reported in Table 2.

We find clear evidence that stringent sanitary measures in destination markets reduced the growth rate of exports. The detailed nature of the data allows to identify the effect by exploiting variation across countries for given firms, and controlling for firm-specific, and firm-product specific shocks. The

Table 2: Effect of Destination Lockdowns

	(1)	(2)	(3)
	Midpoint growth rate of exports		
Lockdown Stringency	-0.580***	-0.599***	-0.713***
	(0.128)	(0.128)	(0.0928)
Observations	7,892,770	7,890,184	6,581,258
R-squared	0.345	0.416	0.502
Firm-Time FE	✓	✓	
HS2-Time FE	✓		
NC8-Time FE		✓	
Firm-NC8-Time FE			✓
Destination FE	✓	✓	✓

coefficients' interpretation is straightforward: using the specification of column (2), we find that going from zero to full lockdown reduces the mid-point growth by 0.7 percentage points. We will in the next section explore the adjustment of exporters of different size using this specification.

2.3 A magnified impact of the shock on export champions

To look into potential heterogeneous effects according to size, we add size dummies to Equation 7, constructed using the pre-crisis distribution in Figure 8, but grouping the top exporters into a bin containing the highest 0.1%. We estimate the following baseline equation:

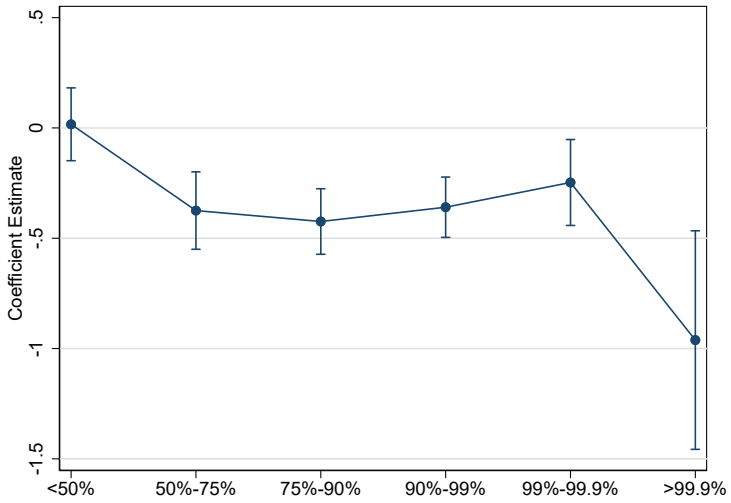
$$g_{fjk,t} = Lockdown\ Stringency_{j,t} \times \eta_{b(f))} + \beta_{ft} + \gamma_j + \delta_{kt} + \epsilon_{fjk,t} \tag{8}$$

where $\eta_{s(f))}$ is a set of six complementary size dummies, and the regressions include firm-month, product-month, and destination fixed effects. Standard errors are clustered at the destination-time level.

The results are provided in Figure 19, where we observe that the negative coefficient associated with the largest exporters is of a higher absolute value. These results are robust to alternative groupings of firms and confirm the observation made on the pre-GFC period (1993-2007) that larger French firms are significantly more sensitive to foreign demand variation (Di Giovanni et al., 2020).[15] What we show

[15] While we document this fact using the reaction of firm-destination exports to destination level demand shocks for six size bins, Di Giovanni et al. (2020) regress the log change in French firm value added on the GDP growth in the world outside of France, the lagged size of the firm and the interaction between the two. The latter strategy indeed captures the elasticity of firm growth to world GDP, which is positive and significant.

Figure 19: Effect of Destination Lockdown by Size Bin



Source: French customs, Author's calculation.

here is that larger firms are more sensitive to foreign shocks not only because they trade more, but also because they react more to a given shock on their export markets.

2.4 No magnified adjustment of top importers to the lockdown of their suppliers

We can now run Equation 7 and Equation 8 where $g_{fjk,t}$ is now the mid-point growth rate of firm f imports. Consistently, $LockdownStringency_{j,t}$ is now the value taken by the Oxford Index of stringency in the origin country j of the supplier of imported product k, divided by 100. The size bins in Equation 8 are defined using the distribution of importers.

Table 3 shows the results of the estimation of Equation7. The take home is that the correlation of lockdown stringency at origin with the midpoint growth rate is much lower compared to what we obtained on the export side. Using again our preferred specification of column (2), we find that going from zero to full lockdown in the origin country reduces on average the mid-point growth of imports by 0.2 percentage points only.

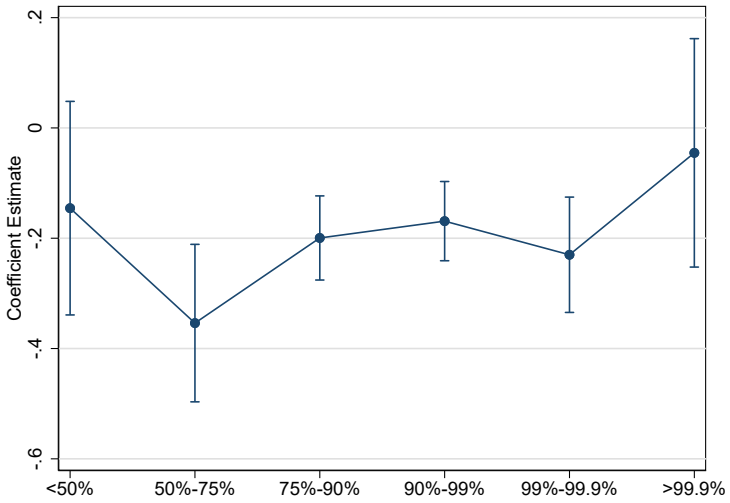
Results, shown in Figure 20, point to the absence of magnification effect for large importers: the confi-

Table 3: Effect of Origin Lockdowns

	(1)	(2)	(3)
	Midpoint growth rate of imports		
Lockdown Stringency	-0.244***	-0.202***	-0.602***
	(0.0446)	(0.0438)	(0.0989)
Observations	10,126,825	10,124,779	7,280,235
R-squared	0.379	0.459	0.568
Firm x Time	✓	✓	
HS2 x Time	✓		
Destination	✓	✓	✓
NC8 x Time		✓	
Firm x NX8 x Time			✓

dence interval for the estimated parameter tells us that the interaction between *Stringency* and the top size bins is not statistically different from zero. To conclude, although larger importers did react more to the macroeconomic shock induced by the sanitary crisis, there is no evidence of an impact channeling through the lockdowns in the countries of their suppliers.

Figure 20: Effect of Origin Lockdown by Size Bin



Source: French customs, Author's calculation.

3 Conclusion

This paper provides a systematic study of the role of firm heterogeneity in driving the trade collapse associated with the Pandemic. We use detailed French firm-level data for January to June 2020, for exports and imports, with information on products and destination(origin) countries. A simple decomposition analysis shows that almost the entirety of the adjustment happened through the firm intensive margin, as opposed to the extensive margin, despite a large drop in the number of ex(imp)porters. More importantly, the data clearly points to a predominant role of the largest traders, whose shipments were reduced proportionally more than those of firms in the rest of the size distribution. This pattern also held, albeit less markedly, for exporters during the Great Financial Crisis. Furthermore, while lockdowns in destination countries affected all firms, econometric evidence shows that the top exporters were affected relatively more, as oppose to the top importers. These results open the door for many interesting hypotheses regarding the type of adjustments of these large exporters, the reasons why they have contributed more, and the role they had in the fast recovery of trade. These issues are the subject of ongoing research that studies the role of GVCs systematically. Overall, this paper provides insight into how the size distribution of traders and their differential response which jointly drive the dynamic response of aggregate exports and imports to severe shocks.

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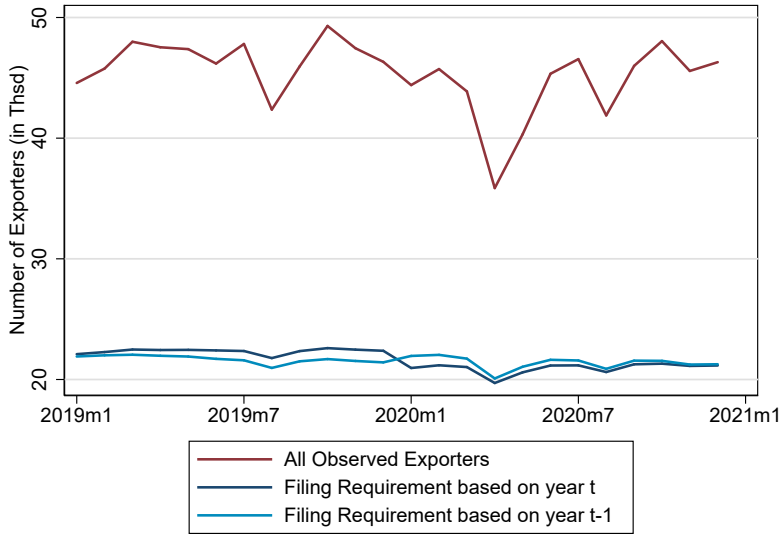
Appendix

Figure A1: Coverage of aggregate statistics with transaction data

Source: French customs, Authors' calculations.

Figure A2: Exporters with and without filing obligation (2019-2021)



Source: French customs, Authors' calculations.

Figure A3: Midpoint growth rate vs log change