From Macro to Micro:
Heterogeneous Exporters in the Pandemic

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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 largest firms drive the trade collapse. 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%. Last, we exploit plausible exogenous variation in sanitary measures faced by exporters across destination countries and across origin countries of their intermediate imports: while top exporters react more to the demand shock, they do not react more to Global Value Chains disruptions. Our results suggest that firm heterogeneity and specific adjustments of “superstar” exporters confronted to a severe demand shock 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

Beyond dissecting the macroeconomic reaction of trade to the Pandemic, understanding the microeconomic mechanisms driving the evolution of exports is key to the comprehension of how aggregate trade adjusts to large shocks. 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 study the microeconomic foundations of the large fall in aggregate French exports that took place during the first semester of 2020 and ask whether it was driven by the demand shock or the supply shock associated with the pandemic. To proceed, we use detailed firm-level and transaction level export data\(^1\) and we decompose trade growth into the usual margins of adjustment. We then document heterogeneity of adjustment according to exporter size and study the demand channel – the collapse of demand at destination of exports – and the supply channel – the disruption of Global Value Chains (GVCs) evidenced by the collapse of intermediate imports of exporters.

Dissecting the trade collapse, 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%. Using data for 2006-2009 we document that similar patterns took place during the trade collapse of the Great Financial Crisis.

Having dissected the collapse of aggregate exports, we dig deeper into the underlying drivers of the larger adjustment of the top exporters, namely the supply versus demand channels. We take the Covid crisis as a natural experience combining severe restrictions on consumption, production, and movement resulting from the imposition of sanitary measures worldwide. Focusing on exporters of different size and different intensity of participation in Global Value Chains (GVCs), our estimation strategy exploits plausibly exogenous variation in lockdown measures in destination countries of their exports and origin countries of their intermediate imports. Lockdown at destination of exports (of final and intermediate products) is indeed a demand shock, while lockdown at origin country of intermediate products imports is a supply shock. We regress growth rates of exports (imports) at the firm-product-destination (origin) 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.\(^2\)

\(^1\)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.
import growth, we show that heterogeneity matters differently in terms of response to the demand and supply shocks. The elasticity of exports with respect to the stringency of the lockdown at destination increases with firm size and is greatest for superstar exporters. On the other hand, while the stringency of the lockdown at the origin of suppliers negatively impacts exporters’ imports of intermediate products, as expected, there is no empirical evidence of a larger impact on the top exporters or on exporters more deeply involved in GVCs.

Our study contributes to the literature on the impact of the pandemic on trade flows (Bonadio et al., 2020; Antrás et al., 2020; Antrás, 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. 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, Meier et al. (2020) on US sectors with high exposure to imports of intermediate goods from China. Our study dissects the aggregate and sectoral impact of Covid by exploiting firm-product-destination/origin monthly data.

Similar to our approach are papers that document the adjustment of exporters and importers to the 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. Using the same data as us, Lafogne-Roussier et al. (2021) use the Covid shock as a case study of disruption of the supply chains involving China. They show

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3 Demir and Javorcik (2020) provide further evidence along the same lines.
4 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”).
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 complement 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, while being large does not increase the impact of the exposition to supply chain disruption.

Our paper also speaks to the literature documenting the role of large firms in international trade Freund and Pierola (2015). The simple decompositions we performed, together with the econometric evidence of an heterogeneous impact of lockdown at destination of exports for firms of different size, suggest that the skewness of the size distribution of exporters coupled with heterogeneous reactions to demand shocks lead to rich adjustment patterns at the macroeconomic 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 are to be taken as a first systematic evidence that such market structure matters for the adjustment to abnormally large demand shocks. Indeed, 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 GVCs (Antràs, 2020) which exposes them to supply chain disruptions, as suggested by early evidence focusing on the Fukushima disaster (Carvalho et al., 2016; Boehm et al., 2019). Our paper confirms that disruptions of intermediate imports during the Covid had an impact on exporters, but does not find evidence that the largest exporters were more affected by such disruptions.

Lastly, our paper contributes to the literature showing how the different margins of trade explain aggregate adjustments, 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.\textsuperscript{5}

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 impact of lockdown stringency at origin of intermediate imports of exporters and at destination for those firms, for firms at different points in the size distribution. Section 3 concludes.

1 Dissecting the trade collapse during Covid

This section presents the detailed data on exports and balance sheets mobilized for our analysis, and 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 measurement of growth rates must be adapted to accommodate such high frequency data.

1.1 The firm-level data

We firstly 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.\textsuperscript{6} 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 only if they exceed a yearly value of 460,000

\textsuperscript{5}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.

\textsuperscript{6}The first six digits of each product code correspond to the 2017 version of the Harmonised System (HS) at the six-digit level.
euros. Below this threshold, the declaration does not contain information on the code of the product and destination. Exporters below this threshold might choose to file their records anyway. We show in Table A4 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 published in public statistics as shown in Figure A3 in the Appendix.\textsuperscript{7}

This data on exports and imports at firm level is matched with the FIBEN dataset, containing balance sheet data collected by Bank of France for firms with a turnover above 0.75 million euros – 200k firms each year. This dataset is by construction missing the small exporters but we show below that this sample is very representative given the skewness of the size distribution of exporters.

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 $f$, $\bar{x}_{f,t}$:

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

Figure 2 plots the evolution of $\bar{x}_{f,t}$ 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.\textsuperscript{8} Both the number of exporters and the average value per exporter recorded a large drop from March to May 2020 compared to the same

\textsuperscript{7}Details concerning the construction and of previous contributions that rely on these data are provided in Bergounhon et al. (2018).
\textsuperscript{8}Such seasonality explains the fall in both metrics in August 2019, which is not unusual.
months in the two previous years, 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.

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

Note: Source: French customs, Authors’ calculations.

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
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 therefore that large firms contributed massively to the contraction of exports, provided that exiters were
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 aligned 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 \( \Delta N_t = E_t - L_t \):

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

(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.

Figure 6: Contributions of the firm extensive and intensive margins

![Graph showing 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.

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 $\bar{x}_{fz,t}$, 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:

$$\Delta \log(X_{f,t}) = \Delta \log(z_{f,t}) + \Delta \log(\bar{x}_{fz,t}) | f \in S_t$$ (3)
This decomposition shows that the large decrease in the intensive margin is not driven by a breakup of 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.
1.4 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):

\[
\frac{\Delta X_t}{X_{t-1}} = \sum_{f \in N} x_{f,t} - \sum_{f \in L} x_{f,t} - 1 - \frac{\sum_{f \in S} \sum_{j \in S_{fk,t}} \Delta x_{fkj,t}}{X_{t-1}} + \sum_{f \in S} \sum_{k \in S_f} \sum_{j \in S_{fk,t}} x_{fkj,t} - \frac{\sum_{k \in N} x_{fk,t} - \sum_{k \in L} x_{fk,t} - 1}{X_{t-1}} + \frac{\sum_{f \in S} \sum_{k \in S_f} (\sum_{j \in N} x_{fkj,t} x_{fkj,t} - \sum_{j \in L} x_{fkj,t} x_{fkj,t} - 1)}{X_{t-1}}
\]

(4)

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). This decomposition is implemented in Figure 8. It 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.

1.5 The collapse 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. We group exporters into bins based on their total exports in 2019. We have around 100k firms and to be in the top 1% / 0.1% / 0.01%, a firm needs exports larger than respectively 65 million / 600 million / 3 billion euros of annual exports, provided that aggregate French exports in 2019 amounted to 488 billion euros. In order to shed light on the heterogeneity of adjustment along the size distribution of firms, we compute the share \( s_b \) of each bin

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9 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.
in the pre-crisis exports and the growth rate of exports for each bin $g_b$. This gives us a decomposition of the aggregate change in exports into the contribution of the different bins $b$. For instance the top 0.01% largest exporters (10 firms) that accounted for 19% of exports pre-crisis recorded a 59% drop in their exports in April-May 2020 compared to April-May 2019 and thus contributed 32% to the aggregate export collapse.

The black bars in Figure 9 show the pre-crisis distribution of firm-level exports as given by exports recorded in April-May 2019, by plotting the share $s_b$ of each bin of exporters 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 $s_b \times g_b$ 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 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.

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

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.
1.6 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 A5 in the Appendix.\textsuperscript{10}

Specifically, the mid-point growth rate writes:

$$g_{fjk,t} = \frac{x_{fjk,t} - x_{fjk,t-12}}{\frac{1}{2}(x_{fjk,t} + x_{fjk,t-12})}$$  \hspace{1cm} (5)

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, \(g_{fjk,t}\) 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 and grouping time periods into two-months intervals, another illustration of the role played by the adjustment of the largest exporters during the Covid crisis is provided by regressing the year-on-year midpoint growth rate \(g_{fjk,t}\) for firm \(f\), product \(k\), destination (origin) \(j\) and time \(t\) on dummies corresponding to the bins of exporters by size \(\alpha_{b(f)}t\):$g_{fjk,t} = \alpha_{b(f)}t + \epsilon_{fjk,t}$  \hspace{1cm} (6)

\(\alpha_{b(f)}\) is a vector of dummies indexing the location of firm \(f\) in the 2019 size distribution as shown in Figure 3.

\textsuperscript{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.
Results are shown in Figure 10. 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.\textsuperscript{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.

Figure 10: 12-month mid-point growth rate of exports by size bin, January-February and April-May 2020

One question arising when considering the specific behaviour of top exporters is whether the observed difference in the magnitude of their adjustment is driven by some idiosyncratic determinant, or whether there is some systematic pattern even within the bins. In order to address this question one can place the top 1,000 exporters into 100 bins and compute for each bin the mid-point growth rate at the peak of the Covid crisis and plot it against the (log) value of exports of this bin in 2019. When so zooming-in on the top 1,000 firms, we observe in Figure 11 a clear negative relationship between size before the crisis and adjustment of exports to the crisis.

\textsuperscript{11}March is considered here as a transition period.
Figure 11: April-May 2020 12-month mid-point growth rate and 2019 exports of the 1,000 largest exporters

Source: French customs, Authors’ calculations.
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 add to Equation 6 controls for potential sector and country composition effects. $\beta_{s(f)}$ controls for the sector (or alternatively the sector times destination) of the firm:

$$g_{fjk,t} = \alpha_{s(f)t} + \beta_{s(f)t} + \epsilon_{fjk,t}$$ (7)

Results are shown in Figure 12 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 12: April-May 2020 12-month mid-point growth rates of exports by size bin, controlling for industry and industry-destination characteristics.

Source: French customs, Authors' calculations.
1.7 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 \textit{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 13 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.

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 14.

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
We now need a more systematic analysis of the role of the pandemic as a combined demand and supply shock. This will help answer the question: why did major exporters adjust more than proportionally? Was it due to the demand shock associated with the lockdowns at destination of exports, or to a supply shock - the disruption of global value chains induced by the lockdowns in countries of origin of intermediate imports? The following section will attempt to answer these questions.

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13 We complement this statistical evidence on exporters by looking at the adjustment of importer in Appendix. Indeed exporters are also frequently importers, and we focus in the core of the text on imports of exporters.
Figure 14: Growth rates of exports during the Covid and GFC crises, by size bin.

Source: French customs, Authors’ calculations.
2 The Covid crisis as a supply/demand shock

The pandemic and the policy adopted to contain it (especially lockdowns) led to strong supply and demand responses: closing of workplaces, work from home, shops closed, etc. In turn, exporters may have been affected by foreign lockdowns through supply disruptions from intermediate inputs, by domestic lockdown, and/or by foreign lockdowns through a demand channel. We now want firstly to sort out these explanations. But more importantly, we want to assess whether top exporters showed a higher elasticity with respect to these shocks.

In the following we will examine sequentially the supply and the demand channels of adjustment. On the supply side, do we observe a higher exposure of the top exporters to foreign supply shocks of intermediate inputs? Do we observe a higher elasticity of top exporters to foreign supply shocks of intermediate inputs? Alternatively, on the demand side, do we observe a higher exposure of top exporters to foreign demand shocks? Do we observe a higher elasticity of top exporters to foreign demand shocks?

To proceed, 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 of importers are defined on their exports.

Given that the origin vs 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 of imports and exports.

2.1 Exporters’ imports of intermediate goods

The first take home is that exporters are also more prone to import as evidenced by Figure 15: both the share of exporters that also import and their share in the population of firms within each bin is increasing systematically in bin size. In the last two bins, i.e. the top 0.1% exporters, all firms export and import. These are also the firms for which the adjustment to the Covid crisis is the sharpest, as shown.

We can now characterise importers of different size with respect to the composition of their imports before Covid. Figure 16 shows the share of intermediate products, final products and capital products in exporter’s imports, by size bin. The take home is that the share of intermediate products in firms’

\[14\text{We rely here on the classification of HS6 products into Broad Economic Categories (BEC) of the UN.}\]
imports is increasing in the size of exporters, suggesting a deeper involvement of large exporters in GVCs. This is the share of final products which is strongly decreasing in the size of exporters, while there is no striking difference between size bins in the share of capital goods.

Given that large exporters are more likely to import, and especially to import intermediate products that will feed back into their production process, we expect these exporters to be more exposed to disruption in their value chain. Thus, the geographic origin of their intermediate imports may be a valid explanation for the observed decline in their intermediate imports, in relation to lockdowns in supplier countries. The next question is accordingly what was the geographic structure of their imports of inputs before Covid. This information is provided in Figure 17. Two important determinants of this structure have to be kept in mind: the regional nature of GVCs and the technological content of certain imported inputs. We observe that the share of imports of intermediate products sourced in the US is increasing in the size of exporters, up to one quarter of the value of imported intermediates for the top 0.01% exporters. A similar share of imports is sourced in Germany at the top of the size distribution of exporters, largely above all other size bins. Other European countries account for at least one half of total imports of intermediate products for all size bins of exporters, excepted the top 1%. Last, China represents at most 10% of imports of intermediate goods by exporters, and even much less for the export champions.
Figure 16: Share in imports of broad categories of products, by size bin of exporters (2019)

Figure 17: Geographic structure of imports of intermediate products, by size bin of exporters (2019)

Source: French customs, Authors' calculations.
We plot in Figure 18 imports of exporters during the period November-December 2019 to July-August 2020. A drop in imports was noted 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 at the end of January (Bangladesh, China, Indonesia, Japan, Malaysia, Nepal, Taiwan). Imports bottomed out in March-April for exporters of all sizes, except for the top 0.01% of exporters, for whom May-June is worse. Finally, the recovery was even more difficult for the largest exporters in July-August.

To wrap up, before Covid larger exporters imported more intermediate goods as a percentage of their imports, but relatively more from the US or Germany and less from other European countries or China. They also reduce more their imports of intermediate products during the trough of the Covid crisis.

Taking stock of these patterns, the next step is to compute the 12-month (mid-point) growth rate in exports and imports by size bin of exporters in November-December 2019, January-February, March-April, May-June and July-August 2020. Results are shown in Figure ??.

Comparing the adjustment of exports and imports, however, does not tell us much about the dependence of exporters on their global value chains. We need to relate the importance of intermediate imports to the activity of exporters. To do this, we will rely on the balance sheets provided by the Fiben database, after having verified that the Fiben sample of exporters is representative of the population of French exporters. The ratio of imports of intermediate products to sales $IIS_{f,2019}$ will provide information on dependence on GVCs before the Covid crisis. It summarizes a firm’s exposure to foreign supply shocks through imported intermediate inputs by its ratio of imported intermediate inputs to sales:

$$IIS_{f,2019} = \frac{X^M_{f,2019}}{Y_{f,2019}}$$ (8)

Let us first check whether the sample of firms in Fiben is representative. The sample is comprising large
exporters as a result of the threshold of turnover (above 750 keuros): 37% of the 2019 exporters have data in Fiben, but they account for 71% of the 2019 export value. And the export share of firms in Fiben reaches 90% in our top bin as shown in Figure 19. The same conclusion holds if one reproduce the previous exercise of computing the 12-month midpoint growth rate of exports by size bin of exporters for the Fiben sample as shown in Figure 20. We can therefore safely use this sub-sample to investigate the exporter’s exposure to foreign supply shocks through imported intermediate inputs using the IIS ratio as a control in size-estimations.

We previously documented that larger exporters more likely to import and especially more likely to import intermediate goods. Figure 21 confirms that the exporter’s exposure to foreign supply shocks through imported intermediate inputs, as measured by the IIS ratio is increasing in exporter size. There is however lots of variation across exporters within a size bin – a regression of IIS on size bin dummies gives a simple correlation of only 5 percent.

The exposure of individual exporters to the disruption of their value chains is accordingly very diverse and should hardly help explaining the differential impact of the Covid crisis on the largest firms. This can be easily verified by sorting the IIS ratio into deciles or bins of fixed length and introducing associated
Figure 19: Share and export share of exporters in Fiben

Source: French customs and Fiben Bank of France, Authors' calculations.

Figure 20: Growth rate of exports by size bin for all exporters and the Fiben sample

Source: French customs and Fiben Bank of France, Authors' calculations.
dummies $\gamma_{r(f)t}$ in size regressions, on the top of our previous bins of exporter size $\alpha_{b(f)t}$:

$$g_{fkjt} = \alpha_{b(f)t} + \gamma_{r(f)t} + \epsilon_{fkjt}$$  \hspace{1cm} (9)

We plot in Figure 22 the midpoint growth rates by size bin without controlling for the exposure to supply chain disruption and with the $IIS$ control, using either fixed intervals or deciles of exposure: the formerly documented size effect holds when controlling for the $IIS$ ratio.

This exercise is not, however, definitive proof of the absence of a differential impact of the exposure of the largest exporters to supply disruptions of intermediate goods. It is possible that the share of their imported supplies in their turnover is not higher, but that the origin of these intermediate products exposes these firms more to the consequences of lockdowns. To address this issue, we need to weight the share measured in this way by the severity of lockdowns in the countries of origin of these imports. This is what we do by calculating the ratio:

$$\text{Input Supply Shock}_{ft} = \frac{M_{int}^{f,2019}}{Y_{f,2019}} \sum_i \frac{M_{int}^{f,2019}}{M_{int}^{f,2019}} \text{Supply Shock}_{it}$$  \hspace{1cm} (10)

Our main measure of the supply shocks in origin $i$ is lockdown stringency intensity, i.e. 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.

We plot in Figure 23 the midpoint growth rates by size bin without controlling for the exposure to supply chain disruption and with the $IIS$-weighted origin lockdown decile control, using decile fixed effects of exposure: here again the formerly documented size effect holds when controlling for the so-weighted $IIS$
Figure 21: IIS ratio by size bin

Note: import values as weights.
Source: French customs, Authors’ calculations.
Figure 22: Midpoint growth rate of exports by size bin, controlling or not for the IIS ratio

Source: French customs, Authors’ calculations.

Figure 23: Midpoint growth rate of exports by size bin, controlling or not for the IIS ratio weighted by the stringency of lockdowns in sourcing countries

Source: French customs, Authors’ calculations.
2.2 Similar adjustment of top exporters to the lockdown of their suppliers

We study in this section the impact of origin-country lockdown on intermediate goods’ imports of exporters. We also ask whether large exporters have been more affected by these lockdown episodes via the channel of their imports.

We start by regressing the growth rate of imports by exporter, product and origin on a series of fixed effects plus the stringency of lockdown at origin. The equation reads:

$$g_{fik,t} = \alpha \text{Lockdown Stringency}_{i,t} + \beta_{ft} + \gamma_i + \delta_{kt} + \epsilon_{fik,t}$$  \hspace{1cm} (11)

where $g_{fik,t}$ is the mid-point growth rate of imports by exporter $f$ of product $k$ from origin country $i$ during month $t$, as defined above. \textit{Lockdown Stringency}_{i,t} is the value taken by the Oxford Index of stringency in origin country $j$, divided by 100 so that it takes values in the range $[0,1]$. Unobservable shocks to the firm $f$ are captured by a firm-time fixed effect $\beta_{ft}$. Time-invariant destination-origin unobserved characteristics (France is indeed the destination of all imports) are captured by a vector of origin fixed effect $\gamma_i$, and $\delta_{kt}$ a product-time fixed effect capturing any unobserved product-level shock common to all destinations and exporting firms.

To look into potential heterogeneous effects according to size, we add size dummies to Equation 11, constructed using the pre-crisis distribution in Figure 9, but grouping the top exporters into a bin containing the highest 0.1%. We estimate the following baseline equation:

$$g_{fik,t} = \text{Lockdown Stringency}_{i,t} \times \eta_{b(f)} + \beta_{ft} + \gamma_i + \delta_{kt} + \epsilon_{fik,t}$$  \hspace{1cm} (12)

where $\eta_{b(f)}$ 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 origin-time level.

So doing we allow for coefficients to vary by size bin, hence capturing a different elasticity of imports to the Covid crisis by size bin of exports.

Table 1 shows the results of the estimation of Equation 11. The take home is that the correlation of
lockdown stringency at origin with the midpoint growth rate is low. Using 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 when interacting with size bins of exporters, shown in Figure ??, point to the absence of magnification effect for large importers: the confidence 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 a larger impact channeling specifically through the lockdowns in the countries of their suppliers.

We must now turn to the other suspect which is the demand channel.

### 2.3 A stronger reaction of top exporters to lockdowns in their foreign markets

We now want to identify the impact on French exporters of lockdowns at destination. 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. 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.

Using the (export-weighted) Oxford index as a direct measure of exposure to the demand shock, we start by computing a weighted average destination lockdown stringency across size bins. Results shown in Figure ?? show that exporters of different size have been affected evenly as evidenced by the comparison of the line for January with the ones for April and May.

With this proof in hand, we can now run regressions similar to Equation 11, but using the subscript $i$ for destination instead of $i$ for origin, where $g_{fjk,t}$ is now the mid-point growth rate of firm $f$ exports. Consistently, $\text{Lockdown Stringency}_{j,t}$ is now the value taken by the Oxford Index of stringency in the destination country $j$ of the buyer of the exported product $k$, divided by 100. The size bins in Equation 12 are still defined using the distribution of exporters. So doing we identify the average impact of Covid at destination on firm-level exports. This identification strategy takes advantage of the heterogeneous responses of destination countries to the Covid crisis in terms of timing and intensity of lockdown measures: we compare export growth of the same exporter to destination A (strong lockdown) with its export growth to destination B (weak lockdown), controlling for product-level shocks. Such heterogeneous response implies that $\text{Lockdown Stringency}_{j,t}$ varies both across trade partners and across time, providing
us with large variation to identify $\alpha$. 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 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 0.6 percentage points. We will in the next section explore the adjustment of exporters of different size using this specification.

We can now ask whether the demand effect is larger for larger exporters or, in other words, whether the elasticity of exports to the demand shock is larger for larger firms. The estimation of an equation similar to Equation 12, but now for exports, gives us the answer. In Figure 26 we observe that the negative
coefficient associated with the largest exporters is of a higher absolute value. This result are robust to alternative groupings of firms and confirms 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). What we show 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: the elasticity of exports of larger firms to a severe demand shock is larger.

Source: French customs, Author’s calculation.

15While 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.
3 Conclusion

This paper provides a systematic study of the role of firm heterogeneity in the collapse of trade during the pandemic. We use detailed French firm-level data from January to June 2020 for exports and imports, with information on the products and countries of destination and origin of exported and imported goods. A simple decomposition shows that almost all of the adjustment occurred through the intensive margin of firms, as opposed to the extensive margin, despite a large decline in the number of exporters. More importantly, these detailed data clearly indicate a predominant role for the largest firms, whose shipments were reduced more than proportionately. This pattern was also true, albeit to a lesser extent, for exporters during the great financial crisis. With respect to value chains, while the lockdowns in the country of origin of intermediate imports led to a decline in those imports, it is not clear that the large exporters were more severely affected or adjusted their imports more drastically. In contrast, while lockdowns in destination countries affected all firms equally, our econometric results show that major exporters were relatively more affected. These results open the door to many interesting hypotheses about the type of adjustment of these large exporters, why they contributed more than proportionally to the decline in aggregate exports, and what role they had in the rapid recovery of trade. Overall, this paper provides insight into how the size distribution of exporters and the greater elasticity of response at the tail of the distribution jointly determine the dynamic response of aggregate exports to severe shocks.
Bibliography


Appendix

We ask in this Appendix 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 A1 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.

**Figure A1: Contributions to imports of the firm extensive and intensive margins**

![Graph showing contributions to imports of the firm extensive and intensive margins.](image)

*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*

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 A2 and get a similar outcome, suggesting that large firms adjustments are pro-cyclical.

Figure A2: Import share before Covid and contribution during Covid, by size bin, controlling for industry and industry-destination characteristics

Note: Source: French customs, Authors’ calculations

On line appendix
Figure A3: Coverage of aggregate statistics with transaction data

Source: French customs, Authors’ calculations.
Figure A4: Exporters with and without filing obligation (2019-2021)

![Graph showing the number of exporters with and without filing obligation (2019-2021).]

Source: French customs, Authors’ calculations.

Figure A5: Midpoint growth rate vs log change

![Graph showing the midpoint growth rate vs log change.]

Source: French customs, Authors’ calculations.