

Trade Under Lockdown

Antoine Berthou¹ and Sebastian Stumpner²

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ABSTRACT

To curb the effect of the Covid-19 pandemic on public health, many countries around the world introduced lockdown policies in 2020. We estimate the effect of these lockdowns on international trade flows, using a rich dataset of monthly bilateral product-level trade flows that covers roughly three quarters of world trade. Our main findings are: (i) Both exporter and importer lockdowns substantially reduced international trade, with importer lockdowns having a stronger impact; (ii) The effect of lockdowns on trade was strongest during the first wave, and has since been declining; (iii) Beyond the direct effect of lockdowns, we find evidence for indirect effects (i.e. lockdowns by third countries) through global value chains.

Keywords: COVID-19, Impact of Lockdowns, Global Value Chains.

JEL classification: F10, F14, F44.

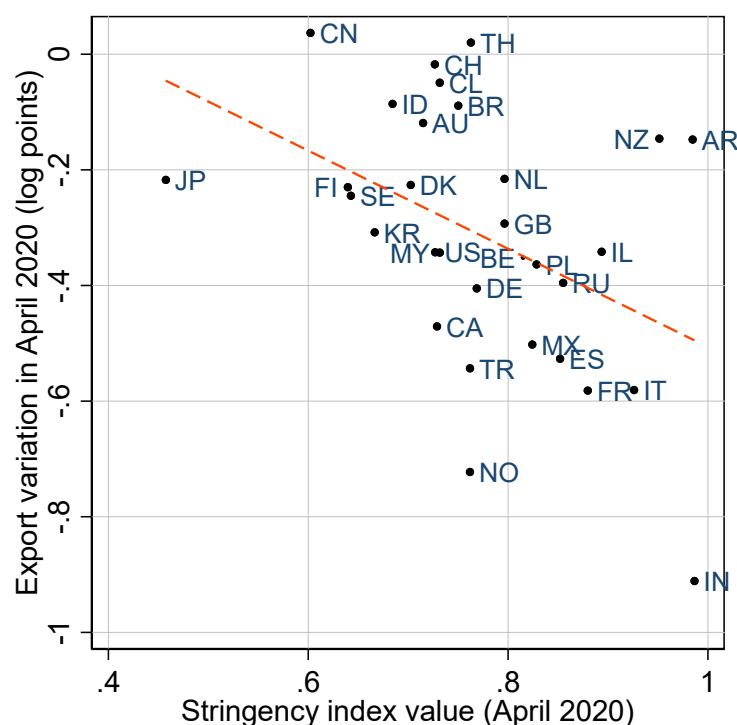
¹ Antoine Berthou : Banque de France and CEPII (email : antoine.berthou@banque-france.fr).

² Sebastian Stumpner : Banque de France (email : sebastian.stumpner@banque-france.fr).

NON-TECHNICAL SUMMARY

To curb the effect of the Covid-19 pandemic on public health, many countries around the world introduced lockdown policies in 2020. These restrictions distorted economic activity on the supply side by disorganizing work, on the demand side by limiting people's ability to consume, or through additional frictions in the functioning of transportation and distribution networks. Adjustments of supply and demand to the new conditions likely impacted bilateral trade in goods between countries, either directly or indirectly through the network of buyers and suppliers in Global Value Chains.

Figure: A stricter lockdown is associated with a steeper decline in exports in the first wave of Covid-19 (Annual Change in Exports and Lockdown Intensity in April 2020).



Note: International trade data from the Trade Data Monitor and data on pandemic-related restrictions from Oxford University.

We estimate the effect of these lockdowns on international trade flows, using a rich dataset of monthly bilateral product-level trade flows, provided by Trade Data Monitor, that covers roughly three quarters of world trade. This very detailed information is combined with data about the intensity of lockdowns implemented in 170 countries in the world. The data cover the entire year 2020 and therefore allow to track the impact of lockdowns on trade during the first wave, and part of the second wave.

We first document that both importer and exporter lockdowns reduced bilateral trade in a sizeable way. We estimate that, on average, bilateral trade in each sector falls by about 10% when an exporter goes into full lockdown, and by about 21% for an importer (full) lockdown.³ This suggests that restrictions weighed more strongly on demand (by both firms

³ A full lockdown corresponds roughly to the lockdown intensity in France during the spring of 2020.

and households) than on the capacity of firms to produce and export, over the entire year of 2020. These estimated effects do not change when we control for other concurrent policies (in particular trade restrictions and fiscal support) or for the evolution of the pandemic itself.

We then show that the effect of lockdowns on trade flows has changed over time. While the lockdowns strongly impacted bilateral trade during the first wave of the pandemic in spring 2020, the magnitude of this effect weakened during the second half of 2020. A likely explanation for this is that both firms and households adapted to the new business environment and expanded possibilities such as work from home or shopping online. By the end of 2020, the effect of lockdowns in the importing country on trade flows had fallen by about two thirds compared to the spring of 2020. We fail to find any significant effects of lockdowns in the exporting country on trade flows by the end of 2020.

Finally, trade between two countries may depend on lockdowns in third countries through global value chains. We measure this indirect dependence from a theoretical GVC accounting framework combined with data from a global input-output table. We find a decline in trade due to forward linkage effects, i.e. a decline in intermediate goods exports that depend on final demand in a third country entering a lockdown. Likewise, we find some support for a decline in trade due to supply disruptions of imported inputs that are used for the production of exported goods (backward linkages).

L'impact des confinements sur le commerce international

RÉSUMÉ

Pour endiguer l'effet de la pandémie de Covid-19 sur la santé publique, de nombreux pays dans le monde ont introduit au printemps 2020 des politiques de confinement. Nous estimons l'effet de ces confinements sur les flux commerciaux internationaux au mois-le-mois, en utilisant des données très riches, détaillées au niveau des produits. Ces données couvrent environ trois quarts du commerce mondial. Nos principales conclusions sont les suivantes : (i) Les mesures de confinement dans les pays exportateurs et importateurs ont réduit de manière substantielle le commerce mondial, les mesures de confinement des importateurs ayant un impact plus fort ; (ii) L'effet des mesures de confinement sur le commerce a été le plus fort au cours de la première vague, et a diminué depuis ; (iii) Au-delà de l'effet direct des mesures de confinement, nous montrons que le commerce bilatéral entre pays a été indirectement affecté en raison des relations commerciales avec des pays tiers via les chaînes de valeur internationales.

Mots-clés : COVID-19, impact des confinements, chaînes de valeur mondiales.

Les Documents de travail reflètent les idées personnelles de leurs auteurs et n'expriment pas nécessairement la position de la Banque de France. Ils sont disponibles sur publications.banque-france.fr

1 Introduction.

Amid the 2020 Covid pandemic, global trade experienced a very deep and exceptionally swift fall. It occurred at a time when many countries around the world relied on lockdown policies, and introduced in particular strong restrictions on people’s mobility to contain the pandemic. These restrictions distorted economic activity on the supply side by disorganizing work, on the demand side by limiting people’s ability to consume, or through additional frictions in the functioning of transportation and distribution networks. Adjustments of supply and demand to the new conditions likely impacted bilateral trade in goods between countries, either directly or indirectly through the network of buyers and suppliers in global value chains (GVCs).

This paper estimates the effect of country lockdown policies on international trade, using a rich dataset of monthly product-level bilateral trade flows that covers roughly three quarters of world trade. The data are at the six-digit HS level (roughly five thousand products) and extend until December 2020, allowing us to study both the collapse and the recovery of world trade. We combine this data with information on country-level lockdown stringency, and estimate its impact on bilateral trade between countries.

Beyond the direct effect of exporter and importer lockdowns, bilateral trade may be affected by lockdowns in third countries through global value chains. Intermediate goods account for well over half of world trade, which makes GVCs a potentially important mechanism for the regional propagation of economic shocks. We therefore focus particularly on the exposure of bilateral trade flows to shocks in third countries through the network of buyers and suppliers in GVCs, combining our detailed trade data with information from global input-output linkages. One of the contributions of this paper is that we track the effect of other countries’ lockdowns on trade through the entire global network of input-output relationships.

Our main results can be summarized as follows: (i) Both exporter and, especially, importer lockdowns had quantitatively sizeable effects on international trade, even when we control for other pandemic-related policies (trade and fiscal policy); (ii) The effect of lockdowns on trade became weaker in the second half of 2020; (iii) We find evidence for effects of third country lockdowns through global value chains (GVCs).

We first document that both importer and exporter lockdowns reduced bilateral trade, and that the magnitude of these effects were sizable. We estimate that, on average, bilateral trade in HS 2-digit sectors falls by about 10% when an exporter goes into full lockdown, and by about 21% for an importer (full) lockdown, suggesting that restrictions

weighed more strongly on demand (by both firms and households) than on the capacity of firms to produce and export. For both types of lockdowns, most of the adjustment comes from a reduction of trade within continuing trade relations defined by HS 6-digits product categories (the intensive margin). The number of traded products between country pairs declines, but adjustments along the extensive margin explain only a small part of the overall fall of world trade.

A potential concern with these estimations is that lockdowns are themselves endogenous events, and depend on the evolution of the pandemic, which likely itself affects the behavior of firms and households. A second concern may be that governments responded to the pandemic not only through lockdowns, but also with other policy measures such as fiscal policy support or outright intervention in international trade flows through restrictions on exports or imports. We address these two concerns by controlling for the evolution of the pandemic and other government policies (trade and fiscal).

We then show that the effect of lockdowns on trade flows has changed over time. While the lockdowns strongly impacted bilateral trade during the first wave of the pandemic in spring 2020, the magnitude of this effect weakened during the second half of 2020. A likely explanation for this is that both firms and households adapted to the new business environment and expanded possibilities such as work from home or shopping online. By the end of 2020, the effect of lockdowns in the importing country on trade flows had fallen by about two thirds compared to the spring of 2020. We fail to find any significant effects of lockdowns in the exporting country on trade flows by the end of 2020.

We next show that demand shocks from lockdowns were transmitted through GVCs. We derive a measure for exposure to demand shocks from a global input-output framework, and simultaneously test for direct effects from importer lockdowns and indirect effects from third country lockdowns. While we do find support for the presence of indirect effects through forward linkages, we find that industries that source their inputs from countries going into lockdown experienced a fall in exports only with a lag (backward linkages).

This paper adds to several strands of literature. First, we add to literature that uses quantitative multi-country trade models to understand the international transmission of shocks during the Covid-19 pandemic (Barrot et al., 2020; Gerschel et al., 2020; Lisack et al., 2020; Bonadio et al., 2020; Sforza and Steininger, 2020). This literature typically models lockdown policies as a reduction in labor supply, which is heterogeneously distributed across sectors due to the possibility of teleworking. Our objective in this paper is an empirical exploration of the effect of lockdowns on international trade, and therefore

complementary to this line of literature.

Second, our paper is closely related to empirical work studying the evolution of international trade during the Covid-19 pandemic. In particular, it is related to papers studying the transmission of Covid-19 shocks through global value chains. [Lafrogne-Roussier et al. \(2021\)](#) and [Meier and Pinto \(2020\)](#) study the effect of the early lockdown in China on economic activity in France and the US, respectively, focusing on an intermediate input channel (backward linkages). Our approach is complementary to these two papers, but focuses instead on world trade and studies the effects of lockdowns in all countries. We also differ by taking into account higher-order GVC linkages, and by looking at both backward and forward linkages.¹

Finally, our work is related to empirical literature analyzing the effect of the pandemic on other outcomes. [Liu et al. \(2021\)](#) and [Heise \(2020\)](#) study import reallocation amid the pandemic. [Meinen et al. \(2021\)](#) explore the regional impacts of Covid-19 and the heterogeneous response of regions due to differences in economic structures and trade relations. [Crozet et al. \(2021\)](#) study the role of letters of credit in the trade collapse. [Fuchs et al. \(2020\)](#) and [Leibovici and Santacreu \(2020\)](#) look at the evolution of trade in some key medical products during the pandemic. [Goldbach and Nitsch \(2021\)](#) explore the Covid-19 effects on capital flows.

The paper is organized as follows. In Section 2, we describe the data, present descriptive evidence on the evolution of world trade, and describe the econometric model. Section 3 presents the baseline estimation results. Section 4 examines the direct and indirect effects of lockdowns through global value chains. The last section concludes.

2 Data and Econometric Strategy.

2.1 Data Sources.

The analysis is based mainly on two data sources. The first source of data is the Oxford Stringency index, compiled by the University of Oxford ([Hale et al., 2020](#)). This measure

¹Other empirical papers such as [Zajc Kejzar et al. \(2021\)](#) and [Espitia Rueda et al. \(2021\)](#) test whether sectors that are generally more or less integrated in GVCs grew differently than other sectors during the recession. However, this is based on ad-hoc indicators of a sector's participation in global value chains (such as the ratio of imported intermediates to exports), and these papers do not specifically derive exposure to foreign shocks through the network of input-output relationships, nor test for these effects. Other papers like [Hayakawa and Mukunoki \(2021\)](#) or [Bas et al. \(2021\)](#) provide estimations of the effects of the pandemic on trade but their analysis does not focus on GVCs.

is updated on a daily basis, but we take monthly averages to harmonize the frequency with trade flow data. In the main analysis and baseline estimations, we use the composite stringency index, which reflects restrictions along different dimensions of the economic and social activity of countries, stemming from school or workplace closing, shops and restaurants, to restrictions on public transportation and international travels.

The second dataset that we use is the detailed export and import information by country pair (“dyad”), product (HS 6-digit) and month compiled from national sources by Trade Data Monitor. Given the very large size of this data at this very detailed level, we restrict attention to data from 31 reporting countries (trading with 170 partner countries). In selecting the 31 countries, we pay particular attention to both high coverage in terms of aggregate trade, and good geographical representation. Our final dataset includes all major trading economies (US, China, Japan, South Korea, several European economies, etc.), and accounts for roughly three quarters of world trade in 2018 (76.8% of world exports and 74.4% of world imports).² The data cover the period from January 2018 to December 2020, and therefore enable us to study both the collapse and the recovery of world trade.

2.2 Descriptive Evidence.

Measuring lockdowns with the Oxford’s Stringency Index.

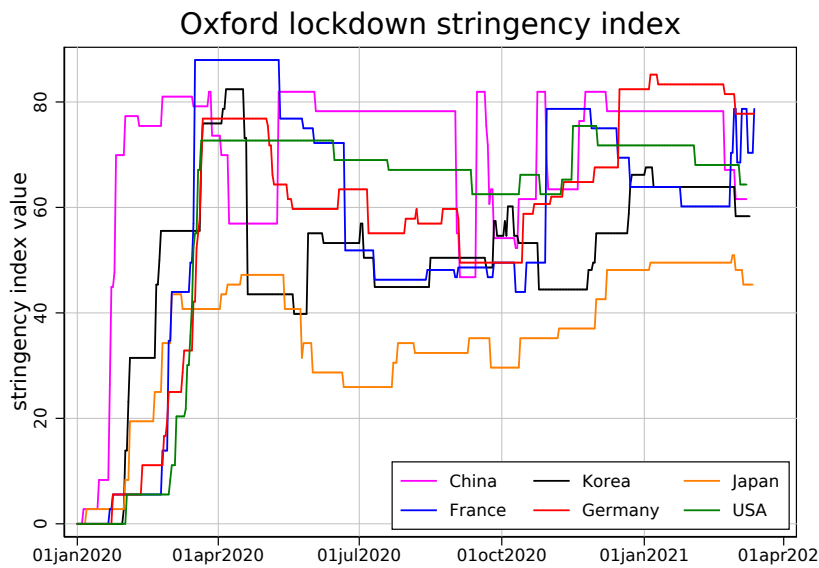
The Covid-19 pandemic triggered a wide range of government responses to limit its spread among the population. This included closing of schools, workplaces, restaurants etc. as well as restrictions to transportation or to international travel. These restrictions can be illustrated using the composite index compiled by researchers from the University of Oxford (Hale et al., 2020) (see Figure 1). Since January 2020, many governments introduced restrictions along the different aspects of economic and social activity covered through the Oxford Stringency index. After an initial peak during the first wave in the spring of 2020, restrictions were progressively lifted and then reimplemented during the second wave in the fall of 2020.

Despite a high correlation in lockdown stringency across countries, it is apparent from

²The complete list of countries includes three North American countries (Canada, Mexico, and the US), three South American countries (Argentina, Chile, and Brazil), 13 European countries (Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Poland, Spain, Switzerland, Sweden, United Kingdom), ten Asian countries (China, India, Indonesia, Israel, Japan, Malaysia, Russia, South Korea, Turkey, Thailand), as well as Australia and New Zealand. The comparison with world trade is done for 2018 using the BACI trade dataset compiled by CEPII.

Figure 1 that restrictions were implemented at different pace and with different intensity across countries. For instance, South Korea adopted substantially stricter policies than Japan, even though the pandemic arrived in both countries at the same time.³ More formally, using all 170 countries in our sample and regressing our country-by-month measure of lockdown stringency for all months in 2020 on a set of time dummies, we find a R2 of 0.66. This implies that about a third of the total variation in the stringency measure is across countries at a point in time.

Figure 1: Oxford lockdown stringency index by country



Note: Composite Oxford Stringency Index, University of Oxford.

Evidence on trade in goods.

We provide in Figure 2 some descriptive evidence regarding the evolution of world trade, proxied by aggregate exports of the 31 countries in our sample. The growth rate of world trade is shown as the sum of the stacked bars (which will be discussed in the next paragraph). Global trade plummeted in April and May 2020 by about 25% year-on-year when lockdowns were implemented for the first time in advanced economies and especially in Europe. Global trade then recovered swiftly returning to positive year-on-year (yoy)

³South Korea reported its first case on Jan 20th, 2020. Japan's first case was noted on Jan 16th, 2020.

growth from September 2020 onwards. Interestingly, this positive yoy growth continued for the remainder of the year, despite a second wave of lockdowns starting in October 2020.

Figure 2 also shows a decomposition of aggregate trade growth into an intensive and extensive margin. The intensive margin is the change in trade within continuing relationships, defined as exporter-importer-product (HS6) cells. The extensive margin captures the contribution of entry and exit of relationships. The black line in Figure 2 shows the growth rate of the number of existing relationships.

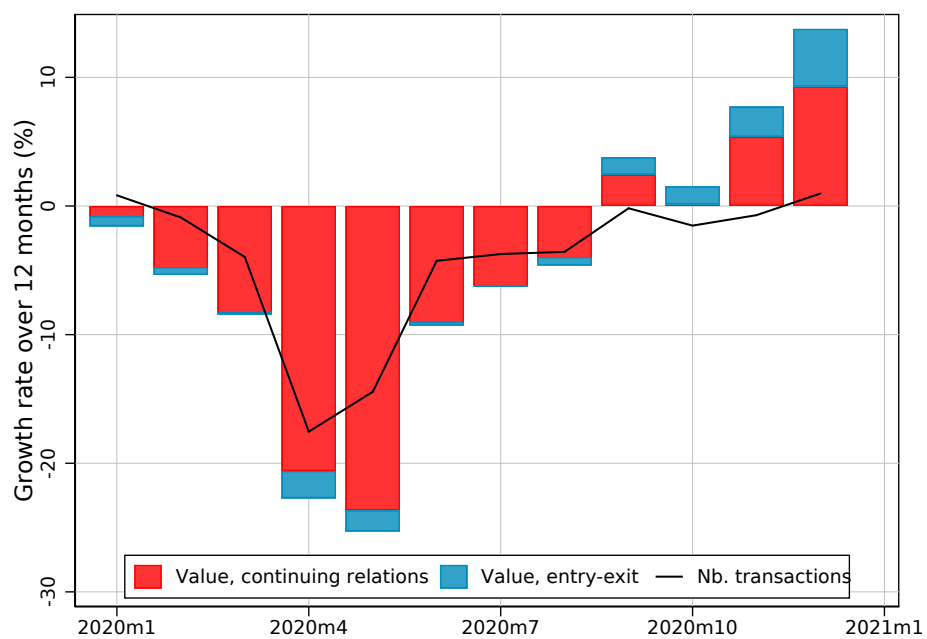
The main takaway here is that the intensive margin made up the bulk of the adjustment. The extensive margin also had a non-negligible contribution, but it appears less dominant. Interestingly, while the number of transactions dropped very significantly in the spring of 2020, its contribution to global exports growth remained limited, meaning that the destruction of trade relations was predominant among relations characterized by small trade values. In the end of 2020, the number of trade relations had barely recovered while the contribution of the extensive margin was positive on a yearly basis, meaning that new trade relations were associated with quite large trade values.

In Figure 3 we decompose the growth of world exports and imports by geographic zones. For this geographic decomposition, we expand the sample to all 101 reporting countries that are covered in TDM (including the 31 countries for which we have detailed trade data). We divide countries into six regions: Europe (EU27 plus UK and Switzerland), the United States, China, advanced Asia (Japan, South Korea and Taiwan), emerging Asia (India, Indonesia, Thailand, Vietnam, Malaysia, Philippines), and all others.

Figure 3 shows that the collapse of world trade in the spring of 2020 was driven by all regions. Europe represented about half of the global export and import losses in April and May 2020, while the trade losses for China concentrated in January and February 2020. China started to recover year-on-year in July 2020, and Europe in November 2020 despite new restrictions being introduced. Exports and imports show quite similar patterns.

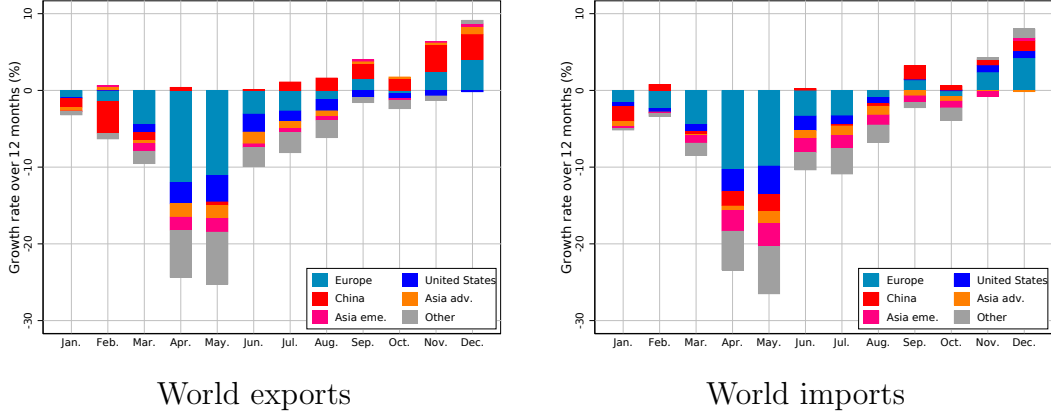
Figure 4 shows that in the spring of 2020, trade growth of individual countries varied systematically with lockdown stringency. The two top figures show the correlation of yearly export and import growth with lockdown stringency in April 2020, respectively. Note that the regression coefficient of both export and import growth with respect to lockdown stringency is close to -1, which would imply that implementing a full lockdown would reduce trade growth by 63ppt ($\exp(-1)-1$). Our main results in section 4 show that this “naive” approach delivers a coefficient that is much too large, mostly because it

Figure 2: World export growth and decomposition (for 31 reporting countries, year-on-year, percentage change).



Note: Total export growth for 31 reporting countries. Yearly growth rate of exports between month m and month m-12. Continuing trade relations correspond to a triplet exporter-importer-product (HS6) where a trade value can be observed in month m and in month m-12. Entry-exit corresponds to the contribution of entry and exit of individual trade flows to the growth of total trade. The number of transactions is simply the percentage change over a year of the number of individual trade flows reported. Raw data detailed by country pair and product from the Trade Data Monitor.

Figure 3: Geographical decomposition of world trade growth in 2020 (year-on-year, all countries)



Note: Aggregate export growth. Raw data detailed by country pair and product from the Trade Data Monitor.

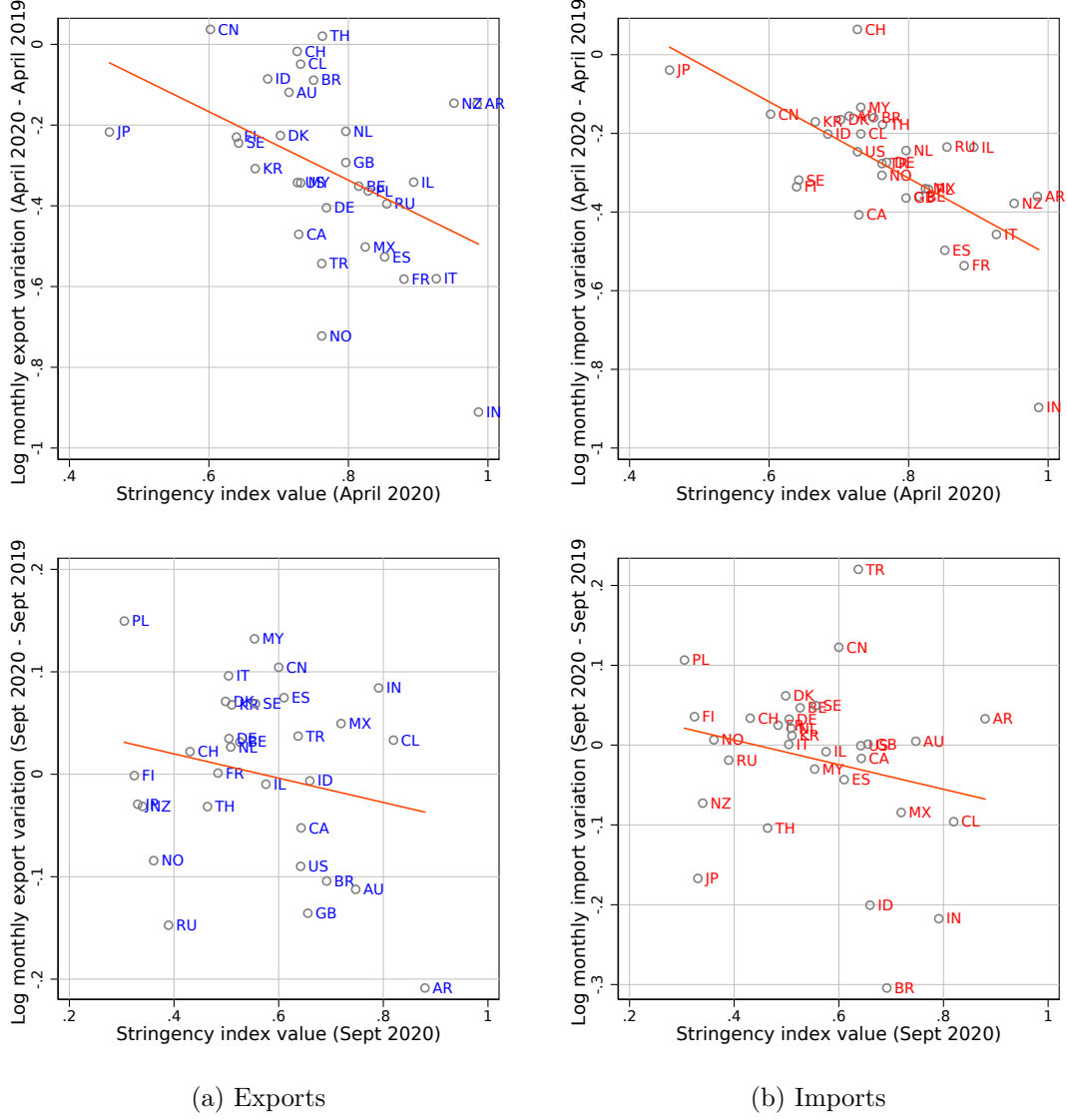
does not control for simultaneous shocks to demand or supply in partner countries (e.g. through lockdowns in these countries). While the graphs show a clear negative correlation for April 2020, this relationship becomes much weaker in the fall of 2020 (bottom graphs, for September 2020), indicating that the effect of lockdowns on trade growth may have been changing over time. We explore the time-variation of the effect more systematically in section 3.3

Finally, Figure 5 presents the total export growth by sector in April 2020 on a year-on-year basis, for the reporting countries in our sample (summed over all countries). The most strongly affected sectors are motor vehicles and parts, Leather, and Railways and Aircrafts. International transactions in these sectors may have suffered from disruptions both on the supply side (organization of production, logistics, transportation) and demand side (shops closed, and more generally organization of work in distribution networks). In our baseline estimations, we abstract from sectoral heterogeneity in the effect, but provide sector-by-sector results in the appendix.

2.3 Econometric Strategy.

The estimation strategy relies on the export (X_{ijkt}) and import (M_{ijkt}) data reported by 31 countries with 252 partner countries in the TDM data, where i is the exporting country, j is the importing country, k is a sector or a product (HS 2-digits in the baseline

Figure 4: Relation between lockdown stringency index and trade growth

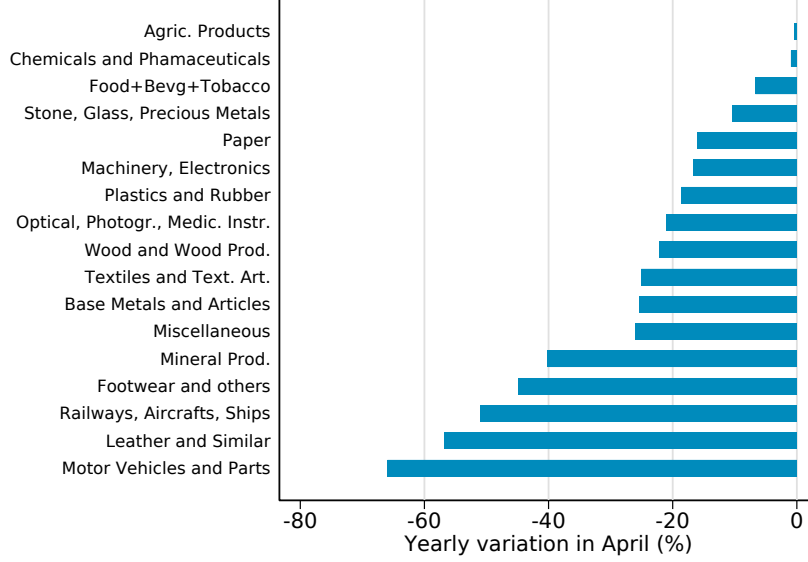


Note: Aggregate export and import growth. Raw trade data from the Trade Data Monitor. Lockdown stringency index from the University of Oxford.

estimations, HS 6-digits when the analysis requires more detail), t is the time dimension of the data (monthly). We merge this data with the University of Oxford's lockdown stringency index, which is updated daily. To match this index with our trade data, we take the monthly average of the index. Once merged we have over 170 potential trade partners for our 31 reporting countries.

Equations 1 and 2 are the two baseline estimated equations in log levels. In the first

Figure 5: Export growth by sector in April (Aggregate, yoy variation)



Note: Aggregate export growth. Raw data detailed by country pair and product from the Trade Data Monitor.

equation, we rely on import flows from the reporting countries in our sample to estimate the effect on the lockdowns in each exporting (partner) country. In the second equation, we rely on export flows from the reporting countries in our sample to estimate the effect of the lockdowns in each importing (partner) country. With this approach, we maximize the number of countries in the dimension where we want to identify the effects of the lockdown's stringency (i.e. about 170 countries). We then saturate the empirical equation with country-product-time fixed effects in the dimension which is not relevant for the analysis: The importer dimension when we estimate the impact of the exporter lockdown, and the exporter dimension when we estimate the effects of the importer lockdown. This fully controls for the demand side effects when we estimate the supply-side effects of lockdowns and vice versa.

$$\ln M_{ijkt} = \alpha \text{Exporter Lockdown Stringency}_{it} + \gamma_{ijk} + \gamma_{jkt} + \epsilon_{ijkt} \quad (1)$$

$$\ln X_{ijkt} = \beta \text{Importer Lockdown Stringency}_{jt} + \gamma_{ijk} + \gamma_{ikt} + \epsilon_{ijkt} \quad (2)$$

We estimate two parameters in these equations. The trade impact of lockdown strin-

gency in the exporting country (α) and the trade impacts of the lockdown stringency in the importing country (β). γ_{ijk} is an exporter-importer-product fixed effect controlling for time-invariant country-pair characteristics impacting the level of exports (distance, language etc.). γ_{jkt} is an importer-product-time fixed effect in import Equation 1, controlling fully for demand shocks. γ_{ikt} is an exporter-product-time fixed effect in export Equation 2, controlling fully for supply shocks.

With this set of fixed effects, our identification is based on the cross-country differences in the implementation of lockdown measures over time, controlling for the average rise in restrictions at the global level. This is a Difference-in-Difference: We identify the effect of an importer lockdown by comparing (e.g.) the change in French exports of wine to Korea (which imposed a more restrictive lockdown) relative to the change in French exports of wine to Japan (lighter lockdown). The idea is that any French wine-specific supply shock affects both export flows equally, and is therefore captured by γ_{ikt} .

Note that our estimation strategy departs from the structural estimation of a gravity equation, where we would saturate the empirical model with exporter-by-product-by-time and importer-by-product-by-time fixed effects to capture multilateral resistance terms. This approach has been used for instance to capture the effects of bilateral distance, trade agreements or tariffs on bilateral trade between countries. In our case, the shock is not bilateral but country-specific so that we cannot absorb time-varying effects for both the exporter and the importer. Instead, we choose to saturate the model on the exporter side when we estimate the effects of the importer lockdown, and conversely saturate the model on the importer side when we estimate the effects of the exporter lockdown. This strategy allows to control for multilateral resistance terms for the exporter or the importer. Notice also that most of the literature estimating structural gravity equations uses yearly data, while we employ monthly data. To the extent that the multilateral resistance terms are constant over time, they would be captured by the exporter-by-importer-by-product fixed effects.

There are two main threats to identification. First, lockdowns are endogenous events. In particular, they likely are an outcome of the local intensity of the pandemic, which could also impact directly trade flows as economic agents adapt to the new conditions in terms of working or consumption attitudes.⁴ The effect of a lockdown on trade may

⁴Recent work however suggests that country-level institutional factors also mattered for the decision of governments to implement a hard or soft lockdown. For instance, [Ferraresi et al. \(2020\)](#) use daily data on lockdown stringency during the first wave and show that countries closer to the next election and politically more centralised countries were more likely to implement stricter lockdowns. They also report that stringency was higher in more developed economies.

therefore reflect the intensity of the pandemic rather than the implementation of strict administrative measures per se. Second, countries could also implement other policies to address either the need to secure enough supplies for critical goods and equipments (trade policy) or to cushion the adverse effects of the pandemic on economic activity (fiscal policy).

These are different sources of omitted variable bias. We address both of these threats by directly controlling for the evolution of the pandemic (measured as death count) or for concurrent changes in trade and fiscal policy. All of our main results are robust to introducing these controls, which is shown in the appendix.

3 Baseline Results.

3.1 Effect of Lockdowns on Bilateral Trade.

Baseline estimation results can be found in Table 1. Columns 1-2 report the results from estimating the import equation where we identify the effects of the lockdown stringency in the exporting country, at different levels of disaggregation of the data: Imports in HS2 sectors or imports by HS6 product category. Columns 3-4 show results for the equation using reported exporter flows, which we use to estimate the effect of importer lockdowns.

The results show a strong negative effect of both exporter and importer lockdowns on bilateral trade. Our baseline specification uses flows at the HS2 level of aggregation (columns 1 and 3, respectively). The coefficient of -0.101 on exporter lockdown stringency implies that an exporter going into full lockdown reduces bilateral trade by -9.6% ($=\exp(-0.101)-1$). The effect is slightly smaller when we move to the HS6 level, which likely reflects the fact that the log change at the HS2 level also includes disappearing HS6 flows as long as the relationship continues at the HS2 level. However, even at the HS6 level, which reflects the adjustment at the intensive margin, the coefficient implies a reduction of bilateral trade by -7.0%.

The estimation results of the impact of the importer's lockdown stringency on the value of bilateral trade are detailed in columns 3-4 of Table 1. The baseline result using HS2 flows implies a reduction in bilateral trade by -21.3% following a full importer lockdown, substantially larger than the effect of an exporter lockdown. This difference also persists at the HS6 level, showing that an importer lockdown had a stronger effect on trade also at the intensive margin. Overall, the larger coefficient on importer lockdown stringency sug-

gests that restrictions weighed more strongly on demand (by both firms and households) than on the capacity of firms to produce and export.

Table 1: Impact of lockdown stringency in origin and destination countries

	(1)	(2)	(3)	(4)
Dep. var.	Log value of monthly trade flows reported by 31 countries			
Reporter flow	Import		Export	
Aggregation	HS2	HS6	HS2	HS6
Stringency index X	-0.101 ^a (0.021)	-0.073 ^c (0.038)		
Stringency index M			-0.240 ^a (0.018)	-0.183 ^a (0.017)
R ²	0.88	0.85	0.86	0.82
Obs.	5,379,965	62032305	6,936,773	82808354
Period	2018-2020			
Fixed effects	ijk+jkt	ijk+jkt	ijk+ikt	ijk+ikt
	Effect of complete lockdown on bilateral trade			
Quantification (%)	-9.6%	-7.0%	-21.3%	-16.7%

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. In columns 1-2, standard errors are clustered by origin country and time, and by destination country and time in columns 3-4. The lockdown stringency index ranges from 0 and 1. Fixed effects are exporter-importer-product (*ijk*), and either exporter-product-time (*ikt*) or importer-product-time (*jkt*).

3.2 Extensive Margin.

As discussed above, the aggregate impact of lockdowns on bilateral trade flows combines two margins of adjustment: The reaction of the bilateral export or import value by product (detailed in Table 1), and the reaction through the number of sector or products traded within country pairs. These two effects combined explain the strong impact of lockdowns on the value of bilateral aggregate exports or imports.

We complete our baseline investigation by estimating the effects of the lockdown stringency in exporting and importing countries on the log number of HS6 products traded between country pairs. We also estimate the effects of lockdowns on the number of HS2 sectors in which trade flows can be observed. Finally, we estimate the effects of lockdowns on the log number of HS6 products within HS2 sector categories. This approach allows to track the covid impacts across different sectors (aeronautics, cars, chemicals etc.) or

across detailed products within each of these sectors. The empirical specification is very similar to the one used for our baseline estimations: The dependent variable in the estimation is now the log number of sectors or products traded between country pairs, and the estimation results are obtained using OLS.

Estimation results are detailed in Table 2. In columns (1) and (2) we confirm that lockdowns had an impact on both the total number of HS6 products being exported and imported within country pairs. This result is explained by both a decline in the number of HS2 sectors traded (columns 3 and 4) and a decline in the number of HS6 products traded within country pairs and sectors. Mirroring the intensive margin results (columns 2 and 4 of table 1), we find that changes in the extensive margin are larger following an importer lockdown compared to an exporter lockdown.

These results indicate that the drop in aggregate trade flows due to lockdowns within country pairs is explained by a combination of the drop in the value of bilateral exports and imports for detailed products, and a drop in the number of products traded as well. This decline in the number of products traded is not the result of some specific sectors being impacted (e.g. aeronautics). Instead, the number of products traded have declined in response to sanitary restrictions within each individual sector.

3.3 Changing Effects Over Time.

Is the impact of restrictions on economic activity changing over time? As lockdowns were introduced in Asia and then in Europe during the winter and spring of 2020, all economic agents (producers, consumers, wholesalers, retailers, as well as the transport sector) had to adapt suddenly to new economic and social conditions. This shock was largely un-anticipated and translated into disruptions on supply, demand / distribution, and transport / logistics. However, as the first wave of the pandemic hit new countries, firms and consumers also adapted to the new conditions, in particular via a wider use of teleworking. In a number of countries, the lockdowns implemented during the second wave did not reach the level of restrictions observed during the first wave, which left economic activity less affected during the second half of 2020.

We explore here whether the effects of lockdowns on trade flows has been changing during the year 2020. To do this we re-estimate our baseline equation, but augment it with interaction terms between the lockdown index and time dummies identifying two-month periods (“bi-mesters”). Each coefficient in this estimation therefore identifies the effects of lockdown’s stringency on bilateral exports or imports within HS2 products at a different

Table 2: Impact of lockdown stringency on the extensive margin of bilateral trade

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	Log of product extensive margin reported by 31 countries					
Reporter flow	Import	Export	Import	Export	Import	Export
Margin	Nb. HS6		Nb. HS2		Nb. HS6 within HS2	
Aggregation	Country pairs		Country pairs		Country pair and HS2	
Stringency index X	-0.122 ^a (0.016)		-0.093 ^a (0.013)		-0.033 ^a (0.007)	
Stringency index M		-0.197 ^a (0.018)		-0.115 ^a (0.012)		-0.128 ^a (0.008)
R ²	0.98	0.97	0.96	0.95	0.94	0.93
Obs.	171,624	175,439	171,583	175,428	5,387,213	6,939,801
Period	2018-2020					
Fixed effects	ij+jt	ij+it	ij+jt	ij+it	ijk+jkt	ijk+ikt

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Fixed effects : i = exporter, j = importer, k = product or sector, t = time (month and year). Trade data from the Trade Data Monitor and originally reported by country-pair and month.

point in time. The exact specifications are reported in equations 3 and 4.

$$\ln M_{ijkt} = \sum_{v=1}^6 \alpha_v \text{Exporter Lockdown Stringency}_{it} * D_v + \gamma_{ijk} + \gamma_{jkt} + \epsilon_{ijkt} \quad (3)$$

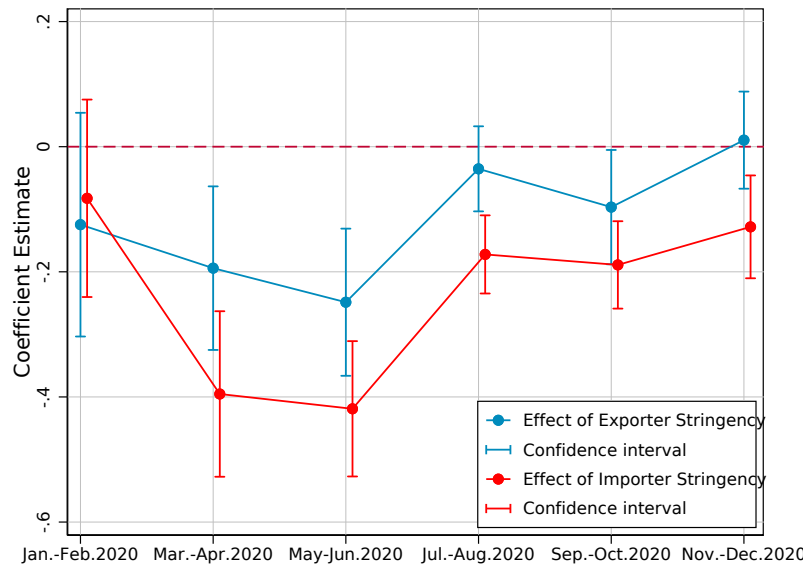
$$\ln X_{ijkt} = \sum_{v=1}^6 \beta_v \text{Importer Lockdown Stringency}_{it} * D_v + \gamma_{ijk} + \gamma_{ikt} + \epsilon_{ijkt} \quad (4)$$

Figure 6 reports the evolution of the effect of lockdowns, implemented in the exporting country (blue line) or importing country (red line), on bilateral trade over time.

We draw two main conclusions from this figure. First, the effect of both exporter and importer lockdown on trade was strongest in the spring of 2020, and has since been declining. As mentioned above, a likely explanation for this is the adaptation of both firms and households to the new environment. Teleworking was extended in many economic sectors, and, with the exception of activities where social interactions are required (e.g. bars and restaurants), allowed for a continuation of economic activity.

Second, the effect of importer lockdowns is consistently stronger than that of exporter lockdowns. By the end of 2020, the effect of lockdowns imposed in the exporting country on bilateral trade is no longer different from zero, which implies that the adaptation allowed exporters to supply their foreign clients irrespective of lockdowns implemented in their own country. In contrast, importer lockdowns continued to reduce bilateral trade even towards the end of 2020. This suggests that even after several months of adaptation, restrictions had a stronger effect on consumer demand than they did on the capacity of firms to export.

Figure 6: Effect of lockdowns on trade flows over time



4 The Role of Global Value Chains.

The analysis so far has focused on direct effects of lockdowns, imposed in either the exporting or the importing country, on bilateral trade. However, the demand and supply disruptions following lockdowns may have not only affected trade flows directly, but also indirectly through global value chains. For instance, exports of a country might be adversely affected if it cannot source intermediate inputs from abroad due to a lockdown in input-supplying countries (backward linkages). Likewise, exports may fall if the destination country uses the goods as inputs for the production of goods sold to a third country,

and a lockdown in that third country reduces demand (forward linkages).

4.1 Forward Linkages.

We start by focusing on the role of forward linkages in the equation that estimates the effect of importer lockdowns.⁵ The goal is to derive an expression that captures demand shocks from lockdowns in either the importing country or any other third country, and to then test for these effects separately in the same estimation.

To derive this expression, we make use of a multi-country, multi-industry input-output framework as in Bems et al. (2011), Johnson and Noguera (2012), and Stumpner (2019). This framework allows us to account for direct demand shocks from the importing country, and all (first, second, or higher-order) demand shocks from any third country.

Output Y_{is} of country i in sector s can be either used as intermediate input by sector $v \in \{1, \dots, S\}$ in country $j \in \{1, \dots, N\}$ (X_{ijsv}^M), or used for final demand in country j (X_{ijs}^C) (suppressing time subscripts for the moment). The market-clearing condition is then:

$$Y_{is} = \sum_j \sum_v X_{ijsv}^M + \sum_j X_{ijs}^C = \sum_j X_{ijs}$$

where $X_{ijs} = \sum_v X_{ijsv}^M + X_{ijs}^C$ are total shipments from country i to country j in sector s .

Let $a_{ijsv} \equiv \frac{X_{ijsv}^M}{Y_{jv}}$ denote expenditure on inputs from country i , industry s , as a fraction of gross output in the destination industry. We collect the coefficients in the matrix

$$A_{ij} = \begin{bmatrix} a_{ij11} & a_{ij12} & \dots & a_{ij1S} \\ a_{ij21} & \ddots & & \\ \vdots & & & \\ a_{ijS1} & \dots & \dots & a_{ijSS} \end{bmatrix}$$

We can then write the global input-output matrix as follows:

$$A_{NS \times NS} = \begin{bmatrix} A_{11} & A_{12} & \dots & A_{1N} \\ A_{21} & \ddots & & \\ \vdots & & & \\ A_{N1} & \dots & \dots & A_{NN} \end{bmatrix}$$

⁵Note that in this equation we fully control for exporter-product-month shocks, and therefore also for potential shocks from backward linkages.

The system of market clearing conditions can then be written as

$$Y = AY + \sum_j X_j^C = \sum_j \Omega X_j^C, \quad (5)$$

where $\Omega \equiv (I - A)^{-1}$ is the Leontief inverse, X_j^C denotes the $(NS \times 1)$ vector of final expenditure by country j : $X_j^C = [X_{1j1}^C, X_{1j2}^C, \dots, X_{NjS}^C]'$, and $Y = [Y_{11}, Y_{12}, \dots, Y_{NS}]'$ is the $(NS \times 1)$ vector that contains gross output in all countries and sectors.

Output of sector s in country i can then be written as a function of final demand:

$$Y_{is} = \sum_{j=1}^N \sum_{k=1}^N \sum_{v=1}^S \omega_{iksv} X_{kqv}^C = \sum_{j=1}^N \phi_{ijs}$$

where ω_{iksv} is the (s, v) element in the (i, k) block of the Leontief inverse Ω . The term ω_{iksv} captures the amount of gross output of country i and sector s that is used (either directly or indirectly) to produce one unit of gross output in country k and sector v . Multiplying by final demand in any country j of the product produced by country k and sector v , X_{kqv}^C , and summing over all countries k and sectors v , we find the amount of output (in value) by country i and sector s that is used, directly or indirectly, to satisfy final demand in country j . We denote this term by $\phi_{ijs} \equiv \sum_{k=1}^N \sum_{v=1}^S \omega_{iksv} X_{kqv}^C$.

Assuming that the shock to final demand only varies at the country level, we have $\Delta \log(X_{kqv}^C) = \Delta \log(X_j^C)$, and

$$\Delta \log(Y_{is}) = \sum_j \frac{\phi_{ijs}}{Y_{is}} \Delta \log(X_j^C), \quad (6)$$

where we further assume that global input-output coefficients a_{ijsv} are fixed.⁶ This equation says that the decline in gross output is a weighted average of the demand decline in all countries of final demand, where the weights $\frac{\phi_{ijs}}{Y_{is}}$ sum to one and equal the share of gross output that is used, directly or indirectly, to satisfy final demand in country j .

We then use this equation to find an expression for the change in bilateral product-level exports as a function of demand shocks in all destinations. Using the market clearing condition for X_{ijs} , $X_{ijs} = X_{ijs}^C + \sum_v X_{ijsv}^M$, and taking a first order approximation, we

⁶This is exactly true in a model where the elasticity of substitution between intermediate goods and other production factors is one, and also the elasticity of substitution between intermediate goods from different sectors and different origin countries is one.

have

$$\begin{aligned}
\Delta \log(X_{ijs}) &= \frac{X_{ijs}^C}{X_{ijs}} \Delta \log(X_{ijs}^C) + \sum_t \frac{X_{ijsv}^M}{X_{ijs}} \Delta \log(Y_{jv}) \\
&= \underbrace{\frac{X_{ijs}^C}{X_{ijs}} \Delta \log(X_j^C)}_{\text{Direct Demand Change}} + \underbrace{\sum_t \frac{X_{ijsv}^M}{X_{ijs}} \sum_k \frac{\phi_{jkv}}{Y_{jv}} \Delta \log(X_k^C)}_{\text{Indirect Demand Change}} \\
&\quad \underbrace{\hspace{10em}}_{\text{Total Demand Change}}
\end{aligned}$$

where we substitute equation 6 in the second step.

The first term on the RHS captures direct exposure to demand shocks in state j . It equals the share of exports that is used for final demand in country j times the size of the demand shock. The second term captures all first- and higher-order indirect effects. Through these effects, exports from country i to country j may be affected by demand shocks in a third country k (the country of final demand). It equals the share of exports used as intermediate input by sector v in country j , times the share of that sector's output that is consumed, directly or indirectly, by country k , and is then summed over all recipient sectors v in country j . The sum of direct and indirect demand changes then gives the total demand change exposure for bilateral exports.

The indirect demand term captures both exposure to final demand changes in the export destination country (if an exported intermediate input is used in production in the destination country to produce a final good that is consumed in the destination country) and to final demand changes in the rest-of-the-world (ROW). To single out exposure to ROW demand changes, we therefore unpack this term as follows:

$$\text{Indirect Demand Change}_{ijs} = \underbrace{\sum_v \frac{X_{ijsv}^M}{X_{ijs}} \frac{\phi_{jjv}}{Y_{jv}} \Delta \log(X_j^C)}_{\text{Indirect Importer Demand}} + \underbrace{\sum_v \frac{X_{ijsv}^M}{X_{ijs}} \sum_{k \neq j} \frac{\phi_{jkv}}{Y_{jv}} \Delta \log(X_k^C)}_{\text{Indirect ROW Demand}}$$

To measure input-output linkages, we use data from the OECD global input-output framework which covers 36 sectors (among which roughly 20 tradable sectors) for 64 countries and a ROW aggregate for 2015 (the most recent year available).⁷ The global IO table is based on the ISIC Rev. 4 industry classification, and we aggregate our bilateral product-level trade flow data to that level using a HS6-to-ISIC Rev 4 concordance table.

⁷The 36 sectors include one agriculture sector, three mining sectors, 16 manufacturing sectors, and 16 service sectors.

In the estimation we focus on exports of manufacturing industries only, but our measures capture all indirect exposure to demand shocks that arise from exports of manufactured intermediate goods that are used in the production of services.

We approximate the change in final demand by our measure of lockdown stringency, $\Delta \log(X_j^C) = \text{Stringency}_j$ (suppressing a time subscript) for each of the terms above, and construct a new set of RHS variables that capture both direct and indirect exposure to demand changes.

Results are in table 3. Since estimations are now conducted at a different level of aggregation (different set of partner countries and different sectoral level of aggregation both determined by IO data), we start in column 1 by re-running our original estimation. The coefficient estimate that we find is very similar to the one found in our original data at the HS2 level (column 3 of table 1).

Table 3: Impact of lockdown stringency on trade : Forward linkages

	(1)	(2)	(3)	(4)
Dep. var.	Log value of monthly exports reported by 31 countries			
Reporter flow	Export			
Importer Lockdown Stringency	-0.267 ^a (0.033)			
Total Demand		-0.361 ^a (0.041)		
Direct Demand			-0.372 ^a (0.043)	-0.327 ^a (0.040)
Indirect Demand			-0.345 ^a (0.044)	
Indirect Importer Demand				-0.378 ^a (0.049)
ROW Demand				-0.218 ^a (0.056)
R ²	0.91	0.91	0.91	0.91
Obs.	1,180,956	1,171,102	1,171,102	1,171,076
Period	2018-2020			

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by destination country and time. Lockdown stringency index from University of Oxford (with range between 0 and 1). Each estimation includes exporter-importer-sector and exporter-sector-time fixed effects.

Column 2 introduces our new variable of the total demand change, taking into account all

direct and indirect linkages. The coefficient estimate is larger in magnitude than the one in column 1, although the difference is not very large. One possibility for this difference is that the new measure captures exposure to demand shocks more accurately than the simple importer effect, so that measurement error dilutes the estimated effect of demand shocks in column 1.

Column 3 shows that the effect of the total demand change is driven both by exposure to direct and to indirect demand changes. We split up the total demand change into its two components, and find coefficients of very similar magnitude. This would suggest that distance to final demand is not an important factor in determining the magnitude of the decline in trade flows.

Finally, we trace some of the indirect demand changes to lockdowns in the rest of the world. The last columns of table 3 further splits up indirect demand into indirect importer demand and indirect ROW demand. The negative and significant effect on the ROW demand variable shows that lockdowns in the rest of the world reduced bilateral exports through forward linkages.

4.2 Backward Linkages.

To estimate the effect of backward linkages, we follow a slightly different strategy. Controlling fully for the importer demand side, exports of a country and industry may be affected either through a lockdown at home (which may affect productivity of local firms) or by a lockdown in other countries from which local firms source their intermediate inputs. This implies that, when estimating the effect of backward linkages, we should still control for local lockdown stringency of the exporting country in order to control for effects on productivity of local firms. This is unlike the estimation on the importer side, where the variable capturing total demand changes replaces importer lockdown stringency.

According to input-output data, firms source a large share of intermediate inputs domestically. This implies that a shock based on all intermediate input purchases - including domestic ones - would be highly correlated with domestic stringency. In order to avoid this problem, we focus only on imported intermediate inputs.

We construct a weighted average of lockdowns in sourcing countries, with weights equalling

import shares:⁸

$$\text{Imported Intermediate Inputs}_{jv} = \sum_i \sum_s \frac{X_{ijsv}}{\sum_i \sum_s X_{ijsv}} \text{Stringency}_i$$

Results that include this measure can be found in table 4. We again start by redoing our original estimation in this new sample in column 1. Including only the imported intermediate inputs measure, we find a negative and significant effect (column 2) which disappears, however, once we control for exporter stringency (column 3).

Table 4: Impact of lockdown stringency on trade : Backward linkages

Dep. var.	(1)	(2)	(3)	(4)
	Log value of monthly exports reported by 31 countries			
	Import			
Reporter flow				
Exporter Stringency	-0.188 ^a (0.029)		-0.183 ^a (0.032)	-0.164 ^a (0.030)
Imported Intermediate Inputs		-0.241 ^a (0.083)	-0.050 (0.090)	
Imported Intermediate Inputs (Lag)				-0.251 ^b (0.122)
R ²	0.92	0.92	0.92	0.93
Obs.	1,210,031	1,210,031	1,210,031	1,128,058
Period	2018-2020			

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Fixed effects : i = exporter, j = importer, k = product or sector, t = time (month and year). Trade data from the Trade Data Monitor and originally reported by country-pair and month.

However, the effects of disruptions in the sourcing of intermediate inputs may affect exports only with a lag. In column 4, we introduce instead a lagged measure of imported intermediate goods (average of months $t - 1$ to $t - 3$), where we do find some evidence for backward linkage effects.

In sum, we conclude that we find mixed evidence for the presence of backward linkage effects, but stronger evidence for the role of forward linkage effects.

⁸In most countries, the share of intermediate inputs sourced domestically is very high. This implies that any measure that includes the domestic country as a sourcing country will be highly correlated with the exporter stringency.

5 Conclusion

This paper presents an analysis of the effects of lockdowns during the Covid-19 pandemic on international trade between countries. The estimation results point to a strong negative impact of lockdown policies on bilateral trade, during the first wave of the pandemic in 2020. This effect was particularly pronounced on imports, and it is robust to controlling for different policies that were implemented around the same time (trade policy, fiscal support), and to controlling for the evolution of the pandemic itself. We also find that the effect then dissipates or weakens by the summer of 2020, which suggests that individuals and firms adapted quickly to the new conditions.

In the second part of the paper, we study the role of GVCs for the transmission of shocks. While other literature on GVCs during Covid has analyzed the role of backward linkages for exports during the trade downturn, we study the role of both backward and forward linkages. For forward linkages in particular we develop an analytical framework that allows us to track the effect of lockdowns on trade through higher-order linkages. Combining global input-output tables with trade flow data, we show that indirect dependence on final demand in third countries contributed to a decline in bilateral exports.

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A Robustness analysis.

A.1 Lockdowns versus pandemic.

In this exercise we try to answer this question: Was global trade impacted due to the stringency of lockdown, or due to a change in agents behaviors on the supply or demand sides in the presence of a greater risk for health? Indeed, consumers may for instance choose not to consume in the presence of a higher risk of being infected in retail stores despite only weak restrictions to social or professional activity. Similarly, workers may decide not to go working if they perceive a higher risk of contamination if they use public transports.

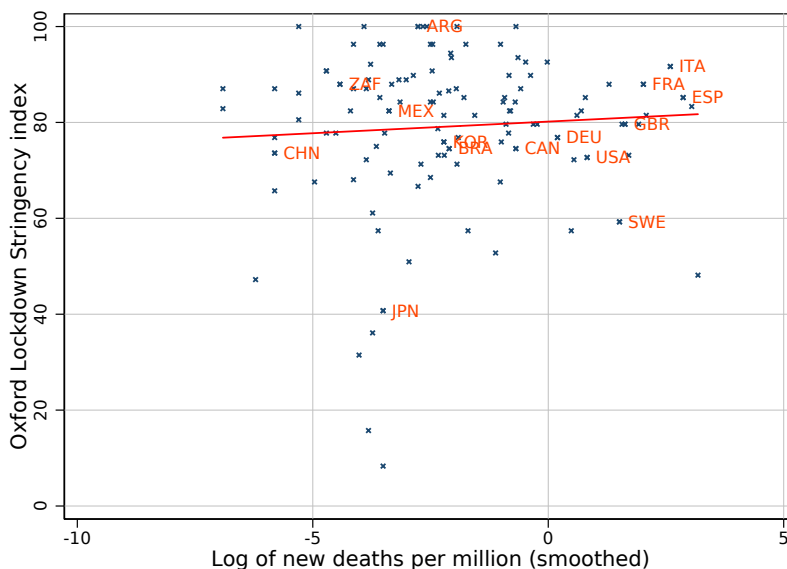
Ideally we would like to use data on positive tests obtained within each country and month, but the testing policy has proved to be quite heterogeneous and erratic especially during the first wave of the pandemic. Instead, identified deaths due to Covid-19 prove to be a more reliable indicator of the spread of the pandemic, with a good coverage across countries. Though this indicator may suffer from mis-reported cases, it can be considered as a proxy for the spread of the virus.

We report in Figure 7 the correlation between the Oxford lockdown stringency index and the log of new deaths by Covid-19. The correlation appears broadly positive: Countries facing more new deaths by Covid-19 introduced more stringent lockdowns in April 2020. However, there is also a substantial noise in this relation. Among European countries in April 2020, Sweden introduced much fewer restrictions to economic and social activity for a given level of new deaths compared to, e.g., Germany or France.

In the econometric analysis, we augment our baseline equation, which now includes as an explanatory variable the log of one plus the number of deaths for each country and month, downloaded from the website of Our World in Data (OWID). We re-estimate with this additional control our baseline estimation based on exporter-importer-HS2 trade data. The estimation controls for the baseline set of fixed effects.

Estimation results are reported in Table 5. Our results on the effects of exporter or importer lockdowns on trade are only weakly impacted by these extra controls. In columns 1 and 3, we report for the reference our baseline estimation results obtained when using the log of bilateral trade in HS2 sectors as the dependent variable.

Figure 7: Oxford lockdown stringency versus new deaths by Covid-19.



Note: Data from Our World in Data. Oxford lockdown stringency and $\text{Log}(1+\text{new deaths smoothed per million})$ as of April 1st, 2020.

On the one hand, in column 2, the death toll in the exporting country has no significant impact on bilateral trade, and in column 3 the coefficient on the exporter lockdown variable is unchanged. On the other hand, in columns 5 and 6, the number of deaths due to the Covid-19 pandemic as reported in the importing country seem to be detrimental to the value of bilateral trade. However, introducing this additional control only weakly modifies the coefficient on the importer lockdown variable.

All in all, these estimations suggest that we are really well capturing the effects of sanitary restrictions on bilateral trade, and not the correlated effect due to restrictions self-imposed by individuals (consumers or workers) in the presence of the pandemic waves.

A.2 Policy I: Trade policy.

As discussed in the introduction of this paper, a second source of bias is related to the concomittant implementation of trade policies during the pandemic. Indeed, some countries in need of medical products or personal protective equipments have eased the conditions to import such goods especially during the first wave in 2020. Similarly,

Table 5: Impact of lockdown stringency on trade: controlling for deaths cases

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	Log value of monthly trade flows reported by 31 countries					
Reporter flow	Import			Export		
Stringency index X	-0.101 ^a (0.021)		-0.111 ^a (0.023)			
Log(1+deaths per million, X)		-0.002 (0.005)	0.008 (0.005)			
Stringency index M				-0.240 ^a (0.018)		-0.214 ^a (0.020)
Log(1+deaths per million, M)					-0.040 ^a (0.005)	-0.020 ^a (0.006)
R ²	0.88	0.88	0.88	0.86	0.86	0.86
Obs.	5,379,965	5,379,965	5,379,965	6,936,773	6,936,773	6,936,773
Period	2018-2020					
Fixed effects	ijk, jkt			ijk, ikt		

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Deaths cases from Our World in Data. Fixed effects : i = exporter, j = importer, k = product or sector, t = time (month and year). Trade data from the Trade Data Monitor and originally reported by country-pair and month.

countries producing such goods have – in some cases – introduced restrictions on their export.

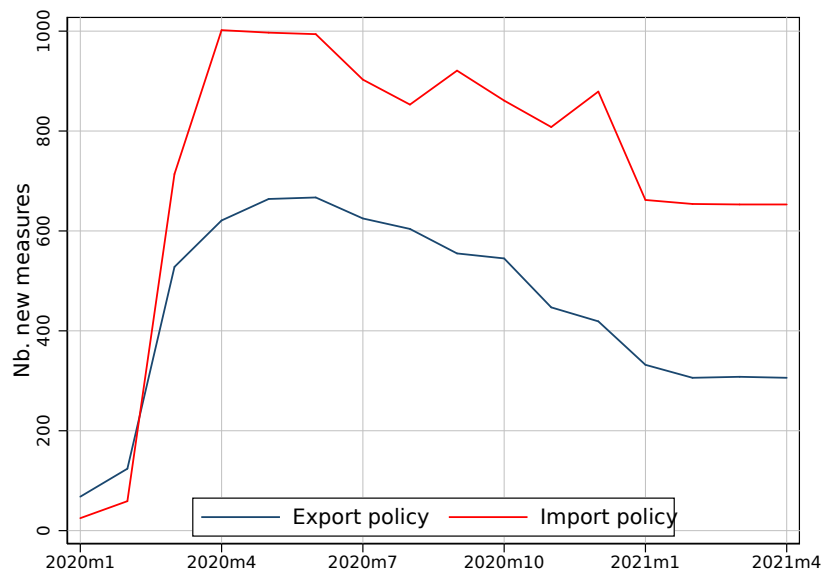
A list of such trade policy actions was published by the World Trade Organization (WTO) (“COVID-19: Measures affecting trade in goods”) with dates of implementation of such measures and the Harmonized System codes of targeted products.

Descriptive evidence.

We report in Figure 8 a simple count of the number of export and import policies introduced during the pandemic in 2020. Export policies are generally restrictive and for example prohibit the export of certain PPEs during a given period of time. Import policies on the contrary tend to ease the import of targeted products and can lift tariffs for

a certain period of time.⁹ The number of trade policy measures has been rising quite rapidly between January and April / May 2020 before being progressively removed. In early 2021, about 60% of Covid-19 related import policies were still in place and about half of new export policies.

Figure 8: The role of pandemic-related trade policy.



Note: Graph based on WTO data “COVID-19: Measures affecting trade in goods”.

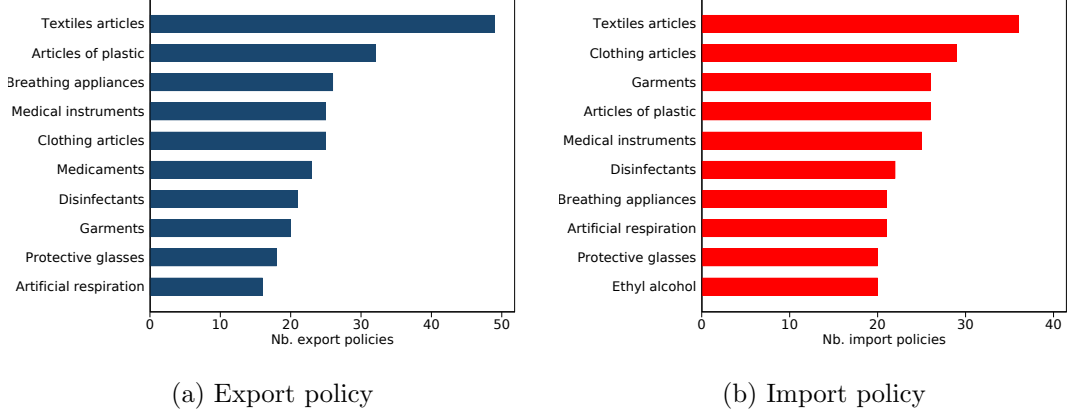
We report in Figure 9 a total number of policies by category of HS 4-digit products. Export and import policies typically targeted textiles articles (facemasks, which are better identified within HS-6 or more detailed product codes). All product categories are related to personal protective equipments, or medical equipments such as respirators and are concentrated in a few product categories.

Econometric correlations.

The econometric evaluation of the impact of Covid-19 related trade policies proceeds in two steps. In a first step, we simply evaluate the correlation between export or import

⁹Example of export policy: “Temporary export prohibition on certain drugs and medical devices”. Example of import policy: “Temporary elimination of import tariffs on hand sanitizers; hand sanitizer dispensers; bleach; disinfectant wipes...”.

Figure 9: HS4 products most impacted by Covid-19 trade policy



Note: Graph based on WTO data “COVID-19: Measures affecting trade in goods”.

policies and the value of bilateral trade between trade partners. In the second step, we evaluate the robustness of the estimated lockdown impact on bilateral trade when we introduce as a control in our main specification the trade policy variables.

In our first step, the analysis relies on bilateral trade and trade policy data reported at the 6-digits level, i.e. a more disaggregated and detailed set-up compared with our baseline estimations which are detailed at the HS 2-digits level. The reasons is that we want in this exercise to precisely capture products being targeted by the trade policies.¹⁰

The econometric analysis relies on a simple OLS estimation of the correlation between the policies and the value of bilateral trade in each product. Estimation results are reported in Table 6. In columns 1-3, we evaluate the impact of the exporter policy. The estimation controls for exporter-year (it) fixed effects and saturate the importer side with importer-product-time fixed effects (jkt). The remaining variance therefore comes from heterogeneity across products over time on the exporter side, which is the exact dimension of the exporter policy dummy variable. In column 1, the coefficient on the exporter dummy is negative and significant, which implies that countries having adopted a restrictive export policy have relatively lower values of bilateral trade in targeted products. The effect of exporter policies remains significant (although attenuated) in column 2 when we

¹⁰Note that we rely on the level of details available into the trade policy database provided by the WTO: When the policy is reported with a product detail higher than six digits, we simply take the average of the policy dummy indicator within the HS6 code; when there is less detail (HS2 or HS4 cases represent the minority) we have to attribute the policy to all HS6 sub-codes.

control for country-pair (ij) fixed-effects (and therefore for “gravity” controls such as bilateral distance, common language etc.). However, the effect of exporter policies loses significance when the estimation controls for exporter-product fixed effects (ik).

A similar pattern can be observed for the impact of import policies in columns 4-6. In column 4, the estimation simply controls for exporter-product-time fixed effects (ikt) and importer-time fixed effects (jt), with all remaining variance coming from importer-product heterogeneity over time. A positive coefficient on the importer policy dummy variable is estimated, meaning that import policies are positively correlated with the value of bilateral trade in targeted products. This conclusion remains valid in column 5 when we introduce country-pair (ij) fixed effects. However, the effect of the importer policy loses significance when importer-product (ik) fixed effects are introduced.

An interpretation of this empirical pattern is that the implementation of trade policies is highly correlated with exporter-product and importer-product patterns, i.e. their relative productivity if exporting country i, or importing country j, in product k. This relative productivity term relates to comparative advantage or disadvantage. Countries with a comparative disadvantage in exporting Covid-19 related products (like face masks) seem to have introduced restrictive policies in order to restrict their export. In the height of the pandemic wave in April or May 2020, we have multiple anecdotal evidence of such cases, with countries producing face masks but not in large volumes restricting their export of such products, even to very close partners. Conversely, countries with a comparative disadvantage in producing personal protective equipments loosened the restrictions on such imports in order to meet domestic needs.

All in all, these estimation results suggest that these trade restrictions did not have an economically strong causal impact on the value of bilateral trade in Covid-19 related products such as those identified by the WTO. Instead, restrictions responded to the relative strength of the production in these goods among countries in our sample.

Lockdowns versus trade policy.

The central question in our analysis is: Could the estimated quantitative impact of lockdowns on international trade in goods be explained by the implementation of trade policies in exporting and importing countries. The evidence presented in Table 7 suggests

Table 6: Effects of Covid-19 related trade policies on bilateral trade: correlations.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	Log value of monthly trade flows reported by 31 countries					
Reporter flow	Import		Export			
Last month	Dec.	Dec.	Dec.	Dec.	Dec.	Dec.
Export policy	-0.157 ^b (0.077)	-0.141 ^c (0.080)	-0.010 (0.015)			
Import policy				0.153 ^a (0.031)	0.166 ^a (0.030)	0.011 (0.011)
R ²	0.43	0.49	0.67	0.48	0.56	0.64
Obs.	64601198	64601183	64531187	86280714	86280683	86220784
Period	2018-2020					
Fixed effects	it+jkt	ij+it+jkt	ik+ij+it+jkt	ikt+jt	ij+ikt+jt	ij+ikt+jt+jk

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Fixed effects : i = exporter, j = importer, k = product or sector, t = time (month and year). Trade data from the Trade Data Monitor and originally reported by country-pair and month.

that this is not the case. Indeed, export and import policies do not have a significant impact on bilateral trade once the estimation controls for country-product fixed effects, i.e. for relative productivity or supply capacity.

We complete this analysis by reporting in Table 7 additional estimation results based on an augmented version of our baseline empirical specification estimated at 6-digit level of disaggregation of the Harmonised System product classification (HS6). In column 1, the baseline empirical specification controls for both the exporter's lockdown stringency and for the export policy. The coefficient on the lockdown stringency variable is negative and highly significant, and comparable to the result presented at the same level of product disaggregation in column 3 of Table 1. The coefficient on the export policy dummy however remains statistically insignificant. This result remains valid also in column 2 when we additionally control for exporter-time dummies (it) which fully captures the exporter lockdown, or in column 3 where the sample period covers the first wave of the Covid-19 pandemic but not the second wave.

On the importer side, we obtain similar results: The effects of lockdowns' stringency

in the importing country on bilateral trade remains negative and statistically significant as in the baseline estimations. Interestingly, we find some evidence here that importer policies have had an impact on bilateral trade. But the main result is that this does not really modify our assessment that the lockdowns, and more generally the restrictions implemented in exporting and importing countries, have reduced the value of bilateral trade between trade partners.

Table 7: Impact of lockdowns on trade controlling for trade policy

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	Log value of monthly trade flows reported by 31 countries					
Reporter flow		Import			Export	
Last month	Dec.	Dec.	May	Dec.	Dec.	May
Stringency index X	-0.078 ^b (0.036)					
Export policy	-0.016 (0.015)	0.009 (0.014)	0.019 (0.028)			
Stringency index M				-0.172 ^a (0.017)		
Import policy				-0.008 (0.010)	0.023 ^b (0.011)	0.039 ^c (0.021)
R ²	0.85	0.85	0.86	0.82	0.82	0.83
Obs.	63625341	63625341	49789303	84920182	84920182	66427254
Period	2018-2020					
Fixed effects	ijk+jkt	ijk+it+jkt	ijk+it+jkt	ijk+ikt	ijk+ikt+jt	ijk+ikt+jt

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Fixed effects : i = exporter, j = importer, k = product or sector, t = time (month and year). Trade data from the Trade Data Monitor and originally reported by country-pair and month.

A.3 Policy II: Fiscal policy.

A second source of bias in the estimation of the impact of lockdowns on international trade is due to the fiscal support provided by governments to domestic economic agents, households and firms, which took the form of direct financial support (above the line measures) or liquidity support, on top of automatic stabilizers. As this support comple-

ments the policy restrictions imposed by governments during the different waves of the pandemic, it may induce a bias in the estimation of the lockdowns on bilateral trade in goods in our econometric investigation.

In this section we rely on two data sources to identify financial support by governments. Firstly, we use the data collected by the IMF in its “Database of fiscal policy responses to Covid-19”. This data provided in particular information on total fiscal support, above and below the line, in percentage of countries’ Gross Domestic Product. The summary data reports the cumulated total spending by each country, but has no time dimension. A second source of data is the Economic support index, provided on a monthly basis by the University of Oxford together with the Oxford’s lockdown stringency index that we use in the main part of the analysis and is our key variable of interest.

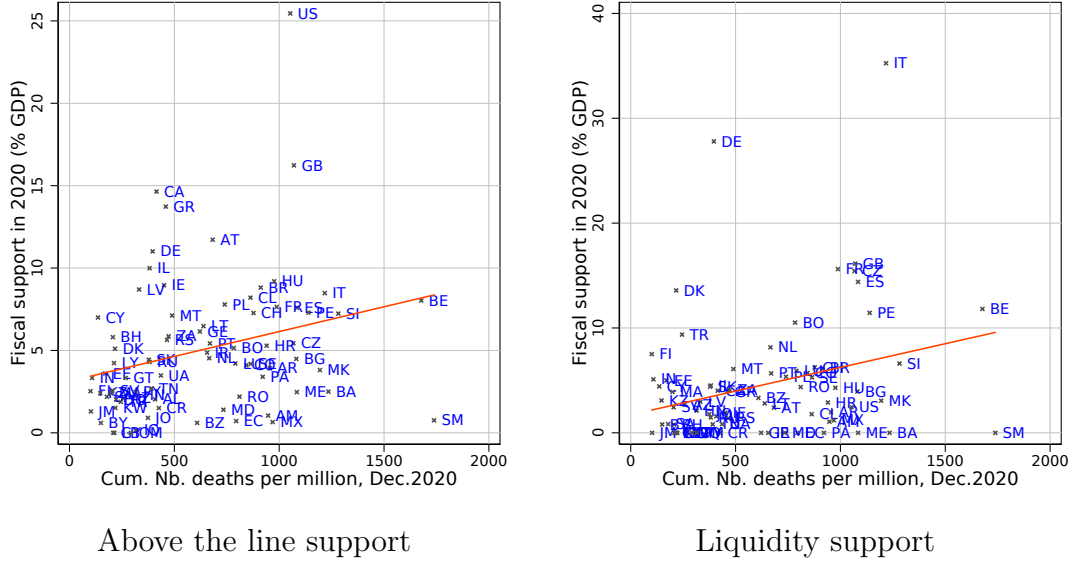
We report in Figure 10 a first piece of evidence based on the correlation between the cumulated number of deaths per million (x-axis) and the fiscal support (y-axis) by country. The correlation is obviously positive and statistically significant, meaning that countries having faced tougher pandemic waves have – on average – introduced more fiscal support. There is however a substantial heterogeneity in this relation.

One implication from this graph is that an attenuation bias can be expected in the estimated impact of lockdowns on international trade, as countries hard hit by the pandemic have on average introduced more support to soften the economic impact.

We test the stability of our estimated impact of lockdowns on international trade by augmenting our baseline equation to include controls for (i) broad economic support, and (ii) trade policy as discussed in the previous section.

The summary results for these additional estimations are provided in Table 8. The empirical estimations rely on bilateral trade data detailed at HS 2-digits level. Coefficients for additional controls (above the line support and liquidity support from the IMF, the economic support index from the IMF, and an HS2 level indicator of export and import policies) are not reported as we are mainly interested in the effect of exporter and importer lockdowns’ stringency. The main result is that introducing additional controls does not significantly modifies the economic impact of lockdowns on bilateral trade. The estimation results from the baseline specification, which we report in columns 1 and 4 of the table, are indeed only weakly modified when we introduce additional controls.

Figure 10: Country-level fiscal support and epidemic intensity



Note: Data on fiscal support in % of GDP, provided by the International Monetary Fund (IMF). Data on deaths per million from Our World in Data (OWID).

All in all, these results suggest that the impact of lockdowns on international trade is precisely estimated in the baseline specification, and the point estimate does not seem to be strongly impacted by an endogeneity problem.

Table 8: Impact of lockdown stringency in origin and destination countries

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	Log value of monthly trade flows reported by 31 countries					
Reporter flow		Import			Export	
Aggregation	HS2	HS2	HS2	HS2	HS2	HS2
Stringency index X	-0.101 ^a (0.021)	-0.116 ^a (0.022)	-0.115 ^a (0.022)			
Stringency index M				-0.240 ^a (0.018)	-0.230 ^a (0.018)	-0.228 ^a (0.018)
R ²	0.88	0.88	0.88	0.86	0.86	0.86
Obs.	5,379,965	5,331,311	5,331,311	6,936,773	6,853,588	6,853,588
Period	2018-2020					
Fixed effects	ij+jt	ijk+jkt	ijk+jkt	ij+it	ijk+ikt	ijk+ikt
	Additional controls					
Fiscal support	no	yes	yes	no	yes	yes
Trade policy	no	no	yes	no	no	yes

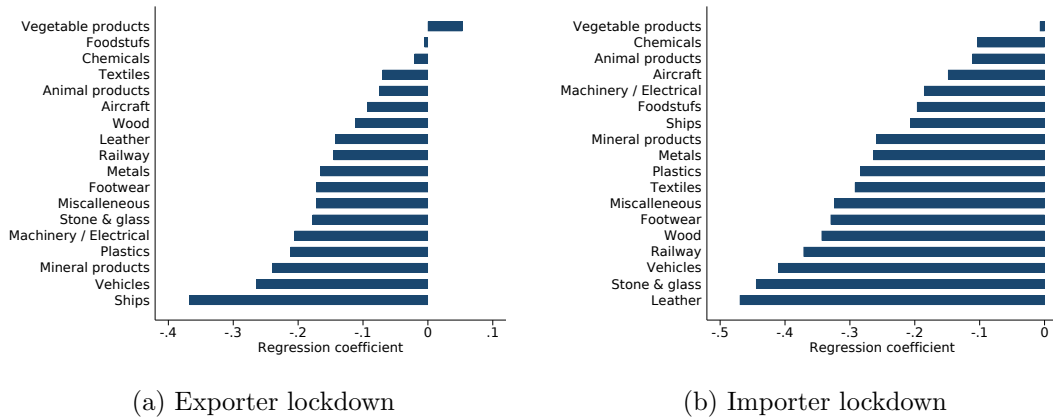
Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Fixed effects : i = exporter, j = importer, k = product or sector, t = time (month and year). Trade data from the Trade Data Monitor and originally reported by country-pair and month. Fiscal support variables: Above the line support, Liquidity support (IMF); Economic support index (Oxford University, Covid-19 database).

B Sector heterogeneity.

B.1 Sector-level estimations.

In this section we estimate the sectoral impact of the lockdown measures. Different sectors may have been exposed to different shocks during the spring of 2020. One example is the greater demand for medicine or masks, which were used to fight the pandemic and were associated with larger amounts of international trade (see Figure 5). On the other hand, other sectors may have been strongly impacted for different reasons, related to disruptions in global supply chains, or changes in the patterns of global demand. Our objective here is to provide some descriptive analysis about the response of trade within HS2 sectors consecutive to lockdown changes in exporting or importing countries.

Figure 11: Regression coefficient on lockdown stringency by HS2 sector



Note: Regression coefficient of the effects of lockdown stringency (exporter or importer side) by HS 2-digits sector. The estimated equation controls for country-pair and time fixed effects. Standard errors are clustered by exporter-time in the import equation, and importer-time in the export equation. Trade data are from the Trade Data Monitor. Lockdown stringency index from the University of Oxford.

In our empirical approach, we estimate Equations 1 and 2 separately for each HS2 sector and report the coefficients estimated in Figure 11. These estimations confirm that lockdowns had highly heterogenous impact on different sectors. For instance, vehicles trade was severely hit by both the exporter and importer lockdowns. Conversely, chemicals or vegetable products were less negatively hit – or even positively – which suggests that the Covid-19 crisis also created some trade opportunities in certain sectors, for instance given the needs for importing medical products.

A first interesting pattern emerges from sectors of transport equipments (ships, vehicles, railways), which were hit hard due to the exporter lockdowns but less so due to importer lockdown. This may signal that for these sectors, the shock on the supply-side introduced strong distortions on production.

A second interesting case is the one of the aeronautics, which was severely hit during the first wave of the pandemic but does not report the largest sensitivity in our estimations (until November) to exporter or importer lockdowns. One reason could be that in this sector, only very few countries compete on a global scale. In our un-weighted estimations, we may under-estimate the response of the aircraft industry due to the weak response of small producers. This is an argument for turning to weighted estimations to correct for this bias. A second reason is that commands of new Aircrafts are generally passed well in advance, so that the demand for new Aircrafts may only respond with some delay. A third reason may be that we need to account for higher-order relations along the supply chains. For instance, aircraft sales may respond not only to changes in the demand of the country of destination, but also to the travel conditions of this country with third destination.

Overall, this heterogeneity could appear for different reasons, related to supply or demand conditions at home and abroad. National policies may also have been implemented with some heterogeneity, (i) across different regions where production is located (see for instance the US, where the pandemic during the spring firstly impacted large cities in the East coast such as New York City), and (ii) across different sectors as national governments may have encouraged the continuation of production in strategic sectors such as agriculture, food, or pharmaceutical.

B.2 Demand for medical products.

We first test for the role played by the demand and supply for medical products. To do so, we downloaded a list of medical products established by the World Trade Organization (WTO). We then interacted detailed products identified in this list with the lockdown's stringency indicator for the exporting and importing country. Medical products are identified in HS6 product categories, so the equation is estimated at this level of product disaggregation after merging the medical products list with the trade data.

Estimation results are provided in Table 9. The coefficient on the interaction term between the exporter stringency and the medical products dummy is statistically significant, and the coefficient on the exporter stringency remains negative and statistically significant.

The interaction term between the importer stringency and the medical products dummy is highly significant and positive, meaning that importers' lockdowns had no significant impact on imports of Covid-19 related medical products. These results go in line with previous results shown on the impact of import trade policies implemented during the pandemic.

Table 9: Impact of lockdown stringency on trade: controlling for medical products.

Dep. var.	(1)	(2)
	Log value of monthly trade flows reported by 31 countries	
Reporter flow	Import	Export
Stringency index X	-0.096 ^b (0.038)	
Stringency X × Medical	0.354 ^a (0.010)	
Stringency index M		-0.192 ^a (0.017)
Stringency M × Medical		0.368 ^a (0.007)
R ²	0.83	0.81
Obs.	57869987	78867299
Period	2018-2020	
Fixed effects	ijk, jkt	ijk, jkt

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Medical products list from World Trade Organization.

B.3 Estimation results by BEC product category.

Finally, we report here the estimation results of our main specification based on data converted into Broad Economic Categories. This allows to investigate if different categories of goods – Intermediate, consumption or capital goods – reacted differently to lockdowns.

Estimation results are reported in Table 10. The results show in particular that all

categories of goods were impacted by the lockdowns implemented by both the exporter and the importer. Capital goods trade suffered more from exporters' lockdowns while importers' lockdowns impacted more strongly bilateral trade in consumption goods.

All these results suggest that while GVC trade can be an important channel of transmission of lockdown related shocks during the pandemic, this channels does not seem to have amplified the trade impacts of the restrictions implemented in the exporting and importing countries. Indeed, the effects of exporter and importer lockdowns on international trade do not appear stronger than for other categories of goods. In the Global Value Chains section, we provide a more detailed analysis of the transmission channels along value chains, through backward and forward linkages.

Table 10: Impact of lockdown stringency in origin and destination countries by BEC category

Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)
	Log value of monthly trade reported by 31 countries					
Reporter flow BEC stages	Intermediate	Import Capital	Consumption	Intermediate	Export Capital	Consumption
Stringency index X	-0.098 ^a (0.029)	-0.269 ^a (0.050)	-0.142 ^a (0.031)			
Stringency index M				-0.157 ^a (0.022)	-0.121 ^a (0.039)	-0.247 ^a (0.026)
R ²	0.89	0.89	0.91	0.88	0.83	0.89
Obs.	691,347	161,178	584,986	810,644	240,942	691,350
Period	2018-2020					
Fixed effects	ijk, jkt			ijk, ikt		

Note: Significance levels: ^a p<0.01, ^b p<0.05, ^c p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Deaths cases from Our World in Data. Fixed effects : i = exporter, j = importer, k = product or sector, t = time (month and year). Trade data from the Trade Data Monitor and originally reported by country-pair and month.