Trade Under Lockdown *

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Preliminary version

Abstract

The Covid-19 pandemic and the measures of lockdown that have been implemented in many countries in the early months of 2020 have strongly impacted global economic activity. This paper studies the role of lockdowns on international trade. We use trade data for 31 reporting countries detailed by product and partner, combined with data on the intensity of lockdowns in a large number of countries. This data covers a period up to November 2020 and is updated on a monthly basis. We estimate trade equations to identify the impact of lockdown stringency implemented in exporting and importing countries on trade flows. We find that both exporter and importer lockdowns had a strong effect on bilateral trade. Implementing a lockdown of maximum stringency reduces bilateral exports by 11-22% and bilateral imports by about 15-22%. However, the magnitude of these effects has been declining over time. We then show that lockdowns had very heterogeneous effects across sectors, and we study the role of third country shocks through trade diversion/deflection effects and global value chains.

Keywords: COVID-19, lockdown, trade elasticities.

JEL Classification: F14, xxx.

*The opinions expressed are the authors own and do not necessarily reflect the views of the Banque de France or the Eurosystem.

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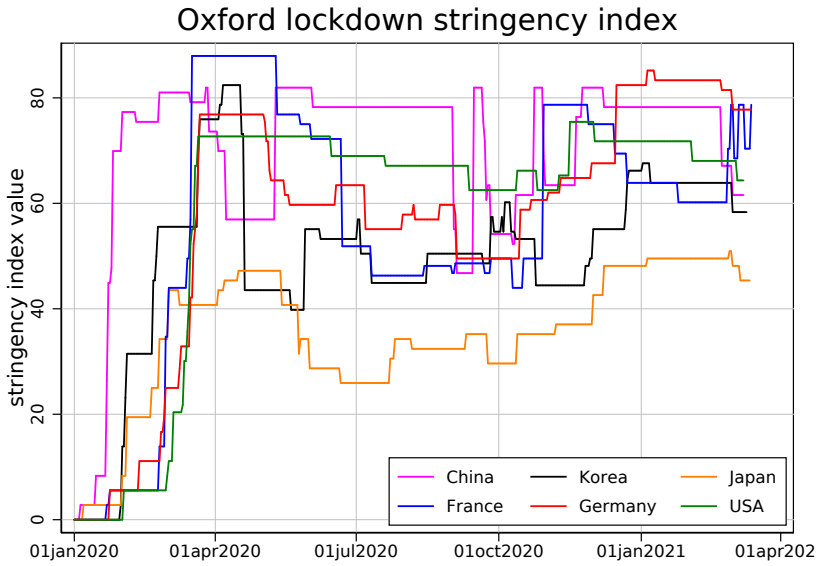
1 Introduction.

The Covid-19 pandemic triggered a wide range of government responses to limit its spread among the populations. 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. However, these restrictions were implemented at different pace and with different intensity, with a peak reached in April 2020 before restrictions were progressively removed. As a second wave of the pandemic hit many countries during the fall of 2020, new restrictions were again implemented.

Figure 1: Oxford lockdown stringency index by country



Note: composite Oxford Stringency Index, University of Oxford.

The objective of this paper is to document the trade impact of the administrative restrictions / lockdowns implemented in exporting and importing countries. To this aim, we combined the monthly averages of the Oxford stringency index with trade data reported by 31 countries at a monthly frequency, and detailed by partner country and HS6 product.

Our first result is that both exporter and importer lockdown stringency substantially reduced bilateral trade. Implementing a lockdown of maximum stringency in the exporting country reduces bilateral trade by 11-22% on average between two countries while the importer's lockdown can reduce bilateral trade by about 15-22%, suggesting that lockdowns affected the economy through adverse shocks on both demand and supply. The results on exporting and importing country are additive so that bilateral trade would fall by 25-45% when both partners go into a full lockdown. We then detail the transmission channels: lockdowns affect both the value of bilateral trade within each product (the intensive margin) and the number of products traded (the extensive margin). We show that the impact of lockdowns on trade tends to be statistically insignificant with low levels of stringency but strongly impacts the value of bilateral trade at high levels of stringency. Importantly, its impact has been declining over time, which implies that new lockdowns may have a weaker impact on trade compared with the first wave of the pandemic when the shock was largely unanticipated.

Looking at the effects of lockdowns at the sectoral level, we find strong heterogeneity of effects. Among the most strongly affected sectors are transport equipments where the complexity of global value chains may have introduced additional difficulties to deal with the new conditions, but also sectors like leather or footwear that are presumably more impacted by shocks on the consumption side. Interestingly, other sectors such as food and chemicals have been virtually unaffected or even positively impacted, as a higher demand for goods in these sectors may have emerge due to the pandemic spread. In estimations where goods are classified into Broad Economic Categories (Intermediate, capital or consumption goods) we do not find however any over-reaction of intermediate goods relative to other categories, which implies that though GVC trade may have contributed to the transmission of Covid-related shocks, no over-reaction or failure of GVCs can be identified at this level of aggregation of the trade data.

We then study the adjustment of trade prices vs quantities to lockdowns. To do so, we analyze the behaviour of HS6 unit values and quantities, using a dataset of over 50 million observations. Our results confirm the negative impact of the exporter and importer lockdowns on traded quantities. Surprisingly, the exporter lockdown is associated with a decline of (cif) import unit values while the importer lockdown is associated with an increase in (fob) export unit values. With a negative supply shock in the exporting country, and a negative demand shock in the importing country, we may have expected

an increase in trade prices due to the exporter lockdown, and a decline in trade prices due to importer lockdown. This ambiguous result may be eplained by issues related to the quality of reported quantities, changes in transportation costs, or more complex shocks than simply negative supply or demand shocks in exporting or importing countries.

Finally, we examine the role of global value chains and third country effects. Indirect demand linkages in third countries appear to be important drivers of the transmission of the shock. We find also evidence of trade diversion and deflection effects due to lockdowns implemented in third countries.

How should these findings be interpreted? A clear challenge to the interpretation of our results is that lockdowns are themselves endogenous events, and are chosen as a function of the current or predicted evolution of the pandemic. For instance, Antràs et al. (2020) develop a model of trade and epidemics by combining ingredients from the micro-founded gravity equation in trade with a Susceptible-Infected-Recovered (SIR) model. In the most comprehensive version of the model, agents' behavior endogenously reacts to the threat of infection, which both flattens the epidemic curve but also impacts trade shares with relatively unhealthy countries. In the context of our empirical investigation, it is possible, therefore, that our results do not show the effect of lockdowns themselves, but that trade flows were instead driven by a direct effect of the evolution of the pandemic on the behaviour of firms and consumers. In that case, trade flows would have fallen even in the absence of a lockdown. While we cannot rule out this possibility, we think that our estimates are very suggestive of a causal effect of lockdowns on trade flows. One piece of evidence in favor of a causal interpretation is that consumer expenditure fell sharply only in the days after the introduction of a lockdown, while the pandemic was already gradually evolving before (Carvalho et al., 2020).

This research completes and was inspired by existing work analyzing the effects of restrictions implemented in many countries on economic activity. Guerrieri et al. (2020) in particular analyze the transmission of the Covid-19 shock on the economy via supply and demand-side channels. The Covid-19 impact on global trade is transmitted via different channels: (i) the foreign demand for home produced final goods and intermediate inputs originating directly from trade partners or indirectly from third countries (forward linkages); (ii) foreign input production in trade partners or third countries (backward linkages) (Baldwin and Freeman, 2020a). Accounting for third country effects (indirect

linkages) appears also important to show the importance of China as a global supplier of intermediate inputs, while global input output tables show that supply chains are also highly built on a regional basis (Baldwin and Freeman, 2020b).

Calibrated macroeconomic models with input-output linkages allow to investigate the transmission of the pandemic shock through global value chains (Barrot et al., 2020; Gerschel et al., 2020; Lisack et al., 2020; Bonadio et al., 2020). These models generally simulate a reduction in the supply of labor, which is heterogeneously distributed across sectors due to the possibility of tele-working. (Barrot et al., 2020) conduct their analysis on France and other European countries with a quantitative model calibrated for 54 sectors, and show that a general lockdown has a sizeable negative impact on GDP, in particular in more upstream sectors. Bonadio et al. (2020) calibrate their model for 64 countries and 33 sectors using the OECD Inter-Country Input-Output tables (ICIO). While most of the GDP impact of lockdowns is due to the domestic lockdown, about a quarter of the total impact comes from foreign shocks. Importantly, re-shoring value chains in the home economy would not lead necessarily to a decline in the GDP impact of the shock, as these value chains would be less diversified and more exposed to the home economy's lockdown. We contribute to this literature by providing empirical evidence of the role of backward and forward linkages in the transmission of lockdowns across countries.

The paper is organized as follows. We first describe the data for trade and lockdown stringency. We then present descriptive evidence of the effects of the lockdown stringency on trade. The third section describes the empirical methodology and the econometric model. The fourth section presents the estimation results. The last section concludes.

2 Data and descriptive evidence.

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) and updated on a daily basis. In the main analysis and baseline estimations, we used 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. We also complete the analysis based on detailed information on sub-components of this indicator.

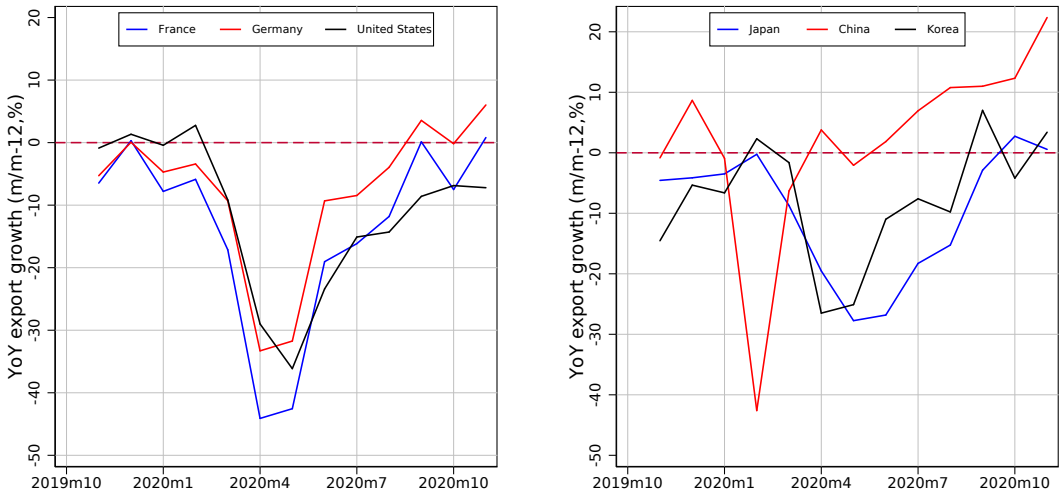
The second dataset that we use is the detailed export and import information by country pair ("dyad"), product (initially HS 6-digits) and month compiled from national sources by the Trade Data Monitor. The main advantage of this data, compared with other sources regularly used for research such as Comtrade or BACI (CEPII), is that it allows frequent updates based on early release by individual countries. From this dataset, given its huge size at this level of disaggregation, we downloaded monthly / bilateral data on exports on imports for 31 reporting countries and up to 252 partner countries. The 31 reporting countries include all major trading economies (US, China, Japan, several European economies, etc.), and account for 74% of world exports and 71% of world imports in 2018. In the baseline analysis, we aggregated this data into HS2 sectors (about 100 of them), but used the HS6 dimension in order to match the data with Broad Economic Categories (United Nations), which is then useful to identify separate impacts for intermediate goods, capital goods and final goods.

2.2 Descriptive evidence.

We provide in this section descriptive statistics on the evolution of aggregate exports and imports for selected countries from our final dataset, between 2019 and 2020. This data reported in Figure 2 indicate that the aggregate trade collapse was very synchronized between large advanced economies such as the United States, France and Germany, though the collapse seemed more pronounced for France. The trade recovery then started in May 2020 when countries started to progressively remove some of the lockdown measures in

place at the height of the crisis. When the second wave hit Europe during the fall of 2020, and despite new lockdowns being introduced progressively between October and November, we do not observe any strong drop in the volume of trade for these countries. In the Spring of 2020, the total value of goods exported by China was already above pre-crisis levels and appeared very resilient during the second wave. Japan and Korea resumed their year-on-year export growth by October or November 2020 and also seemed to be resilitent to the second wave. The results presented later in this paper confirm that indeed, lockdowns have been impacting exports and imports to a lower extent over time during the year 2020.

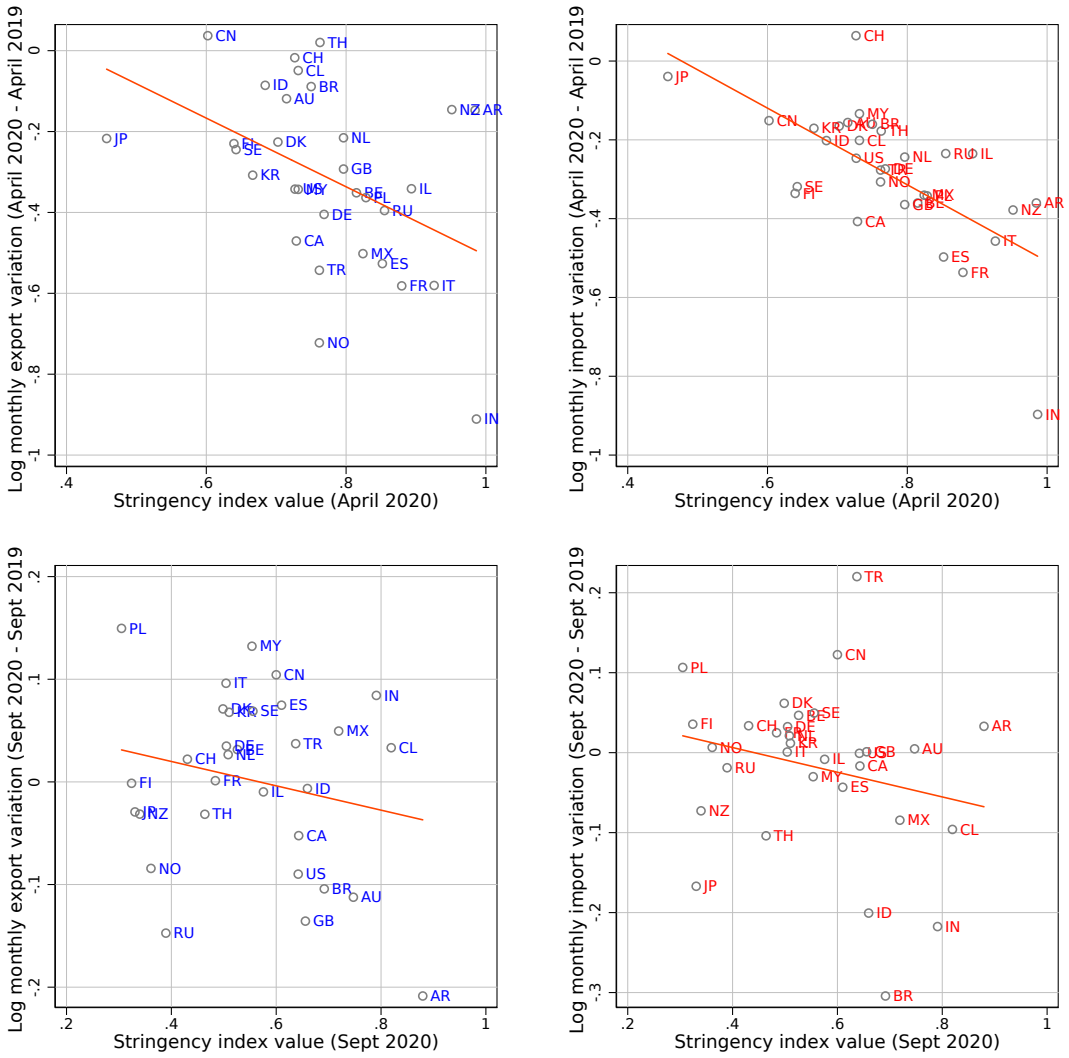
Figure 2: Aggregate export growth by country during the Covid crisis



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

We present in Figure 3 a scatter plot of the empirical relation between the lockdown stringency reported for the reporting countries from our trade dataset, and the exports and import variation between April 2019 and April 2020. Export and import growth are both strongly negatively correlated with lockdown stringency, which may signal that the lockdown during the pandemic impacted both exports and imports through supply and demand channels. The bottom two panels of this figure reports similar correlation in September. The main interesting result here is that this correlation appears to be much weaker after the summer of 2020.

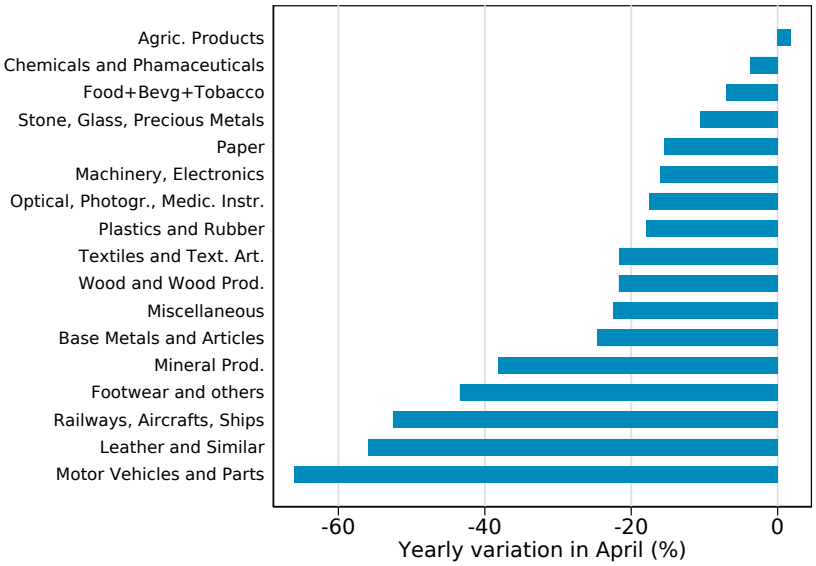
Figure 3: Relation between lockdown stringency index and trade growth



(a) Exports (b) Imports

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

Figure 4: 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.

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 reporting country, j is the partner country, k is a sector or a product (HS 2-digits in the baseline estimations, HS 6-digits when we address the question of prices versus quantity effects), 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 parters for our 31 reporting countries.

Equations 3 and 3 are the two baseline estimated equations in log levels. In the first 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 on the lockdowns in each importing (partner) country. With this approach, we always 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), and therefore the variance in the lockdown's stringency indicator. We then saturate the empirical equation with fixed 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 implicitly controls for the demand side effects when we estimate the supply-side effects of lockdowns and vice versa.

We estimate two parameters in these equations. The trade impacts of lockdown stringency 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 . γ_{ikt} is an exporter-product-time fixed effect in export Equation .

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 (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}.

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

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

Note that we do not introduce in this equation the GDP of both importing or exporting countries as in a gravity framework, as both GDPs are impacted by the Covid-19 shock. So, the lockdown measures in the exporting or importing countries are expected to capture respectively the supply and demand shocks due to the pandemic. In one of the estimations reported in the results section, we rely on the detailed lockdown stringency indexes published by the University of Oxford, rather than on the composite index, which we use in our main estimations.

In these estimations, standard errors are clustered in the dimension of our main variable of interest, i.e. exporter-time in the import Equation , and importer-time in the export Equation . All estimations are obtained using Ordinary Least Squares using appropriate sets of fixed effects.

4 Baseline estimation results.

4.1 Effects of lockdown stringency on bilateral trade.

Baseline estimation results are reported in Table 1. We firstly report in columns 1 to 3 the results of the estimation of our import equation where we identify the effects of the lockdown stringency in the exporting country, at different levels of disaggregation of the data: Total reported imports from each partern, imports in HS2 sectors or imports by HS6 product category. As discussed in the empirical methodology section, the estimated equation controls for exporter-importer(-sector or product) fixed effects as well as importer(-sector or product)-time fixed effects. In this estimation, the we can identify a strong negative impact of the exporter's lockdown stringency on bilateral total imports. The effect remains highly significant when it is estimated at the sector or product level, but the estimation coefficient is now substantially reduced. This signals a strong sector or product heterogeneity in the response to lockdowns. One reason could also be that total bilateral imports were affected by a decline in the number of products or sectors within each pair of trade parterns, i.e. the product extensive margin of bilateral imports. Conversely, the more demanding estimation controlling for importer-product-time fixed effects in column 3 controls for product-level patterns over time, and reflects the adjustment at the intensive margin.

The estimation results of the impact of the importer's lockdown stringency on reported exports are detailed in columns 4-6 of Table 1. This estimation controls for exporter-importer(-sector or product) fixed effects as well as for exporter(-sector or product)-time fixed effects, which fully captures the supply-side of this equation as well as global sector or product-specific shocks. It leaves all the variance to be explained on the importer side and the identification again is based on cross-country and time variations in lockdowns among importers. The results confirm the strong impact of the importer lockdown on bilateral reported exports. This result is consisent with more constraints being introduced on the demand side due to lockdowns implemented in importing countries.

We quantify the trade effects of the lockdown using the regression coefficients in each column. Exporter and importer lockdown intensity is bounded from 0 to 1 in the data published by the University of Oxford. Estimation results in column (1) imply that a complete lockdown in the exporting country can result in a decline of bilateral total

value of imports by about 22% (= exp(−0.247) − 1), while in column (4), importers' lockdown can lead to a decline of bilateral total exports by about 14.6% (= exp(−0, 158)− 1). Supply and demand-side effects of countries' lockdowns therefore have a impact on bilateral trade. In the quantification, the effects of exporter and importer lockdown is additive, so for two countries with the maximum score in the Oxford stringency, bilateral trade could in principle be reduced by about 36.5% (i.e. summing the quantifications in columns 1 and 4).

Table 1: 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	Total	HS2	HS6	Total	HS2	HS6
Stringency index X	-0.247^a	-0.115^a	-0.088^b			
	(0.055)	(0.022)	(0.039)			
Stringency index M				-0.158^a	-0.250^a	-0.193^a
				(0.031)	(0.019)	(0.018)
R^2	0.91	0.88	0.85	0.94	0.86	0.82
Obs.	166,631	5,218,641	60162465	170,395	6,732,433	80291062
Period	2018-2020					
Fixed effects	ij+jt	ijk+jkt	ijk+jkt	ij+it	ijk+ikt	ijk+ikt
	Effect of complete lockdown on bilateral trade					
Quantification (%)	-21.9%	-10.9%	-8.4%	-14.6%	-22.1%	-17.6%

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.

4.2 Extensive margin.

As discussed above, the aggregate impact of lockdowns on bilateral exports 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 bialteral 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 last approach allows to disentangle the impact of lockdowns on some very specific sectors such as aeronautics, from the within-sector impact on the variety of products being traded. 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.

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 producted 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.

4.3 Lockdowns versus deaths.

In this exercize 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, comsumers 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 ridsk of contamination if they use public transports.

Ideally we would like to use data on positive tests obtained within each country and

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		-0.088^a		-0.036^a	
	(0.017)		(0.014)		(0.008)	
Stringency index M		-0.197^a		-0.113^a		-0.133^a
		(0.019)		(0.013)		(0.009)
R^2	0.98	0.97	0.96	0.95	0.94	0.93
Obs.	166,673	170,406	166,631	170,395	5,225,639	6,735,356
Period	2018-2020					
Fixed effects	ij+jt	ij+it	ij+jt	ij+it	ijk+jkt	ijk+ikt

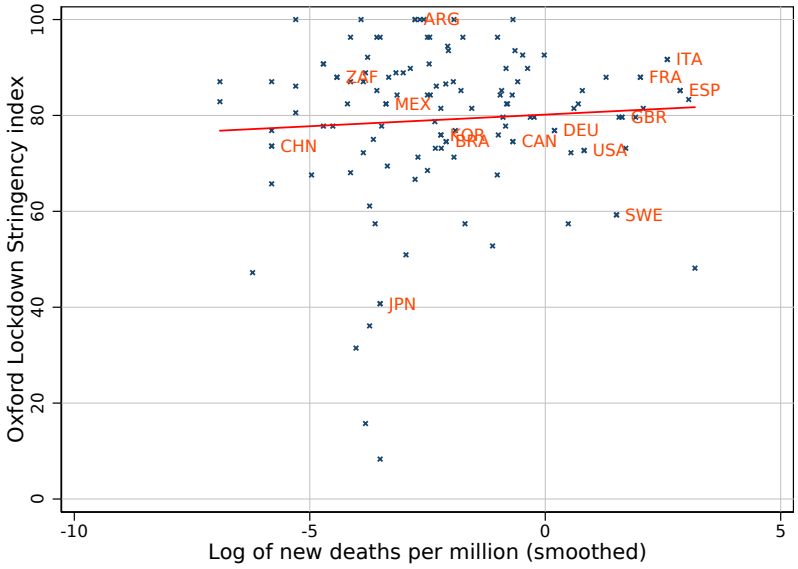
Note: Significance levels: ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1. Standard errors clustered by origin country and time (reported import data) and by destination country and time (reported export data). Lockdown stringency index from University of Oxford (with range between 0 and 1). Fixed effects : i = 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.

month, but the testing policy has proved to be quite heterogeneous and erratic especially during the first wave of the pandemic. Instead, identified deaths du 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 5 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., France or Germany.

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 basedline estimation based on exporter-importer-HS2 trade data. The estimation

Figure 5: Oxford lockdown stringency versus new deaths by Covid-19.



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

controls for the baseline set of fixed effects.

Estimation results are reported in Table 3. Our results on the effects of exporter or importer lockdowns on trade are only weakly impacted by these extra controls. While the log of the number of death by Covid-19 is indeed associated with a lower value of trade (columns 2 and 5), this effect tends to disappear when the Oxford's lockdown stringency indicator is included into the estimation. The effect of deaths remains only significant when the estimation is based on reported export data, and the estimation controls for the number of deaths and the lockdown stringency in the destination country (column 6).

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 wokers) in the presence of the pandemic waves.

Table 3: 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	-0.115^a		-0.112^a			
	(0.022)		(0.025)			
Log(1+deaths per million, X)		-0.013^b	-0.002			
		(0.005)	(0.006)			
Stringency index M				-0.250^a		-0.229^a
				(0.019)		(0.021)
Log(1+deaths per million, M)					-0.042^a	-0.019^a
					(0.006)	(0.007)
R^2	0.88	0.88	0.88	0.86	0.86	0.86
Obs.	5,218,641	5,218,641	5,218,641	6,732,433	6,732,433	6,732,433
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.

4.4 Non-linearity.

We next explore if our baseline results results are monotone in lockdown stringency using an alternative strategy where we stratify bins of stringency identified with dummy variables, instead of the continuous version of the Oxford stringency index. Estimation reported are reported in Table 4. These estimations rely on the version of our data aggregated within HS2 sectors.

The exporter lockdown's impact on trade appears significant only with the highest level of restrictions (i.e. with the value of the indicator above 80%). Conversely, the effect appears insignificant or even slightly positive for low values of the indicator. The positive impact on bilatera trade for low values of restrictions could be explained by a trade recovery once the sanitary restrictions loosened after the spring of 2020. On the importer side, the effect of lockdowns appears quite linear and becomes stronger as the indicator

takes higher values.

One implication of this result is that the effects of the Covid-19 crisis on international trade should weaken during the summer of 2020 with restrictions being progressively removed. On the other hand, trade should suffer again during the fall and winter of 2020/2021 as restrictions were restored as countries were facing the second wave of the pandemic.

4.5 Changing effects over time.

Is the impact of restrictions on economic activity changnig 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 trasport 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 th pandemic hit ogressively 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 "bi-mesters" : 1 = January and February; 2 = March and April; 3 = May and June; 4 = July and August; 5 = September and October; 6 = November and (December). Each coefficient in this estimation therefore identifies the effects of lockdown's stringency on bilateral exports or imports within HS2 products at a different point in time. The exact specification is reported in Equations 3 and 4.

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

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

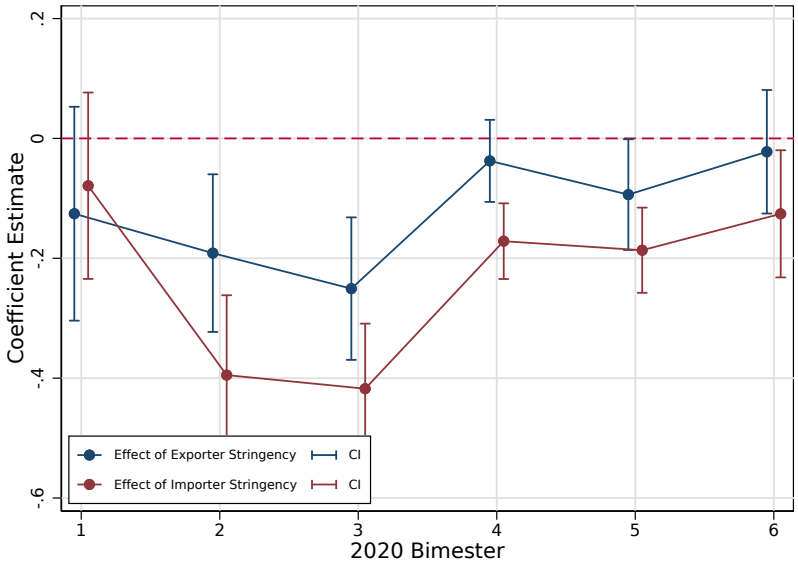
Table 4: Impact of lockdown stringency on trade: non-linearity

	(1)	(2)	(3)	(4)
Dep. var.	Log value of monthly trade flows reported by 31 countries			
Reporter flow	Import		Export	
Stringency dummy X (Score < 30)	0.024^{b}	0.024^{b}		
	(0.012)	(0.012)		
Stringency dummy X (30 >= Score < 60)	0.010	0.012		
	(0.018)	(0.018)		
Stringency dummy X (60 >= Score < 80)	-0.009	-0.002		
	(0.019)	(0.019)		
Stringency dummy X (Score >= 80)	-0.063^{a}	-0.055^{b}		
	(0.022)	(0.023)		
Log(1+deaths per million, X)		-0.013^{b}		
		(0.006)		
Stringency dummy M (Score < 30)			0.004	0.004
			(0.012)	(0.011)
Stringency dummy M (30 >= Score < 60)			-0.034^{b}	-0.030^{b}
			(0.016)	(0.016)
Stringency dummy M (60 >= Score < 80)			-0.071^{a}	-0.054^{a}
			(0.016)	(0.017)
Stringency dummy M (Score >= 80)			-0.165^{a}	-0.146^{a}
			(0.019)	(0.020)
Log(1+deaths per million, M)				-3.301^{a}
				(0.723)
R^2	0.89	0.89	0.86	0.86
Obs.	3,218,799	3,218,799	4,296,360	4,296,360
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). 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.

We plot the estimated coefficients for each month in Figure 6. These results indicate that the effect of lockdowns on bilateral trade within each HS2 has been declining over time, in line with the descriptive evidence in the beginning of this paper showing that the rebound of trade has continued during the fall and winter of 2020 despite new restrictions being introduced in a number of countries due to the second wave. Starting from July-August, the effects of exporter lockdowns on foreign imports do not appear to be significant anymore. The effects of importers lockdowns on bilateral exports are quantitatively weaker but the estimated coefficient remains statistically significant.

Figure 6: Effect of lockdowns on trade flows over time

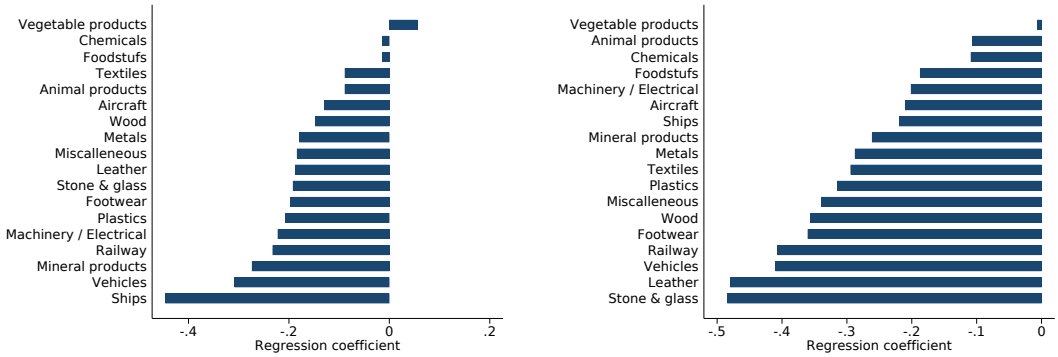


4.6 Sector-level estimations.

We estimate here 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 4). 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 7: Regression coefficient on lockdown stringency by HS2 sector



(a) Exporter lockdown

(b) Importer lockdown

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 3 and 3 separately for each HS2 sector and report the coefficients estimated in Figure 7. These estimations confirm that lockdowns had highly heterogenous impact on different sectors. For instance, vehicles trade was severly 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.

An 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 heterogenity 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.

4.7 Sub components of the Oxford stringency index.

We report in this section the results of estimations where we consider separately different components of the lockdown stringency index in our main empirical specification with data aggregated at HS2 sector level.. These indicators reflect restrictions on schools opening (C1), workplace opening (C2), public events (C3), gatherings (C4), public transports (C5), capacity to get out from home (C6), restrictions on internal movements of people (i.e. within each country between regions or cities) (C7) or international travel (C8).

Different aspects of these restrictions could possibly impact both supply or demand. For example, schools closing can impact labor supply but also plausibly the time left for private consumption. Workplace closing can have strong impact on the supply of labor. Restrictions on public transports or restrictions on travels (internal to the country or international) could possibly impact both supply or demand effects of the Covid-19 shock.

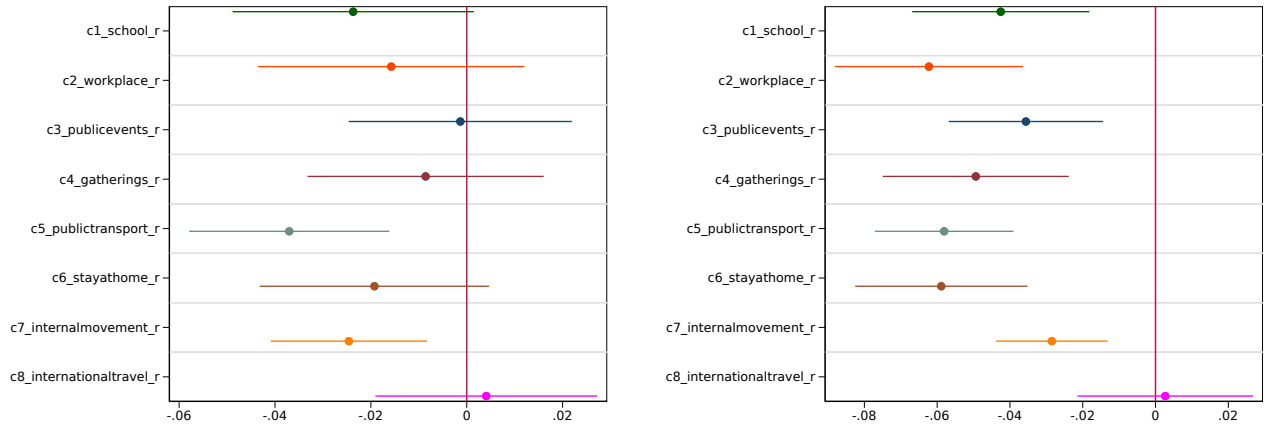
The parameters from our empirical estimations are reported in Figure 8. Two results appear. First, restrictions on public transport seem to have the strongest impact on bilateral exports, while restrictions on international travel have no significant effect. This

last result may be explained by the fact that our data does not cover trade in services. On the importer side, all components of the index have a significant impact on bilateral trade with the exporting country, with the exception, again, of international travel.

These results should be interpreted with caution. All sub-components of the Oxford's lockdown stringency index are very much correlated between each other, which limits the capacity to disentangle their respsective effect.

One interesting work for future research would be to see have the different instruments composing this index have been used over time, and whether this can impact the changing marginal effect of lockdowns all along the year 2020.

Figure 8: Elasticities for sub-components of the Lockdown Stringency Index



(a) Lockdown of the exporter

(b) Lockdown of the importer

Note: Estimation coefficients and confidence intervals using the baseline empirical specification separately for each indicator, and separately for lockdown measures in exporting and importing countries. The exporter is the reporting country.

4.8 Volumes versus price effects.

Finally, we present here an estimation of the volume versus price effects of the Covid-19 crisis in trade. To this aim, we use data reported at the finest level of disaggregation in the TDM data, by HS 6-digits product level. This allows to better measure unit values (as an approximation of the traded goods' price) while composition effects may impact unit values at more aggregated levels.

The empirical specification is the one used in our baseline estimations with HS6 disaggregation of the trade data. We report estimation results when the dependent variable is either the value of bilateral trade, the trade quantity, or the unit value (all expressed in logarithms).

Estimation results reported in Table 5 confirm that both exporter and importer lockdowns are strongly negatively related the exported quantity at the monthly level (see columns 2 and 5). However, the effect of the exporter lockdown stringency on bilateral trade is not statistically significant, which can be possibly explained by quantities being in some cases mis-reported.

Surprisingly, we find a negative impact of the exporter's lockdown stringency on unit values, whereas the importer's lockdown stringency is estimated with a positive sign. This result tends to contradict what we would expect if the exporter lockdown was purely associated with a negative supply shock, and the importer lockdown with a negative demand shock. In this setting, export prices would be expected to increase due to higher production costs, whereas import prices would decrease due to lower demand.

Different reasons may explain this unexpected result. As discussed above, badly reported quantities may generate a measurement issue for unit values. More importantly, the both the exporter and importer lockdowns' impact on unit values may evolve over time, and may reflect the transmission of demand and supply shocks along global value chains, or third country effects due for instance to lockdowns implemented in countries where competitors are located, which may modify in turn the price index of the destination.

Table 5: Impact of lockdown stringency in origin and destination countries : quantity versus price effect (levels)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	Log value of monthly exports reported by 18 countries					
Reporter flow	Import			Export		
Dep. variable	Log value	Log Quantity	Log U.V.	Log value	Log Quantity	Log U.V.
Unit of obs.	Monthly level					
Stringency index X	-0.091^b	-0.064	-0.028^a			
	(0.040)	(0.046)	(0.009)			
Stringency index M				-0.193^a	-0.211^a	0.015^a
				(0.018)	(0.019)	(0.004)
R^2	0.85	0.92	0.95	0.82	0.92	0.95
Obs.	55584602	55789072	55584602	75818391	76223070	75818387
Period	2018-2020					
Fixed effects	Importer-Exporter-HS6 Importer-HS6-time			Importer-Exporter-HS6 Exporter-HS6-time		

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.

5 The role of Global Value Chains.

5.1 Estimation results by BEC product category.

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 6. 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.

Table 6: Impact of lockdown stringency in origin and destination countries by BEC category

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	Log value of monthly trade reported by 31 countries					
Reporter flow	Import			Export		
BEC stages	Intermediate	Capital	Consumption	Intermediate	Capital	Consumption
Stringency index X	-0.115^a	-0.287^a	-0.165^a			
	(0.030)	(0.052)	(0.032)			
Stringency index M				-0.170^a	-0.145^a	-0.246^a
				(0.023)	(0.042)	(0.027)
R^2	0.89	0.89	0.91	0.88	0.84	0.89
Obs.	671,132	156,504	567,508	787,026	233,939	670,975
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.

5.2 GVCs and Covid-19: forward and backward linkages.

The demand and supply disruptions following lockdowns may have not only affected trade flows directly, but also indirectly through gobal 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).

For now, we focus on forward linkages and test for their role using a global input-output framework (backward linkages to be introduced later). The output Y_{is} of country i in sector s can be either used as intermediate input by sector $t \in \{1, ..., S\}$ in country $j \in \{1, ..., N\}$, or used for final demand in country j. The market-clearing condition is then:

$$Y_{is} = \sum_j \sum_t X^M_{ijst} + \sum_j X^C_{ijs} = \sum_j X_{ijs}$$

where $X_{ijs} = \sum_t X^M_{ijst} + X^C_{ijs}$ are total shipments from country i to country j in sector s, X^M_{ijst} denote sales of intermediate goods from sector s in country i to sector t in country j, and X^C_{ijs} are sales of final consumption goods.

Let $a_{ijst} \equiv \frac{X^M_{ijst}}{Y_{jt}}$ denote expenditure on inputs from state i, industry s, as a fraction of gross output in the destination industry. We collect the coefficients in the matrix

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

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

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

The system of market clearing conditions can then be written as

$$Y = AY + \sum_j X_j^C = \sum_j \Omega X_j^C, \tag{5}$$

where $\Omega \equiv (I - A)^{-1}$ is the Leontief inverse, X_j^C denotes the vector of final expenditure by state j: $X_j^C = [X_{1j1}^C, X_{1j2}^C, ..., X_{NjS}^C]'$, and $Y = [Y_{11}, Y_{12}, ..., Y_{NS}]'$.

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

$$Y_{is} = \sum_{j=1}^{N} \sum_{k=1}^{N} \sum_{t=1}^{S} \omega_{ikst} X_{kjt}^C = \sum_{j=1}^{N} \phi_{ijs}$$

where ω_{ikst} are the elements of the matrix Ω. and we define $\phi_{ijs} \equiv \sum_{k=1}^{N} \sum_{t=1}^{S} \omega_{ikst} X_{kjt}^C$. ϕ_{ijs} can be understood as 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.

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

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

where we also assume that global input-output coefficients a_{ijst} are fixed.[1]

Using the market clearing condition for X_{ijs}, $X_{ijs} = X_{ijs}^C + \sum_t X_{ijst}^M$, and taking a first order approximation, we have

$$\begin{aligned} \Delta \log(X_{ijs}) &= \frac{X_{ijs}^C}{X_{ijs}} \Delta \log(X_{ijs}^C) + \sum_t \frac{X_{ijst}^M}{X_{ijs}} \Delta \log(Y_{jt}) \\ &= \frac{X_{ijs}^C}{X_{ijs}} \Delta \log(X_j^C) + \sum_t \frac{X_{ijst}^M}{X_{ijs}} \sum_k \frac{\phi_{jkt}}{Y_{jt}} \Delta \log(X_k^C) \end{aligned}$$

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

[1] This 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 substition between intermediate goods from different sectors and different origin countries is one.

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 t 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 t in country j.

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). 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-ISIC Rev 4 concordance table.

We measure $\Delta \log(X_j^C)$ by the change in the lockdown stringency index, and then introduce the two RHS variables in the estimation, measuring direct and indirect exposure to demand shocks. Results in table 7 are from our initial sample of 18 countries with data until August 2020 (to be updated soon). Column 1 introduces only the measure of total demand, and column 2 splits up total demand into a direct and indirect demand component. Column 3 further splits up the indirect demand component into final demand coming from the exporting country, the importing country, or any third country.

The results show that the shock to demand coming from lockdowns is being passed on through both direct and indirect channels, with roughly similar marginal effects. This would suggest that distance to final demand is not an important factor in determining the magnitude of the decline in trade flows. The last columns further shows that third-country demand shocks are also being passed on through global value chains.

5.3 Upstreamness or downstreamness of product or sector.

Work in progress...

Table 7: Transmission through Demand Linkages

	(1)	(2)	(3)
		Exports	
Total Demand	-0.460***		
	(0.051)		
Direct Demand		-0.475***	-0.386***
		(0.053)	(0.050)
Indirect Demand		-0.439***	
		(0.056)	
Indirect Exporter Demand			0.137
			(0.281)
Indirect Importer Demand			-0.487***
			(0.059)
Indirect Third Country Demand			-0.216***
			(0.075)
Observations	912,313	912,313	912,295
R-squared	0.915	0.915	0.915
Fixed effects		ijk, ikt	

6 Reallocation of trade flows

On top of the direct effect supply and demand shocks on bilateral trade, lockdowns may have also led to a reallocation of global trade flows. This may happen through either trade diversion (an importer reallocates purchases towards suppliers not in lockdown) or trade deflection (an exporter reallocates sales towards buyers not in lockdown). This section introduces empirical measures for both trade diversion and deflection into the main estimations and shows that lockdowns have led to reallocation of trade through both channels

Specifically, we measure trade diversion and trade deflection variables at the country-product(hs6)-month level as follows:

$$\text{Deflection}_{ikt} = \sum_{l \neq j} \theta_{ilk} * \text{Stringency}_{lt}, \qquad \theta = \text{Export Share}$$

$$\text{Diversion}_{jkt} = \sum_{l \neq i} \pi_{ljk} * \text{Stringency}_{lt}, \qquad \pi = \text{Import Share}$$

where export and import weights are fixed at 2018. Constructing these variables requires information on all global bilateral trade linkages. Since our sample of monthly trade only draws trade flows from 31 reporting countries, we turn to the latest edition of the BACI trade data (for the year 2018), and combine those data with monthly information on lockdown stringency for each country to compute the two variables.

We then introduce the trade diversion variable into our empirical equation estimating the importer lockdown effect (using the data on exports from our 31 reporting countries), and likewise introduce the trade deflection variable into our empirical equation estimating the exporter lockdown effect, and re-estimate these two equations at the HS6 level.

Results from this exercise are in table YY. We find that lockdowns led to significant reallocation of trade flows on both the importer and exporter side. Facing lockdowns on importers, exporting countries reallocate sales towards other countries, and importers facing supply shortages from eporters in lockdown source their imports from third countries.

Table 8: Impact of lockdown stringency on trade : Third country effects

	(1)	(2)
Dep. var.	Log value of monthly exports reported by 31 countries	
Reporter flow	Import	Export
Stringency index X	-0.135^a	
	(0.043)	
deflection2	0.403^a	
	(0.027)	
Stringency index M		-0.218^a
		(0.023)
diversion2		0.407^a
		(0.022)
R^2	0.85	0.82
Obs.	57349719	77340934
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). 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.

7 Conclusion and discussion (TBC)

The results (still preliminary) presented in this paper show that the restrictions that impacted citizens' economic and social life at the height of the Covd-19 pandemic had a strong impact on global trade.

One important take away from this research (at this stage) is that maintaining even limited restrictions could durably impact bilateral trade flows.

References

Antràs, P., Redding, S. J., and Rossi-Hansberg, E. (2020). Globalization and Pandemics. Nber working papers, National Bureau of Economic Research, Inc.

Baldwin, R. and Freeman, R. (2020a). Supply chain contagion waves: Thinking ahead on manufacturing "contagion and reinfection" from the COVID concussion. Vox EU, 01 April 2020.

Baldwin, R. and Freeman, R. (2020b). Trade conflict in the age of Covid-19. Vox EU, 22 May 2020.

Barrot, J.-N., Grassi, B., and Sauvagnat, J. (2020). Sectoral effects of social distancing. SSRN Working Paper.

Bonadio, B., Huo, Z., Levchenko, A. A., and Pandalai-Nayar, N. (2020). Global Supply Chains in the Pandemic. NBER Working Papers N.27224.

Carvalho, V., Garcia, J., Hansen, S., Ortiz, A., Rodrigo, T., Mora, J. R., and Ruiz, J. (2020). Tracking the Covid-19 crisis with High-resolution transaction data. Cambridge-INET Working Paper Series.

Gerschel, E., Martinez, A., and Mejean, I. (2020). Propagation of shocks in global value chains: the coronavirus case. Institut des Politiques Publiques, Policy Brief N.53, March.

Guerrieri, V., Lorenzoni, G., Straub, L., and Werning, I. (2020). Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages? NBER Working Papers N.26918.

Hale, T., Webster, S., Petherick, A., Phillips, T., and Kira, B. (2020). Oxford covid-19 government response tracker. Blavatnik School of Government.

Lisack, N., Berthou, A., Colles, B., Gaulier, G., and Ouvrard, J.-F. (2020). Covid19 et chaines de valeur. Bulletin de la Banque de France 230-2, juillet 2020.