Impacts of covid-19 on international trade : evidence from the first quarter of 2020

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June 2020

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Keywords: COVID-19; International trade
JEL Classification: F15; F53

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Impacts of COVID-19 on International Trade: Evidence from the First Quarter of 2020[§]

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Abstract: The aim of this study is to present early evidence for the impacts of coronavirus disease 2019 (COVID-19) on international trade. Accordingly, we investigate trade among 186 countries in the first quarter of 2020. The disease burden of COVID-19 is measured in terms of the number of cases and deaths. Our findings can be summarized as follows. First, the COVID-19 burden in exporting countries, but in not importing countries, has a significantly negative effect on trade. Second, this negative impact of exporters' COVID-19 burden is seen in exports from developing countries but not from developed countries. Third, the COVID-19 burden in an exporter's neighboring countries has a positive effect on its exports. Fourth, importers' COVID-19 burden has positive effects on trade in the agricultural industry, whereas exporters' COVID-19 burden has negative effects, particularly in the textile, footwear, and plastic industries.

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1. Introduction

This study aims to provide early evidence for the impacts of the ongoing coronavirus pandemic on international trade. This coronavirus causes coronavirus disease 2019 (COVID-19). The World Health Organization (WHO) recognized the pandemic on 11 March 2020. According to the WHO website, as of 16 May 2020, more than 300,000 deaths from COVID-19 have been reported worldwide. To slow the spread of the coronavirus, many countries have imposed some form of restriction on people and businesses. Several countries have declared citywide or nationwide lockdowns. Also, many countries have imposed an entry ban on foreigners. Such restrictions have seriously harmed the world

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economy. For example, China's economy shrank by 6.8% in the first quarter of 2020. This decrease is the first contraction since 1992, when China began releasing its GDP data. According to the World Economic Outlook, April 2020 by the International Monetary Fund (IMF), the global economy is projected to sharply contract by –3% in 2020.

Economists have responded quickly to this pandemic and investigated the economic impacts of COVID-19. For example, an e-book entitled *Economics in the Time of COVID-19*, was released by Baldwin and di Mauro (2020). It includes simulation results and conceptual frameworks for the economic impacts of COVID-19. Also, the Centre for Economic Policy Research launched a new online review on COVID-19 studies called "Covid Economics: Vetted and Real-Time Papers." It includes formal investigations on various impacts of COVID-19, including those on finance, people's mobility, and gender equality. However, to our knowledge, no studies have empirically investigated the impacts of COVID-19 on international trade.

From a theoretical perspective, COVID-19 can be expected to substantially impact international trade in various ways. Naturally, a higher COVID-19 burden in an exporting country decreases the scale of production, which leads to a decrease in export supply. Exports will decrease particularly in industries and countries where remote work/operation is less feasible. The effect of the COVID-19 burden in an importing country is mainly due to decreased aggregate demand in that country. Decreased earnings and fewer visits to retail stores will lead to decreased demand. The international trade of one country may also be affected by the COVID-19 burden in its neighboring countries. For example, decreased exports from an affected country create an export opportunity for its neighbors. On the other hand, negative production shocks due to COVID-19 in a country may reduce production in neighboring countries through supply-chain networks.

To empirically examine the impacts of COVID-19 on worldwide trade, we regress bilateral trade values on various measures for assessing the burden of COVID-19. We use trade data up to March 2020 and refer to two time periods: January-March 2019 and January-March 2020. Trade data covering a longer period will become available over time, but we decided to examine trade during this period because there had already been a serious number of COVID-19 cases and deaths by the end of March 2020, as shown in Figure 1. Also, some countries enacted entry bans on foreigners of specific nationalities from January 2020. Our dataset includes trade among 186 countries. Our use of worldwide data implies strong external validity of our results. We use the number of COVID-19 cases and deaths collected by the European Centre for Disease Prevention and Control as measures of disease burden to investigate the impacts of COVID-19 on international trade.

=== Figure 1 ===

Our findings can be summarized as follows. First, COVID-19 burden, measured in

terms of both the number of cases and the number of deaths, has a significantly negative effect on trade for exporters but not for importers. Second, this negative effect is evident in exports from developing countries but not from developed countries. Third, the COVID-19 burden in an exporter's neighboring countries has a *positive* effect on its exports. Fourth, importers' COVID-19 burden has positive effects on trade in the agricultural industry and negative effects in the paper and machinery industries. On the other hand, exporters' COVID-19 burden has negative effects, particularly in the textile, footwear, and plastic industries. In short, our results suggest that COVID-19 has dramatically decreased international trade. For example, our estimation results indicate that the United States and China lost exports valued at 38 billion USD and 64 billion USD in the first quarter of 2020, respectively.

The rest of this paper is organized as follows. Section 2 theoretically discusses the possible effects of COVID-19 on trade. After explaining our empirical framework in Section 3, we report our estimation results in Section 4. Finally, Section 5 concludes this paper.

2. Conceptual Framework

In this section, we discuss the theoretical background of how COVID-19 affects trade between countries. The spread of infectious diseases in a country affects both the demand and supply sides of that country's economy. We summarize the possible effects of COVID-19 burden in exporting and importing countries separately. We also discuss the effects of the COVID-19 burden in their neighboring countries.

2.1. COVID-19 Burden in Exporting Countries

The spread of COVID-19 has led to social distancing and lockdown measures. These measures decrease people's mobility in workplaces. School closures force some workers to be absent from work in order to care for their children. Death directly reduces the size of the workforce. These changes reduce supplies of goods and lower their price elasticity, shifting the country's supply curve upward and making it steeper. In sum, it is natural that the COVID-19 burden in an exporting country decreases the scale of production, which leads to a decrease in export supply.

However, there are two noteworthy elements in determining the *net* effect on exports. One is decreased domestic demand for exported products. The COVID-19 burden may shrink not only production of a product but also domestic demand for that product. If the decrease in domestic demand is sufficiently larger than the decrease in production, a net increase in exports could be realized by diverting the amount not consumed at home to the

export market. In other words, the relative magnitude of the scale of production over the size of domestic demand plays a key role in determining the net effect on exports.

The other element is the effect of introducing remote work/operation on productivity. Many countries have attempted to sustain economic activity by introducing such telecommuting systems. If these systems improve productivity or efficiency, exports could increase.[1] On the other hand, the scale of production would decrease much more in countries or industries where remote work/operation is less feasible. For example, it is difficult to realize such operation in labor-intensive industries or in industries that need an in-person presence for production.[2] It is also less feasible in countries with less developed information technology (IT) infrastructure. Exports are likely to decrease in such industries and countries due to decreased productivity.[3]

2.2. COVID-19 Burden in Importing Countries

The effect of the COVID-19 burden in an importing country on trade will mainly come from a decrease in aggregate demand in that country. Citywide/nationwide lockdowns reduce people's earnings from business and lead to a drop in aggregate demand unless the government provides sufficient benefits to cover the loss of earnings. However, even if people maintain their earnings, the fear of infection decreases their visits to retail stores or supermarkets, resulting in decreased demand. As is indicated by Eaton et al. (2016), who investigated the effect of the global recession in 2008-2009 on trade, negative demand shocks could reduce spending on durable goods more than spending on non-durable goods. This greater reduction is because durable products are "postpone-able" (Baldwin and Tomiura, 2020). On the other hand, uncertainty about the future or "panic buying" may increase demand for non-durable products. In addition, the import demand for sanitation products, such as face masks and hand sanitizer, may increase due to increased demand for products that defend against COVID-19 infection.

2.3. COVID-19 Burden in Neighboring Countries

[1] Indeed, the relationship between remote work/telecommuting and productivity is not straightforward. In an experimental study by Dutcher (2012), telecommuting has a positive effect on the productivity of creative tasks, but a negative effect on the productivity of dull tasks.

[2] Based on US data, Dingel and Neiman (2020) calculated the share of jobs that could be performed at home. For instance, the share is about 22% for manufacturing and about 5% for agriculture, forestry, fishing, and hunting.

[3] Melitz (2003) demonstrated that only productive firms can export their products to foreign countries because there are fixed costs in exportation. Decreased productivity indicates decreased volume of exports by exporting firms, and some stop exporting.

The international trade of one country may be affected by the COVID-19 burden in its neighboring countries. The burden in neighboring countries has contrasting effects on trade. One is a positive effect. Decreased exports from a country's neighbors due to COVID-19 create an export opportunity for that country because importing countries may change their import source from the neighboring countries to that country. We may call this effect the "substitution effect." Also, decreased imports in the neighboring countries affected by COVID-19 may lower market prices due to decreased demand levels. This decrease in trade prices in the international market may increase imports in other countries.

The other impact is a negative effect, which we call the "contagion effect." Negative production shocks resulting from COVID-19 in a country may reduce production of other countries through supply-chain networks. For instance, Boehm et al. (2019) showed that international trade and foreign direct investment play a larger role in transmitting shocks to domestic production in other countries because the elasticity of substitution between imported intermediates and domestic factors is smaller.[4] Also, as suggested by Halpern et al. (2015), decreased imported inputs results in lowering producers' productivity. Furthermore, Blaum et al. (2018) found that reduced imported inputs raise the prices of products due to input-output linkages. As a result, exports of a country drop if it relies on materials or intermediates imported from neighboring countries with COVID-19 burden.

3. Empirical Framework

This section presents our empirical framework for investigating the impacts of COVID-19 on international trade. We simply specify the trade model as follows:

$$Trade_{ijt} = \exp\{\alpha_1 RTA_{ijt} + \alpha_2 \ln GDP_{it} + \alpha_3 \ln GDP_{jt} + \alpha_4 COVID_{it} + \alpha_5 COVID_{jt} + \delta_{ij} + \delta_t\} \cdot \epsilon_{ijt} \quad (1)$$

$Trade_{ijt}$ is export values from countries i to j at time t. As a time-variant country-pair element, a regional trade agreement (RTA) dummy variable is introduced that takes a value of one if two countries are members of the same RTA and a value of zero otherwise (RTA_{ijt}). The time-variant exporter/importer characteristics include the respective country's logged GDP ($\ln GDP_{it}$). Furthermore, in this study, we assume that time-variant exporter/importer characteristics include the extent of COVID-19 burden in the respective country ($COVID_{it}$). δ_{ij} is country-pair fixed effects that control for time-invariant country-pair characteristics, such as geographical distance between the two countries. ϵ_{ijt} is a disturbance term. We estimate this equation by the Poisson pseudo-maximum likelihood method.

[4] Indeed, using the 2011 earthquake in Japan as an exogenous shock, Boehm et al. (2019) found that the elasticity of substitution is near zero in the short run, and US firms that rely more heavily on Japanese inputs experienced larger drops in production.

Our study considers two time periods: January-March 2019 and January-March 2020. We obtained monthly data on trade values from the Global Trade Atlas maintained by IHS Markit.[5] We use the data on both exports and imports in reporting countries in the Global Trade Atlas. The export values are included in the dataset after multiplying 1.05 to roughly adjust for freight and insurance charges. The 26 reporting countries and their 186 partner countries in our dataset are listed in Appendix A. The data on GDP are taken from the World Economic Outlook by the IMF. Notice that we use the 2018 (2019) GDP figure for January-March in 2019 (2020). The first reason for this inconsistency in years is data limitation; GDP for 2020 has not yet been realized. The second reason is to avoid GDP variables containing the impacts of COVID-19. We capture those impacts solely by $COVID_{it}$. Because we focus on trade in the first quarter of each year, we can interpret our inclusion of GDP in the previous year as controlling for the demand/production conditions just before the first quarter of years. The RTA dummy variable is drawn from Egger and Larch (2008) and its 2020 update by using RTA information available on the World Trade Organization website.

As mentioned in Section 1, we use the number of COVID-19 cases and deaths collected by the European Centre for Disease Prevention and Control as measures of the COVID-19 burden.[6] These data have been collected daily from health authority reports worldwide. We use the sum of the number of cases and the sum of the number of deaths during January-March 2020.[7] The numbers are set to zero for January-March 2019. We add a value of one to these numbers and then take their logs. It is also worth noting what these variables indicate. One issue is that these two numbers may have different impacts on trade because of differences in mortality among countries. For example, as of the end of March, the number of cases in Germany (62,000) was approximately three times that in the United Kingdom (22,000). On the other hand, the number of deaths was 600 in Germany and 2,000 in the United Kingdom. Nevertheless, an increase in either number prompts governments to implement measures to protect people and companies. Thus, we interpret both numbers as indicating the degree of incentive or the probability for such measures.[8]

Before reporting our estimation results, we give an overview of COVID-19 burden. Table 1 lists the top 20 countries in terms of number of deaths as of 31 March. At that time, Italy was the top country, followed by Spain, China, the United States, and France. In terms of number of cases, the United States was the top country, followed by Italy. In this table, we also show figures on people's mobility in retail and recreation and that in workplaces as of 31 March. The data are obtained from the COVID-19 Community Mobility Reports by Google and indicate the percent change in visits to retail stores and recreation sites and to

[5] https://connect.ihsmarkit.com/gta/home

[6] https://data.europa.eu/euodp/en/data/dataset/covid-19-coronavirus-data

[7] Notably, the database reports 27 cases in China on 31 March 2019, which are added to our variable of the cases in China.

[8] COVID-19 burden could be measured as a ratio to the total population. However, using the ratio does not substantially change our results because we control for country-pair fixed effects.

workplaces, compared with those during the 5-week period from 3 January to 6 February 2020.[9] Although Google does not recommend using these figures for cross-country comparison due to differences in data accuracy, all countries mentioned above, except for the United States, saw decreased visits to retail stores and recreation areas (around 90%) and to workplaces (around 70%).[10]

=== Table 1 ===

4. Empirical Results

This section reports our estimation results. We cluster standard errors by country pairs. Columns (I) and (II) in Table 2 show our baseline results. In both columns, the dependent variable is trade values in the first quarter. The extent of COVID-19 burden is measured as the log of the number of cases (I) and the log of the number of deaths (II) during the same period. Our control variables (i.e., RTA dummy and GDP variables) have positive but insignificant coefficients. The main variables of COVID-19 burden show significantly negative coefficients for exporters only. Both the number of cases and deaths in exporting countries have negative effects on trade, whereas those in importing countries do not have significant coefficients. Thus, decreases in workforce size and productivity in exporting countries result in decreased trade. Although we cannot identify whether the impact of COVID-19 decreased demand in importing countries, at the very least it did not lead to decreased trade.

=== Table 2 ===

Of possible interest is the effects of COVID-19 burden on total exports and imports worldwide. By using the results in column (II), that is, those using the number of deaths as a measure of the impact of COVID-19, we compute the following:

$$\Delta Export_i = \sum_j Trade_{ij2019} \times \left(\exp\left(\hat{\alpha}_4 COVID_{it} + \hat{\alpha}_5 COVID_{jt}\right) - 1\right) \quad (2)$$

$$\Delta Import_j = \sum_i Trade_{ij2019} \times \left(\exp\left(\hat{\alpha}_4 COVID_{it} + \hat{\alpha}_5 COVID_{jt}\right) - 1\right) \quad (3)$$

Equation (2) indicates the extent to which the impacts of COVID-19 affects the total worldwide exports from country i in the first quarter, compared with those exports during the same period in 2019. The case of total worldwide imports is formalized in equation (3). We compute these measures for only reporting countries in our trade data source (i.e.,

[9] https://www.google.com/covid19/mobility/data_documentation.html

[10] The figures are not available for some countries, such as China and Iran.

Global Trade Atlas). The results are reported in Table 3. We compute not only the absolute value but also the growth rate. In terms of the growth rate, the largest decrease in exports was seen in Spain, followed by France, China, the United States, and the United Kingdom. For example, the United States and China lost exports valued at 38 billion USD and 64 billion USD, respectively. On the other hand, Canada, Ireland, Mexico, and Portugal saw the greatest decrease in worldwide imports from among our study countries.

=== Table 3 ===

Next, we conduct robustness checks on our results in terms of the study period in our dependent and independent variables. In columns (III) and (IV), we replace the dependent variable with the trade values in only March. This replacement aims to address the fact that the trade contracts fulfilled in January and February might have been made in 2019, during which time most of countries were still unaware of the impact of COVID-19. In columns (V) and (VI), on the other hand, we replace the variables for COVID-19 with those from January to February to take into account the possibility that the effects of the COVID-19 may have a time lag. Such a time lag is likely because trade may not be realized in the same month as its contract. Due to data constraints, however, we can take only a 1-month lag into account.[11] The results of the COVID-19 variables in both kinds of robustness checks show similar results to our baseline results; that is, only exporters' COVID-19 burden has a significantly negative effect on trade. One notable difference is that the RTA dummy and GDP variables have significant coefficients in some specifications.[12]

In Table 4, we examine how the effects of COVID-19 differ according to country income level. Accordingly, we introduce the interaction terms between COVID-19 variables and a dummy variable that takes a value of one if the exporter or importer is categorized as a high-income country according to the World Bank classification. All the coefficients for importer variables are again not significant (except for the interaction term in column (III)).

[11] Another issue in our short study period is that the flow and stock of COVID-19 burden was not differentiated. We avoid this issue by examining only one time point in 2020 (and 2019). However, the impact could differ between the case of observing 10 deaths every month in January-March and the case of observing 30 deaths in only March even though both cases indicate 30 deaths in our COVID-19 variable. We leave this issue for future analysis with a longer study period.

[12] Three more sets of estimation results are available in the Appendix B. First, to take logs, we added a value of one to the COVID-19 variables. Because we do not have any rationale for selecting one, we also attempted a very small number instead of one. We again found that exporters COVID-19 burden had significantly negative effects on trade. Second, we examine the interaction effect between the exporters and importers COVID-19 burden by introducing the interaction term between the two COVID-19 burden variables. In this estimation, we also control for exporter-year and importer-year fixed effects. However, almost all specifications show insignificant results in the interaction term. Third, we examine the impacts of people's mobility in retail, recreation, and workplaces as of 31 March, as shown in Table 1. Specifically, we introduce mobility in retail for importing countries and mobility in workplaces for exporting countries and find that they have significantly positive effects.

On the other hand, we find an interesting contrast in exporter variables. Although the coefficients for exporter cases and death are again estimated to be significantly negative, their interaction terms with a high-income exporter dummy have significantly positive coefficients in some specifications. Particularly in the specifications in columns (V) and (VI), the absolute magnitude is similar between the non-interacted and interacted variables. This similar magnitude implies that the COVID-19 burden in exporting countries has significantly negative effects when exporters are developing countries, not developed countries. This contrast may be because remote work/operation is less feasible in developing countries due to their poorer IT infrastructure. It may also be because developing countries have a comparative advantage in labor-intensive industries, where remote work/operation is less feasible.[13]

=== Table 4 ===

Next, we examine the effects of COVID-19 burden in countries neighboring exporting and importing countries. As discussed in Section 2, the COVID-19 burden in these neighboring countries could have significant effects on trade. Specifically, we compute the distance-weighted sum of COVID-19 burden, as shown below.[14]

$$Neighbors'COVID_{it} \equiv \sum_{j \neq i} \left(\frac{COVID_{jt}}{Distance_{ij}} \right) \quad (4)$$

Here $COVID_{jt}$ represents the raw number of cases and number of deaths in country j. We introduce the logs of these sums (plus one) in exporting and importing countries separately. The estimation results are shown in Table 5. The COVID-19 variables in exporting countries themselves again have significantly negative coefficients. The neighbors' COVID-19 variables also have significant results especially for exporters. Moreover, their coefficients are estimated to be significantly positive.[15] This positive result may indicate the dominant role of the substitution effect; that is, a country may increase its exports thanks to the decrease in neighbor countries' exports due to COVID-19.

=== Table 5 ===

Finally, we estimate our model by industry. Specifically, we regress the model specified in columns (I) and (II) in Table 2. The industry is defined by the tariff section of the harmonized system. Only the results for the COVID-19 variables are shown in Table 6. Although total trade was analyzed, we did not find significant results for importers'

[13] Table B4 is similar to Table 3 when using the results in column (II) of Table 4.

[14] Data on geographical distance are from the CEPII website.

[15] These results are unchanged even when excluding COVID-19 variables in exporting and importing countries themselves.

COVID-19 burden; however, we can see significant results in some industries. In particular, importers' COVID-19 burden had *positive* effects on trade in the agricultural, mineral, and leather industries. Among them, agricultural goods are considered essential for life, so uncertainty about the future might induce consumers to purchase these goods and increase import demand. Negative effects of importers' COVID-19 burden can be found in the paper and machinery industries. A possible reason is that these products are postpone-able or durable products. Consumers possibly hesitate to buy these products. Also, supply-side shocks in importing countries possibly decrease demand for intermediate inputs in machinery industries through input-output linkages. On the other hand, the negative effects of exporters' COVID-19 burden are particularly evident in textiles, footwear, and plastic/glass products. This result might be due to how these products are labor-intensive or require an in-person presence for production.

=== Table 6 ===

5. Concluding Remarks

Based on data in the first quarter of 2020, this paper provides early evidence for the impacts of COVID-19 on worldwide trade. The spread of COVID-19 impacts both exporting and importing countries, but our findings indicate that negative effects on trade mainly come from exporters' COVID-19 burden in developing countries. The negative effects are particularly prevalent in the textile, footwear, and plastic industries. We have also observed that the COVID-19 burden in exporters' neighboring countries has a positive effect on exports, indicating a substitution effect in exporting. In the agricultural industry, however, we found a positive effect of importers' COVID-19 burden on trade. This indicates that importers' COVID-19 burden promotes exports of essential goods to affected countries.

The spread of COVID-19 causes both supply and demand shocks, but our results suggest that addressing supply-side shocks is more important to maintaining the stability of worldwide trade. Supporting developing countries is particularly important because COVID-19 burden results in greater decreases in exports from these countries than those from developed countries. Facilitating trade in agricultural and food industries is also important to meet increased demand in affected countries. We believe this paper contributes to a better understanding of the impacts of COVID-19 on the world economy and helps in considering policy responses to mitigate them.

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Table 1. Various Measures for COVID-19 burden as of 31 March 2020 (Numbers and Percent Changes)

	Cases	Deaths	Retail	Workplace
Italy	101,739	11,591	-90	-70
Spain	85,195	7,340	-92	-76
China	82,241	3,309	n.a.	n.a.
USA	164,620	3,170	-40	-49
France	44,550	3,024	-90	-74
Iran	41,495	2,757	n.a.	n.a.
UK	22,141	1,408	-74	-70
Netherlands	11,750	864	-40	-52
Germany	61,913	583	-53	-43
Belgium	11,899	513	-75	-66
Switzerland	15,412	295	-84	-49
Turkey	11,535	168	-61	-49
South Korea	9,786	163	-11	-5
Brazil	4,579	159	-60	-45
Sweden	4,028	146	-22	-29
Portugal	6,408	140	-72	-64
Indonesia	1,414	122	-35	-35
Austria	9,618	108	-77	-59
Canada	7,424	89	-51	-60
Philippines	2,084	88	-79	-74

Sources: European Centre for Disease Prevention and Control; COVID-19 Community Mobility Reports by Google.

Notes: This table reports the top 20 countries in terms of number of COVID-19 cases and deaths as of 31 March. It also shows the percent change in visits to retail stores, recreation sites, and workplaces as of 31 March.

Table 2. Baseline Estimation Results

	(I)	(II)	(III)	(IV)	(V)	(VI)
RTA dummy	0.043	0.032	0.139*	0.127	0.051	0.041
	[0.039]	[0.040]	[0.084]	[0.082]	[0.040]	[0.039]
ln Importer's GDP	0.157	0.126	0.536**	0.503**	0.218*	0.215
	[0.165]	[0.158]	[0.214]	[0.209]	[0.132]	[0.144]
ln Exporter's GDP	0.211	0.227	0.453*	0.461*	0.434**	0.598***
	[0.225]	[0.213]	[0.260]	[0.247]	[0.176]	[0.168]
ln (1+Importer's cases)	0.000		0.000		0.002	
	[0.004]		[0.005]		[0.002]	
ln (1+Exporter's cases)	-0.009**		-0.010**		-0.010***	
	[0.004]		[0.005]		[0.003]	
ln (1+Importer's deaths)		-0.002		-0.003		0.003
		[0.003]		[0.004]		[0.003]
ln (1+Exporter's deaths)		-0.011***		-0.012***		-0.016***
		[0.003]		[0.004]		[0.004]
Trade period	Jan-Mar	Jan-Mar	March	March	Jan-Mar	Jan-Mar
Covid period	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Feb	Jan-Feb
Number of observations	16,756	16,756	16,182	16,182	16,756	16,756
Log pseudolikelihood	-5E+10	-5E+10	-3E+10	-3E+10	-5E+10	-5E+10

Notes: Estimation results are derived by the Poisson pseudo-maximum likelihood method. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors reported in parentheses are clustered by country pair. In all specifications, we control for country-pair fixed effects and time fixed effects.

Table 3. Total Impacts in the First Quarter of 2020

	Export		Import	
	Absolute (Bil. USD)	Growth (%)	Absolute (Bil. USD)	Growth (%)
Argentina	-0.7	-4.7	-0.8	-7.0
Australia	-3.3	-4.6	-3.4	-6.7
Brazil	-4.1	-6.9	-3.1	-7.4
Canada	-7.2	-6.6	-9.3	-8.4
China	-63.9	-9.8	-30.0	-6.3
Cote d'Ivoire	-0.1	-2.0	-0.2	-5.7
France	-15.2	-10.0	-13.3	-8.3
Germany	-30.2	-8.3	-23.0	-7.5
Greece	-0.5	-5.3	-1.0	-6.6
Hong Kong	-0.3	-0.9	-8.8	-6.5
Indonesia	-3.1	-6.4	-2.6	-6.3
Ireland	-3.0	-6.0	-2.0	-8.4
Japan	-10.9	-5.7	-11.5	-6.4
Korea	-10.0	-6.8	-8.0	-6.5
Mexico	-6.1	-5.5	-7.2	-8.4
Philippines	-1.4	-6.1	-1.6	-6.2
Portugal	-1.2	-7.0	-1.9	-8.4
Russia	-4.3	-3.8	-3.4	-6.4
Singapore	-1.7	-2.5	-5.0	-5.8
South Africa	-0.7	-2.7	-1.2	-5.9
Spain	-8.6	-10.9	-7.2	-8.1
Switzerland	-5.6	-7.6	-4.8	-7.4
Taiwan	-3.5	-3.3	-4.0	-6.2
Thailand	-2.6	-3.7	-3.5	-5.7
UK	-10.6	-9.5	-14.4	-8.1
USA	-38.1	-9.8	-43.0	-7.2

Notes: Impacts in the first quarter of 2020 are relative to the first quarter of 2019. The impacts are computed using the coefficients for the number of importer and exporter deaths in column (II) in Table 2.

Table 4. Estimation Results According to Income-level

	(I)	(II)	(III)	(IV)	(V)	(VI)
RTA dummy	0.034	0.024	0.140*	0.125	0.039	0.044
	[0.039]	[0.040]	[0.084]	[0.084]	[0.039]	[0.039]
ln Importer's GDP	0.055	0.073	0.325	0.307	0.17	0.187
	[0.194]	[0.181]	[0.268]	[0.259]	[0.176]	[0.149]
ln Exporter's GDP	0.693***	0.740***	0.738***	0.751***	0.832***	0.806***
	[0.193]	[0.186]	[0.204]	[0.202]	[0.190]	[0.185]
ln (1+Importer's cases)	0.002		0.004		0.003	
	[0.003]		[0.004]		[0.002]	
* High income importer	-0.003		-0.005*		-0.001	
	[0.002]		[0.003]		[0.004]	
ln (1+Exporter's cases)	-0.017***		-0.014**		-0.012***	
	[0.005]		[0.006]		[0.003]	
* High income exporter	0.009***		0.005		0.015***	
	[0.002]		[0.003]		[0.004]	
ln (1+Importer's deaths)		0.000		0.003		0.002
		[0.003]		[0.004]		[0.003]
* High income importer		-0.005		-0.008*		0.001
		[0.003]		[0.004]		[0.007]
ln (1+Exporter's deaths)		-0.022***		-0.017***		-0.018***
		[0.004]		[0.006]		[0.004]
* High income exporter		0.015***		0.008		0.028***
		[0.004]		[0.005]		[0.008]
Trade period	Jan-Mar	Jan-Mar	March	March	Jan-Mar	Jan-Mar
Covid period	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Feb	Jan-Feb
Number of observations	16,756	16,756	16,182	16,182	16,756	16,756
Log pseudolikelihood	-5E+10	-5E+10	-3E+10	-3E+10	-5E+10	-5E+10

Notes: Estimation results are derived by the Poisson pseudo-maximum likelihood method. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors reported in parentheses are clustered by country pair. In all specifications, we control for country-pair fixed effects and time fixed effects.

Table 5. Impacts of Neighboring Countries' Cases and Deaths

	(I)	(II)	(III)	(IV)	(V)	(VI)
RTA dummy	0.04	0.03	0.135	0.124	0.044	0.041
	[0.041]	[0.041]	[0.085]	[0.083]	[0.040]	[0.039]
ln Importer's GDP	0.000	0.027	0.194	0.247	0.193	0.195
	[0.140]	[0.140]	[0.190]	[0.196]	[0.130]	[0.138]
ln Exporter's GDP	0.228	0.287	0.221	0.300	0.541***	0.651***
	[0.226]	[0.219]	[0.246]	[0.243]	[0.169]	[0.167]
ln (1+Importer's cases)	0.000		0.002		0.003	
	[0.004]		[0.005]		[0.002]	
ln (1+Exporter's cases)	-0.009**		-0.007		-0.008***	
	[0.004]		[0.005]		[0.003]	
ln (1+Importer neighbors' cases)	-0.018*		-0.029**		0.014	
	[0.010]		[0.014]		[0.009]	
ln (1+Exporter neighbors' cases)	0.006		-0.019		0.036***	
	[0.011]		[0.015]		[0.009]	
ln (1+Importer's deaths)		-0.002		-0.002		0.003
		[0.004]		[0.005]		[0.003]
ln (1+Exporter's deaths)		-0.011***		-0.010**		-0.015***
		[0.004]		[0.005]		[0.004]
ln (1+Importer neighbors' deaths)		-0.014		-0.022		0.042*
		[0.010]		[0.014]		[0.022]
ln (1+Exporter neighbors' deaths)		0.01		-0.012		0.066***
		[0.011]		[0.016]		[0.018]
Trade period	Jan-Mar	Jan-Mar	March	March	Jan-Mar	Jan-Mar
Covid period	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Feb	Jan-Feb
Number of observations	16,756	16,756	16,182	16,182	16,756	16,756
Log pseudolikelihood	-5E+10	-5E+10	-3E+10	-3E+10	-5E+10	-5E+10

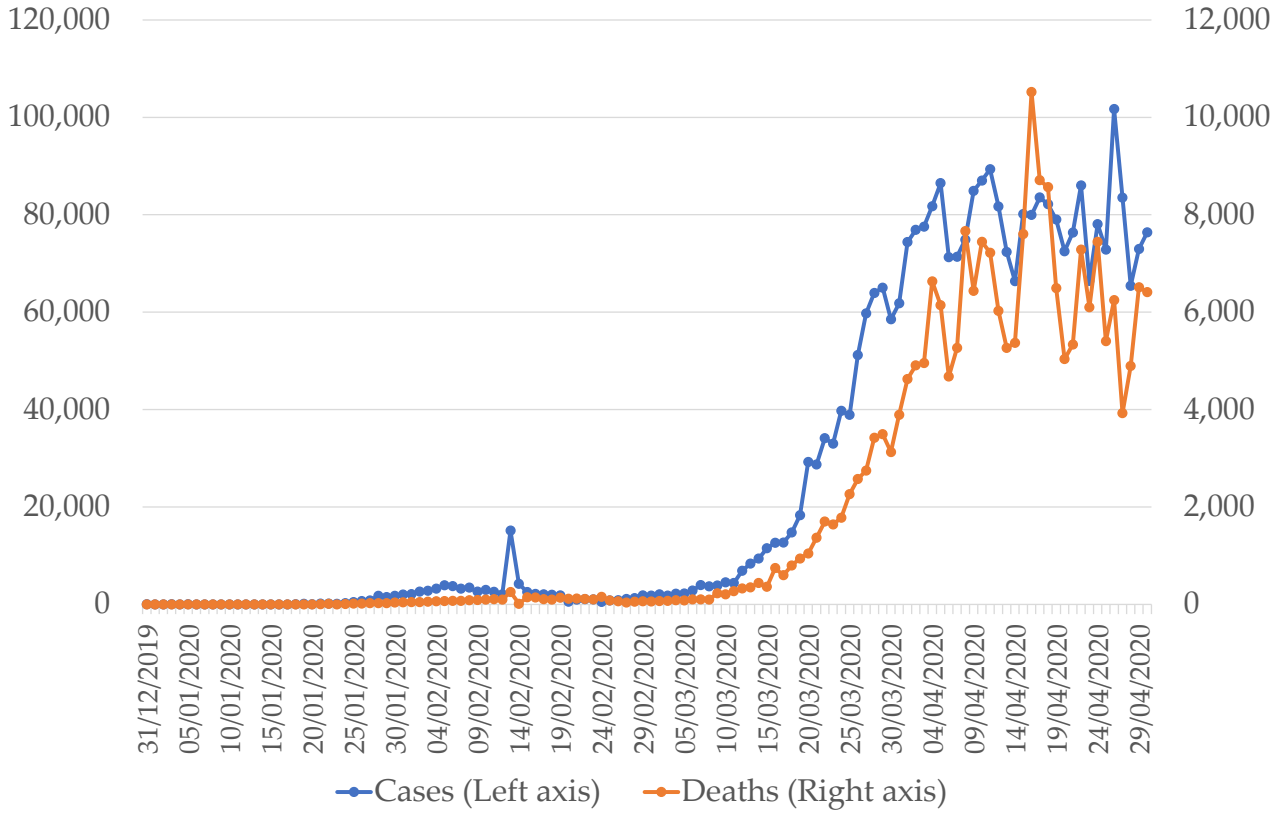
Notes: Estimation results are derived by the Poisson pseudo-maximum likelihood method. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors reported in parentheses are clustered by country pair. In all specifications, we control for country-pair fixed effects and time fixed effects.

Table 6. Estimation Results by Tariff Section

	Importer's cases		Exporter's cases		Importer's deaths		Exporter's deaths	
	Coef	SE	Coef	SE	Coef	SE	Coef	SE
Live animals	0.017***	[0.006]	0.031***	[0.008]	0.01	[0.007]	0.030***	[0.008]
Vegetable products	0.005	[0.010]	0.004	[0.014]	0.005	[0.011]	0.003	[0.011]
Animal/vegetable fats	-0.006	[0.008]	-0.005	[0.010]	-0.009	[0.008]	-0.015	[0.010]
Food products	0.003	[0.002]	0.002	[0.003]	0.000	[0.002]	-0.001	[0.003]
Mineral products	0.014**	[0.006]	0.005	[0.006]	0.010*	[0.006]	-0.004	[0.006]
Chemical products	0.001	[0.004]	0.005	[0.004]	-0.002	[0.003]	0.004	[0.004]
Plastics and rubber	-0.001	[0.002]	0.001	[0.003]	-0.002	[0.002]	-0.001	[0.002]
Leather products	0.011*	[0.006]	-0.014**	[0.007]	0.005	[0.007]	-0.013**	[0.006]
Wood products	0.004	[0.006]	0.009	[0.006]	0.000	[0.005]	0.004	[0.005]
Paper products	-0.008	[0.005]	-0.003	[0.005]	-0.010**	[0.004]	-0.004	[0.004]
Textiles	0.000	[0.007]	-0.014**	[0.006]	-0.002	[0.006]	-0.014***	[0.005]
Footwear	0.002	[0.007]	-0.027***	[0.007]	0.000	[0.006]	-0.024***	[0.005]
Plastic/glass products	-0.001	[0.003]	-0.020***	[0.004]	-0.002	[0.003]	-0.018***	[0.004]
Precious metals	0.004	[0.010]	0.001	[0.007]	-0.005	[0.012]	0.001	[0.009]
Base Metal	-0.005	[0.004]	-0.009***	[0.003]	-0.005	[0.003]	-0.009***	[0.003]
Machinery	-0.005*	[0.003]	-0.014***	[0.003]	-0.008***	[0.003]	-0.015***	[0.003]
Transport equipment	-0.006	[0.006]	-0.006	[0.006]	-0.005	[0.005]	-0.006	[0.005]
Precision machinery	0.000	[0.003]	-0.006**	[0.003]	-0.004	[0.003]	-0.010***	[0.003]
Miscellaneous	0.017**	[0.007]	-0.014	[0.010]	0.019**	[0.009]	-0.01	[0.009]

Notes: Estimation results are derived by the Poisson pseudo-maximum likelihood method. For each section, we estimate equations specified in columns (I) and (II) in Table 2 and then report only the results for cases and deaths. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. "SE" indicates standard errors clustered by country pair. In all specifications, we control for country-pair fixed effects and time fixed effects.

Figure 1. Daily Numbers of COVID-19 Cases and Deaths Worldwide



Source: European Centre for Disease Prevention and Control.

Appendix A. Study Countries

26 Reporting Countries:

AR, AU, BR, CA, CH, CI, CN, DE, ES, FR, GB, GR, HK, ID, IE, JP, KR, MX, PH, PT, RU, SG, TH, TW, US, ZA

160 Partner Countries (Excluding Reporting Countries):

AE, AF, AG, AL, AM, AO, AT, AW, AZ, BA, BB, BD, BE, BF, BG, BH, BI, BJ, BN, BO, BS, BT, BW, BY, BZ, CF, CG, CL, CM, CO, CR, CV, CY, CZ, DJ, DK, DM, DO, DZ, EC, EE, EG, ER, ET, FI, FJ, FM, GA, GD, GE, GH, GM, GN, GQ, GT, GW, GY, HN, HR, HT, HU, IL, IN, IQ, IR, IS, IT, JM, JO, KE, KG, KH, KI, KM, KN, KW, KZ, LA, LB, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MH, ML, MM, MN, MO, MR, MT, MU, MV, MW, MY, MZ, NA, NE, NG, NI, NL, NO, NP, NR, NZ, OM, PA, PE, PG, PK, PL, PR, PW, PY, QA, RO, RW, SA, SB, SC, SD, SE, SI, SK, SL, SM, SN, SO, SR, ST, SV, TD, TG, TJ, TM, TN, TO, TP, TR, TT, TV, TZ, UA, UG, UY, UZ, VC, VE, VN, VU, WS, YE, ZM, ZW

Appendix B. Other Estimation Results.

Table B1. Addition of a Small Number to COVID-19 Variables

	(I)	(II)	(III)	(IV)	(V)	(VI)
RTA dummy	0.048	0.043	0.144*	0.140*	0.052	0.043
	[0.039]	[0.039]	[0.086]	[0.084]	[0.040]	[0.040]
ln Importer's GDP	0.197	0.168	0.578***	0.562***	0.223	0.259*
	[0.166]	[0.165]	[0.214]	[0.215]	[0.142]	[0.141]
ln Exporter's GDP	0.193	0.162	0.439*	0.406	0.272	0.378**
	[0.232]	[0.228]	[0.265]	[0.266]	[0.202]	[0.181]
ln (1.E-06+Importer's cases)	0.001		0.001		0.001	
	[0.002]		[0.002]		[0.001]	
ln (1.E-06+Exporter's cases)	-0.004*		-0.004		-0.003**	
	[0.002]		[0.003]		[0.001]	
ln (1.E-06+Importer's deaths)		0.000		0.000		0.001
		[0.002]		[0.002]		[0.001]
ln (1.E-06+Exporter's deaths)		-0.005***		-0.004*		-0.004***
		[0.002]		[0.002]		[0.001]
Trade period	Jan-Mar	Jan-Mar	March	March	Jan-Mar	Jan-Mar
Covid period	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Feb	Jan-Feb
Number of observations	16,756	16,756	16,182	16,182	16,756	16,756
Log pseudolikelihood	-5E+10	-5E+10	-3E+10	-3E+10	-5E+10	-5E+10

Notes: Estimation results are derived by the Poisson pseudo-maximum likelihood method. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors reported in parentheses are clustered by country pair. In all specifications, we control for country-pair fixed effects and time fixed effects.

Table B2. Controlling for Country-year Fixed Effects

	(I)	(II)	(III)	(IV)	(V)	(VI)
RTA dummy	0.038	0.027	0.179**	0.165*	0.038	0.039
	[0.046]	[0.047]	[0.091]	[0.094]	[0.046]	[0.046]
ln (1+Importer's cases)	0.000		0.000		-0.001***	
* ln (1+Exporter's cases)	[0.001]		[0.002]		[0.001]	
ln (1+Importer's deaths)		-0.001		-0.002		0.000
* ln (1+Exporter's deaths)		[0.001]		[0.002]		[0.001]
Trade period	Jan-Mar	Jan-Mar	March	March	Jan-Mar	Jan-Mar
Covid period	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Mar	Jan-Feb	Jan-Feb
Number of observations	16,684	16,684	16,116	16,116	16,684	16,684
Log pseudolikelihood	-4E+10	-4E+10	-2E+10	-2E+10	-4E+10	-4E+10

Notes: Estimation results derived by the Poisson pseudo-maximum likelihood method. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors reported in parentheses are clustered by country pair. In all specifications, we control for country-pair, exporter-year, and importer-year fixed effects.

Table B3. Additional Measures of COVID-19 Burden

	(I)	(II)	(III)	(IV)	(V)	(VI)
RTA dummy	0.05	0.055*	0.053	0.052	0.062*	0.060*
	[0.032]	[0.032]	[0.032]	[0.032]	[0.033]	[0.032]
ln Importer's GDP	0.186	0.205	0.194	0.122	0.107	0.106
	[0.134]	[0.133]	[0.134]	[0.154]	[0.152]	[0.155]
ln Exporter's GDP	0.589***	0.602***	0.596***	0.567***	0.551***	0.558***
	[0.168]	[0.174]	[0.173]	[0.185]	[0.186]	[0.186]
Mobility change in importer's retail	0.088***	0.097***	0.093***	0.063**	0.060**	0.063**
	[0.023]	[0.024]	[0.025]	[0.029]	[0.029]	[0.029]
* High income importer				0.034	0.054*	0.05
				[0.027]	[0.033]	[0.033]
Mobility change in exporter's workplace	0.069**	0.086***	0.079**	0.055	0.062*	0.063*
	[0.028]	[0.031]	[0.033]	[0.034]	[0.035]	[0.035]
* High income exporter				0.012	0.037	0.026
				[0.030]	[0.035]	[0.036]
ln (1+Importer's cases)		0.003			0.005	
		[0.003]			[0.003]	
ln (1+Exporter's cases)		0.003			0.005*	
		[0.003]			[0.003]	
ln (1+Importer's deaths)			0.001			0.003
			[0.002]			[0.003]
ln (1+Exporter's deaths)			0.002			0.003
			[0.003]			[0.003]
Number of observations	10,696	10,696	10,696	10,696	10,696	10,696
Log pseudolikelihood	-3E+10	-3E+10	-3E+10	-3E+10	-3E+10	-3E+10

Notes: Estimation results derived by the Poisson pseudo-maximum likelihood method. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors reported in parentheses are clustered by country pairs. In all specifications, we control for country-pair fixed effects and time fixed effects.

Table B4. Total Impacts in the First Quarter of 2020

	Export		Import	
	Absolute (Bil. USD)	Growth (%)	Absolute (Bil. USD)	Growth (%)
Argentina	-0.9	-5.8	-1.0	-8.0
Australia	-3.7	-5.3	-4.0	-7.8
Brazil	-5.2	-8.7	-3.4	-8.1
Canada	-9.2	-8.6	-9.6	-8.7
China	-85.6	-13.1	-30.5	-6.4
Cote d'Ivoire	-0.1	-2.1	-0.2	-6.7
France	-15.7	-10.3	-14.5	-9.0
Germany	-37.8	-10.4	-23.7	-7.7
Greece	-0.6	-7.1	-1.0	-6.7
Hong Kong	-0.2	-0.5	-11.7	-8.6
Indonesia	-3.9	-8.2	-3.0	-7.3
Ireland	-3.8	-7.5	-2.1	-8.9
Japan	-13.6	-7.1	-13.3	-7.4
Korea	-12.5	-8.5	-9.0	-7.3
Mexico	-7.8	-7.0	-7.8	-9.1
Philippines	-1.7	-7.7	-1.9	-7.2
Portugal	-1.5	-9.3	-1.6	-7.1
Russia	-5.1	-4.6	-3.9	-7.4
Singapore	-1.9	-2.8	-6.1	-7.0
South Africa	-0.8	-2.9	-1.5	-7.1
Spain	-5.4	-6.8	-9.7	-10.8
Switzerland	-7.2	-9.7	-4.7	-7.2
Taiwan	-3.8	-3.5	-4.9	-7.6
Thailand	-3.0	-4.5	-4.2	-7.0
UK	-11.7	-10.5	-15.9	-9.0
USA	-37.2	-9.5	-53.9	-9.0

Notes: Impacts in the first quarter of 2020 are relative to the first quarter of 2019. The impacts are computed using the coefficients for the number of deaths in importing and exporting countries in column (II) in Table 4.