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Contents lists available at ScienceDirect

## Journal of The Japanese and International Economies

journal homepage: [www.elsevier.com/locate/jjie](http://www.elsevier.com/locate/jjie)

## The impact of COVID-19 on international trade: Evidence from the first shock

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## ARTICLE INFO

## JEL classification:

F15  
F53

## Keywords:

COVID-19  
International trade  
Gravity equation  
Import  
Export

## ABSTRACT

This study investigates how the effects of COVID-19 on international trade changed over time. To do that, we explore monthly data on worldwide trade from January to August in 2019 and 2020. Specifically, our study data include the exports of 34 countries to 173 countries. We estimated the gravity equation by employing various variables as a proxy for the COVID-19 damage. Our findings can be summarized as follows: First, regardless of our measures to quantify the COVID-19 pandemic, we found significantly negative effects of COVID-19 on the international trade of both exporting and importing countries. Second, those effects, especially the effects of COVID-19 in importing countries, tended to become insignificant since July 2020. This result implies that the harmful impacts of COVID-19 on international trade were accommodated after the first wave of the pandemic to some extent. Third, we found heterogeneous effects across industries. The negative effects on non-essential, durable products persist for a long time, whereas positive effects in industries providing medical products were observed.

## 1. Introduction

In the third quarter of 2020, countries have gradually been recovering from the coronavirus pandemic (hereafter, COVID-19) in terms of economic activities. The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020. Subsequently, to slow the coronavirus spread, many countries have imposed some form of restrictions on people and businesses. Several countries have declared citywide or nationwide lockdowns. In addition, many countries have imposed an entry ban on foreigners. Strict restrictions were observed in the second quarter of 2020, in particular. This was the first wave of the pandemic. Afterwards, most countries started to lift such restrictions. As a result, economies also started to regain their growth—for example, GDP in the third quarter recorded positive growth in some countries, such as China.<sup>1</sup> Although the second wave hit Western countries in the third quarter, learnings from the first shock enabled people's social and

economic activities to be better maintained during the subsequent pandemic period.

This study aimed to investigate the effects of COVID-19 on international trade and how such effects changed over time. We explored monthly data on worldwide trade from January to August in both 2019 and 2020. This period includes the period after the first wave. Although it is difficult to identify the end date of the first wave in each country precisely, most countries had the first peak of confirmed cases or deaths around April 2020. COVID-19 impacted international trade significantly and in various ways. In exporting countries, the COVID-19 damage manifested as a reduction in the scale of production scale and the export supply in that country. Exports are expected to drop, particularly in industries and countries where remote work/operation is less feasible. The effect of the COVID-19 damage in an importing country is mainly due to the decrease in aggregate demand in that country. The reductions in people's earnings and their visits to retail outlets led to a reduction in

This study is a revised version of a paper titled "The Impacts of COVID-19 on International Trade: Evidence from the First Quarter of 2020." We would like to thank two anonymous referees, Kyoji Fukao, Shujiro Urata, and seminar participants in the Institute of Developing Economies for their invaluable comments and suggestions. We gratefully acknowledge financial support from the Japan Society for the Promotion of Science (JSPS) in the form of various KAKENHI Grants (18H03637 to Hayakawa and 20H01501 to Mukunoki). All remaining errors are ours.

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<sup>1</sup> Indeed, the empirical analysis for China shows that a provincial rise in the confirmed cases decreases exports and imports, especially until March (Cai and Hayakawa, 2020).

<https://doi.org/10.1016/j.jjie.2021.101135>

Received 27 November 2020; Received in revised form 8 February 2021; Accepted 25 February 2021

Available online 4 March 2021

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demand. We empirically investigated how these negative effects of COVID-19 changed over time.

We expected that the negative effects of COVID-19 on international trade would decrease after the first wave. Most people in the world, especially the current generation, have never experienced a comparable level of restrictions or lockdown orders. At the beginning of the first wave, we did not know how to “behave” in the pandemic world. Thus, many countries chose a simple measure, that is, forcing people to stay at home and closing factories and offices. We acquired some knowledge through this experience and gradually started putting infection control measures (e.g., social distancing) in place. Furthermore, online business talks and conventions became more commonplace. Online shopping also became one of the standard methods for purchasing goods. Therefore, as our experience with the pandemic increases, the adverse effects of COVID-19 are expected to decline over time.

More specifically, we regressed bilateral trade values on various measures of the severity of COVID-19 at a monthly level. We used four measures for the severity of COVID-19. The first and second are the numbers of COVID-19 cases and deaths in importing and exporting countries, respectively. The third measure is people’s mobility with regards to retail and recreation for importing countries and workplaces for exporting countries. Similarly, the fourth measure is the share of days in each month when stay-at-home orders were in effect in importing countries or when workplace-closing orders were in effect in exporting countries. To investigate the changes in the effects of COVID-19 over time, we interacted these COVID-19 measures with dummy variables indicating months. By estimating this model, we explored how the coefficients for the COVID-19 damage changed over the months. We also estimate our model by industries to uncover the heterogeneous effects across industries. Our study data include the exports of 34 countries to 173 countries.

Our findings can be summarized as follows: First, regardless of our measures for the severity of COVID-19, we found negative effects of COVID-19 on international trade in both exporting and importing countries. Second, those effects, especially the effects of COVID-19 in importing countries, tended to be insignificant since July. Third, COVID-19 led to a decrease in imports of mineral products, leather products, and transport equipment, especially in April and May. The negative effects on the imports of non-essential, durable products tend to persist. On the other hand, the impact on the machinery products, which include information technology (IT)-related products, has become insignificant since July. Furthermore, we found positive effects of COVID-19 in importing countries in some medical products, even during March-May. Fourth, labor-intensive industries such as textiles were likely to suffer from the negative impacts of COVID-19 in exporting countries. In particular, the negative effect in the footwear industry lasted until August. The transport equipment industry also experienced negative effects of COVID-19 in exporting countries, especially in April and May.

Our study contributes to the literature on the international trade-COVID-19 nexus. Fuchs et al. (2020) examined the exports of medical products from China during the pandemic period. Specifically, they empirically investigated the role of political and economic ties with China. A similar analysis was conducted by Telias and Urdinez (2020). Hayakawa and Mukunoki (2020a) investigated the effects of lockdown orders on trade by employing worldwide trade data from January to June.<sup>2</sup> Hayakawa and Mukunoki (2020b) examined the role of the

COVID-19 burden in suppliers of machinery parts by focusing on the exports of finished machinery products. A similar analysis was conducted for China’s trade only (Friedt and Zhang, 2020). Focusing on the US, Meier and Pinto (2020) found that industries with a large exposure to intermediate goods imports from China experienced a large drop in exports (and imports, employment, and production). Compared with these existing studies, our study covered trade over a longer period (until August 2020) among a larger number of countries in all industries. This enabled us to shed new light on the time-series changes in the trade effects of COVID-19. Furthermore, we examine the heterogeneous effects of COVID-19 across industries.

The remainder 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 on how COVID-19 affects trade between countries. First of all, COVID-19 damages decrease trade by increasing trade costs between countries.<sup>3</sup> For instance, COVID-19 cases/deaths reduce on-site presence of workers, such as truck drivers and port workers, in the transport and shipping sectors. Lockdown policies and port restrictions reduce air flights and marine transportation between countries. For instance, Heiland and Ulltveit-Moe (2020) have reported that the decrease in container ships’ departure was 29% compared to 2019 in the first week of April 2020. These disruptions in transport sectors delay transportation and increase freight charges. Besides that, the spread of infectious diseases in a country affects both the demand side and the supply side of the economy. Hereafter, we summarize the possible effects of the COVID-19 damages in exporting and importing countries separately.

### 2.1. The trade effects of COVID-19 in exporting countries

We start with the impact of COVID-19 in exporting countries. The spread of COVID-19 led to social distancing and lockdown measures. These measures decrease people’s mobility with regards to workplaces. School closures force some workers to be away from their work to look after their children. Death and prolonged illness directly reduce the workforce. These changes reduce the supply of goods and make them less elastic in price, shifting the country’s supply curve upward and making it steeper. The COVID-19 damage and the subsequent lockdown orders also disrupt transportation sectors in exporting countries, increasing the cost of exporting by raising the port and terminal handling costs.

In sum, it is natural that the COVID-19 damage in an exporting country decreases the scale of production, thereby reducing the export supply in that country.<sup>4</sup> There will be industrial heterogeneity in terms of the degree of supply shocks. For instance, the supply shocks will be smaller in industries providing essential products, such as food and medical products, than non-essential products, such as automobiles and machines. This is because countries are trying to maintain the supply of essential products, and lockdown orders such as factory closure are usually not applied to the manufacturers of these products.

<sup>3</sup> See [https://www.wto.org/english/tratop\\_e/covid19\\_e/trade\\_costs\\_report\\_e.pdf](https://www.wto.org/english/tratop_e/covid19_e/trade_costs_report_e.pdf) for the WTO report about how the COVID-19 pandemic pushed up trade costs.

<sup>4</sup> The contrasting force is also at work if the damage of COVID-19 shrinks not only the production of a product, but also the domestic demand for that product. If the decrease in domestic demand is sufficiently large compared to the decrease in the scale of production, exports may increase in net terms because the amount not consumed at home can be diverted to the export market.

<sup>2</sup> There are several studies on the lockdowns due to COVID-19. Those studies investigated how lockdown policies affected the number of confirmed cases (Askitas et al., 2020; Ghosh, 2020; Ullah and Ajala, 2020), the number of deaths (Conyon et al., 2020), employment (Aum et al., 2020), unemployment insurance claims (Kong and Prinz, 2020), household spending and macroeconomic expectations (Coibion et al., 2020), and indicators of economic activity, such as nitrogen dioxide emissions (Dang and Trinh, 2020; Deb et al., 2020; Keola and Hayakawa, 2020).

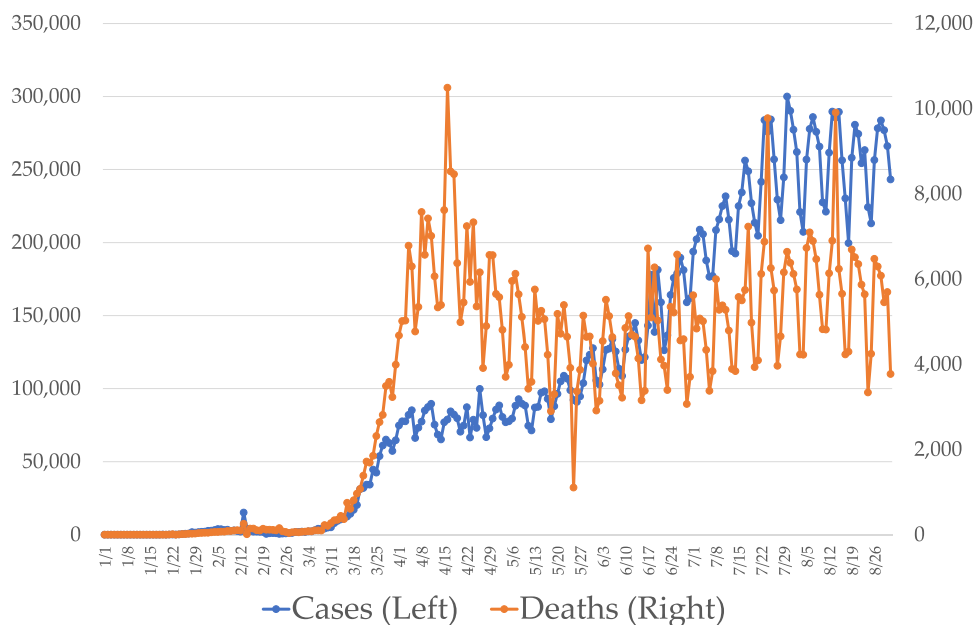


Fig. 1. Daily Numbers of COVID-19 Cases and Deaths in the World (persons).  
Source: European Centre for Disease Prevention and Control.

Nevertheless, the negative effect may decrease over time thanks to the introduction of remote work/operation. The development of telecommunication and information technology (IT) will facilitate remote works/operation and reduce supply shocks in the manufacturing sectors. Many countries have tried to maintain their economic activities by introducing telecommuting systems. These systems contribute to mitigating the adverse effects of COVID-19 on trade. Furthermore, such systems may even improve productivity or efficiency.<sup>5</sup> In this case, exports increase.<sup>6</sup> There will also be industrial heterogeneity of how remote work/operation replaces the on-site production activities. The exports are likely to keep decreasing in these industries where remote works/operation is less feasible, despite the development of IT. For example, such operations are difficult to conduct in labor-intensive industries such as textile, footwear, and leather products. Even in capital-intensive sectors such as machinery and transport equipment, the production scale decreases more greatly if remote work/operation is less feasible and an in-person presence is more critical in the production process. Dingel and Neiman (2020) calculated only 22% of jobs could be performed at home for manufacturing.

## 2.2. The trade effects of COVID-19 in importing countries

Regarding COVID-19 damages for an importing country, the trade effect will mainly come from the decrease in aggregate demand in that country, accompanied by an increase in the port and terminal handling costs. A citywide/nationwide lockdown reduces people's earnings from work and leads to a drop in aggregate demand unless the government provides sufficient benefits to cover the loss of earnings. Even if people maintain their incomes, however, the fear of infections decreases their visits to retail outlets and supermarkets, resulting in shrinking demand.

<sup>5</sup> Melitz (2003) demonstrated that only productive firms can export their products to foreign countries because of the existence of fixed costs in exporting. An improvement in productivity implies that the existing exporting firms increase the volume of exports, and some firms start exporting.

<sup>6</sup> Indeed, the relationship between remote work/telecommuting and productivity is not straightforward. Dutcher (2012) did an experimental study and showed that telecommuting has a positive effect on the productivity of creative tasks, but it has a negative effect on the productivity of dull tasks.

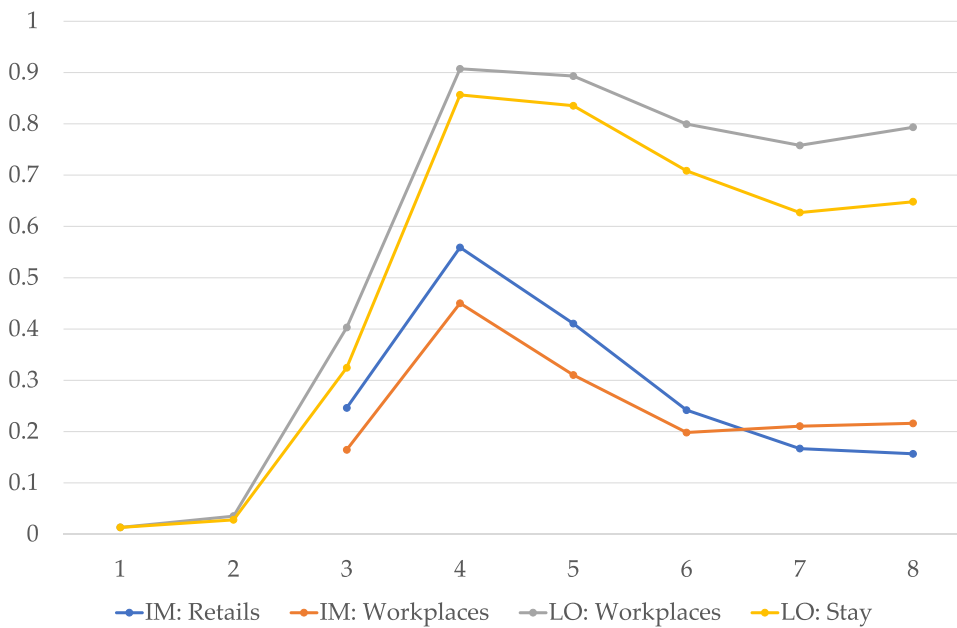
As for the supply shocks, the degree of the negative demand shocks will differ across industries. As indicated in a study by Eaton et al. (2016), which investigated the trade effect of the global recession during the period 2008–2009, negative demand shocks may reduce spending on durable products more than on non-durable products. The reason is that the former products are “postpone-able” (Baldwin and Tomiura, 2020). Therefore, the negative demand shock can be higher in industries providing durable goods. Examples of these industries include plastics and rubber, leather products, wood products, textiles, footwear, plastic/glass products, precious/base metals, machinery, and transport equipment.

In contrast, uncertainty about the future or “panic purchase” may increase the demand for essential products, such as vegetables and food products. Besides, the import demand for sanitation products, such as face masks and hand sanitizer, may increase due to the increased need to avoid infection by COVID-19. Thus, the adverse demand shocks will be smaller, or may even be positive for vegetable, food, and chemical products. Since textile face masks or protective garments for surgical/medical use are categorized as textile products, the negative shocks may also be smaller in that industry, despite the durable nature of the textile products.

Supply shocks also have a knock-on effect resulting in demand shocks of COVID-19 in importing countries through their supply chains. If COVID-19 damages decrease production of a downstream product, they subsequently decrease the import demands of upstream products used for the downstream products. We expect to observe this supply-chain effects in industries where international production networks are well-developed, such as machinery products and transport equipment. The demand shocks discussed in this paper include these supply-induced decreases in demands.

Online shopping plays a key role in mitigating the negative effects on demand caused by less mobility for visiting retail outlets.<sup>7</sup> The negative impact of COVID-19 on trade will be smaller in goods that consumers can buy via the e-commerce (EC) market. Furthermore, even after

<sup>7</sup> A survey conducted by UNCTAD (2020) shows that about 52% of consumers in the respondent countries are doing online shopping more often since the outbreak of COVID-19, and online shopping has increased for most products. The sample countries in this survey include Brazil, China, Germany, Italy, the Russian Federation, Republic of Korea, South Africa, Switzerland, and Turkey.



**Fig. 2.** The World Average of Immobility and the World Average Shares of Lockdown Dates by Months.

Notes: “IM: Retail” and “IM: Workplaces” indicate the world averages of immobility to retail locations and workplaces, respectively. “LO: Workplaces” and “LO: Stay” represent the world average shares of dates with workplace-closing orders and stay-at-home orders, respectively.

Sources: COVID-19 Community Mobility Reports by Google and the OxCGRT

COVID-19 infections/deaths decrease or stop and lockdown measures are lifted, this swift shift from offline shopping to online shopping is expected to persist, at least to some degree. As [Watanabe and Omori \(2020\)](#) suggest, consumers need to make upfront investments to switch to online purchasing. These investments include the cost of purchasing personal computers or smartphones, the costs of connecting to the Internet, purchasing software, and the cost of learning how to use EC platforms. Once these investments are made, people become reluctant to return to the status quo, and this new style of consumption will continue. In other words, the negative effects are likely to persist on the imports of goods that are difficult to purchase online. Furthermore, the rapid increase in online shopping and teleworking enhances the import demands for IT-related machinery products, such as PC, smartphones, microphones, and cameras.

### 3. Empirical framework

This section presents our empirical framework for investigating the impacts of COVID-19 on international trade. We examine these impacts by exploring monthly data on bilateral trade from January to August in both 2019 and 2020. The previous section suggests that COVID-19 damages in exporting countries influence trade through the changes of trade costs and supply capacity. Trade is also affected by COVID-19 damages in importing countries through the changes in trade costs and the level of demand. In order to investigate the total effect of COVID-19 in importing countries and in exporting countries, we regress trade values on respective countries’ damages by COVID-19. Our baseline model is specified as follows:

$$Trade_{ijym} = \exp\{\alpha_1 COVID_{iym} + \beta_1 COVID_{jym} + \delta_{ijy} + \delta_{ijm} + \delta_{ym}\} \cdot \epsilon_{ijym} \quad (1)$$

$Trade_{ijym}$  is the export value from countries  $i$  to  $j$  in month  $m$  year  $y$ . As explained in more detail later,  $COVID_{iym}$  and  $COVID_{jym}$  are the extent of COVID-19 damages in exporting and importing countries, respectively. We controlled for three kinds of fixed effects ( $\delta_{ijy}$ ,  $\delta_{ijm}$ , and  $\delta_{ym}$ ).  $\epsilon_{ijy}$  is a disturbance term. We estimated this equation using the Poisson pseudo maximum likelihood (PPML) method.

We obtained the monthly data on trade values from the Global Trade Atlas maintained by IHS Markit.<sup>8</sup> We use only the export statistics, that

is, the trade data recorded in exporting countries, because the data on imports often show the figures one or two months after the production of the goods. This time lag is inevitable because import statistics record the date of arrival at ports in importing countries, and it takes some time to ship goods from the port in an exporting country to the port in an importing country. This time lag may not significantly affect results when using annual-level data but it does for a monthly level analysis like the one in this paper ([Hayakawa, 2020](#)). Thus, we used the trade data from export statistics in 34 reporting countries. The 34 reporting countries and their 173 partner countries in our dataset are listed in [Appendix A](#).<sup>9</sup>

As mentioned in [Section 1](#), we used four measures to represent the severity of the COVID-19 damage. The first and second ones are the numbers of COVID-19 cases and deaths, of which data were obtained from the European Centre for Disease Prevention and Control.<sup>10</sup> These data have been collected on a daily basis from reports from health authorities worldwide. We used the sum of the numbers of new cases and new deaths in each month.<sup>11</sup> The numbers were set to zero in 2019. We added a value of one to these numbers and then took their logs. The third measure is people’s mobility with regard to retail and recreation and with regard to workplaces. The data were obtained from the COVID-19 Community Mobility Reports provided by Google and indicate the percent change in visits to retail and recreational locations and to workplaces, compared with those during the 5-week period from 3 January–6 February 2020.<sup>12</sup> We multiply this percent change by minus one so that the larger value of our measure indicates more damage as a result of COVID-19. We call this measure “immobility.” When using this measure, we dropped the observations for January and February.

The last measure is the share of days in each month when stay-at-home orders were effective in importing countries or when workplace-closing orders were effective in exporting countries. To construct these variables, we used the Oxford COVID-19 Government Response Tracker (OxCGRT) ([Hale et al., 2020](#)). The OxCGRT systematically collects

<sup>9</sup> For reference, we report our empirical results based on the import statistics in [Appendix B](#).

<sup>10</sup> <https://data.europa.eu/euodp/en/data/dataset/covid-19-coronavirus-data>

<sup>11</sup> Note that the database reports 27 cases for China in December 31, 2019, which are added to the cases for China in January 2020.

<sup>12</sup> [https://www.google.com/covid19/mobility/data\\_documentation.html](https://www.google.com/covid19/mobility/data_documentation.html). The figures in some countries (e.g., China or Iran) are not available.

<sup>8</sup> <https://connect.ihsmarket.com/gta/home>



information on several different common policy responses that governments have taken to respond to the pandemic on 17 indicators for more than 160 countries. For the measure in exporting countries, we used “C2 Workplace closure,” which includes “1 - recommend closure (or recommend work from home),” “2 - require closure (or work from home) for some sectors or categories of workers,” and “3 - require closure (or work from home) for all but essential workplaces (e.g., grocery stores, hospitals).” The measure in importing countries was constructed using “C6 Stay-at-home requirements,” which includes “1 - recommend not leaving home,” “2 - require not leaving home, with exceptions for daily exercise, grocery shopping, and ‘essential’ trips,” and “3 - require not leaving home with minimal exceptions (e.g., allowed to leave once a week, only one person can leave at a time, etc.).” Regardless of the degree of the orders, we counted the number of days when a score of at least one was effective and used its share out of the total number of days in each month.

It is worth discussing the differences among these variables measuring the severity of COVID-19. The numbers of confirmed cases and deaths are relatively fundamental measures of the damage caused by COVID-19. These two numbers may indicate different degrees of damage because of the mortality rate difference between countries. Further, the transition is slightly different between these two numbers. Fig. 1 depicts these numbers in the world at a daily frequency. While the number of cases constantly rises over time, the number of deaths has remained at a comparatively constant level since May. Nevertheless, an increase in either number induces the government to carry out some measures regarding people and businesses.

On the other hand, our fourth indicator (i.e., lockdown orders) directly captures the existence of measures to avoid the spread of infection. The world average shares of dates with such measures are shown in Fig. 2 (LO: Workplaces and LO: Stay). The data show that the shares of these dates rose sharply in April 2020 and have remained at a high level since then. The *outcome* of these lockdown orders on people’s behavior is our third indicator of COVID-19, that is, immobility. The changes in people’s mobility may differ by country, even if lockdown restrictions with the same degree are imposed. The world average of immobility is shown in Fig. 2 (IM: Retails and IM: Workplaces). As is consistent with the lockdown-date shares, the immobility index also rose dramatically in April 2020. However, unlike the lockdown-date shares, the immobility index has gradually decreased since May 2020. In short, we tried to capture the changes in people’s social and economic activities due to COVID-19 from various viewpoints.

Finally, a set of fixed effects controls for various elements:  $\delta_{ijy}$  is country-pair year fixed effects, which control for standard gravity variables such as geographical distance. In addition, these fixed effects capture the effects of trade agreements, the annual average of multilateral resistance terms in each country, the annual average of the exporter’s factor prices (e.g., wages), and the annual average of the importer’s income.  $\delta_{ijm}$  is country-pair month fixed effects. This type of fixed effect controls for the seasonality of trade between two countries. For example, some fresh fruits may be available only in specific months.  $\delta_{ym}$  is year-month fixed effects, which controls for variations in world income. Furthermore, given that most countries started to close their borders to foreign travelers starting around the latter half of March 2020, this type of fixed effect may also control for the effects of people’s cross-border movements and those of trace costs worldwide.

#### 4. Empirical results

We begin with an overview of the changes in trade. Table 1 shows the monthly exports from 34 countries in 2020 relative to those in 2019 by industry defined at a section in a harmonized system. Unfortunately,

**Table 1**

Exports in 2020 relative to exports in 2019 by Month and Industries.

	1&2	3	4	5	6	7	8
Live animals	1.1	1.0	0.9	0.9	1.0	1.0	1.0
Vegetable products	1.0	1.1	1.1	1.0	1.1	1.0	1.0
Animal/vegetable fats	1.1	1.1	1.1	1.0	1.2	1.2	1.1
Food products	1.0	1.0	0.9	0.9	1.0	1.0	1.0
Mineral products	1.0	0.8	0.6	0.5	0.6	0.7	0.7
Chemical products	1.0	1.1	1.0	0.9	1.0	0.9	1.0
Plastics and rubber	0.9	1.0	0.8	0.8	0.9	0.9	1.0
Leather products	0.9	0.8	0.5	0.5	0.7	0.8	0.8
Wood products	0.9	0.9	0.8	0.8	1.0	1.0	1.1
Paper products	0.9	0.9	0.8	0.8	0.9	0.9	0.9
Textiles	0.9	0.8	0.8	1.0	1.1	1.0	1.1
Footwear	0.9	0.8	0.6	0.7	0.8	0.9	0.9
Plastic/glass products	0.9	0.9	0.7	0.7	0.9	1.0	1.0
Precious metals	1.2	1.1	1.1	1.0	1.0	1.1	1.1
Base Metal	0.9	0.9	0.8	0.7	0.9	0.9	0.9
Machinery	1.0	0.9	0.8	0.8	1.0	1.0	1.0
Transport equipment	1.0	0.8	0.4	0.4	0.7	0.8	0.8
Precision machinery	1.0	0.9	0.8	0.8	0.9	1.0	1.0
Miscellaneous	0.9	0.9	0.8	0.8	0.9	1.0	1.0
Total	1.0	0.9	0.8	0.7	0.9	0.9	0.9

Notes: This table represents export statistics. The smallest values are shaded with darker colors.

Source: Authors’ compilation.

**Table 2**

Exports in 2020 relative to exports in 2019 by months and continent-pairs.

Exporter	Importer	1&2	3	4	5	6	7	8
Africa	Africa	1.0	0.9	0.4	0.6	0.9	0.8	0.9
Africa	America	1.1	1.1	0.5	0.6	0.9	1.1	1.1
Africa	Asia	1.1	0.8	0.5	0.7	0.9	0.9	1.0
Africa	Europe	1.0	1.0	0.5	0.7	0.9	0.9	0.9
Africa	Pacific	1.0	1.1	0.3	1.1	0.7	1.3	1.1
America	Africa	1.0	0.9	0.8	0.8	0.7	0.9	0.8
America	America	1.0	1.0	0.6	0.5	0.8	0.8	0.8
America	Asia	1.0	0.9	0.9	0.8	0.9	0.9	0.9
America	Europe	1.0	1.0	0.8	0.7	0.8	0.9	0.9
America	Pacific	1.1	1.0	0.8	0.8	0.8	0.9	0.9
Asia	Africa	0.9	0.9	0.9	0.7	0.9	0.9	1.1
Asia	America	0.9	0.9	0.9	0.8	0.9	1.0	1.0
Asia	Asia	1.0	1.0	0.9	0.8	0.9	0.9	1.0
Asia	Europe	0.9	0.9	0.9	0.9	0.9	1.0	1.0
Asia	Pacific	0.9	0.9	0.9	1.0	0.9	1.0	1.0
Europe	Africa	1.0	0.9	0.6	0.6	0.8	0.9	0.8
Europe	America	1.0	1.1	0.8	0.8	0.9	0.9	0.9
Europe	Asia	1.0	0.9	0.7	0.7	0.9	0.9	0.9
Europe	Europe	1.0	0.9	0.7	0.7	0.9	0.9	1.0
Europe	Pacific	0.9	0.9	0.7	0.7	1.0	0.9	1.0
Pacific	Africa	0.9	0.8	0.7	0.6	0.7	0.7	1.1
Pacific	America	0.9	1.0	1.6	1.5	0.9	1.7	1.2
Pacific	Asia	0.9	0.9	0.9	0.8	0.8	0.7	0.8
Pacific	Europe	0.8	1.5	0.8	0.4	1.1	1.0	0.7
Pacific	Pacific	1.1	0.9	0.6	0.8	0.9	0.9	1.0

Notes: This table represents export statistics. The smallest values are shaded with darker colors.

Source: Authors’ compilation.

**Table 3**  
Baseline estimation results.

	(I)	(II)	(III)	(IV)
Importers' COVID-19	-0.016*** [0.003]	-0.014*** [0.003]	-0.282*** [0.052]	-0.079*** [0.015]
Exporters' COVID-19	-0.015*** [0.003]	-0.017*** [0.002]	-0.518*** [0.087]	-0.075* [0.041]
COVID-19 measure	Case	Death	Immobility	Lockdown
Wald Statistics	0.05	0.58	4.1	0.01
Wald p-value	0.829	0.448	0.043	0.933
Log pseudolikelihood	-8.7.E+10	-8.7.E+10	-4.6.E+10	-8.9.E+10
Pseudo R-squared	0.9977	0.9977	0.9976	0.9977
Number of observations	84,474	84,416	46,666	84,474

Notes: This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors reported in parentheses are those clustered by country pairs. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. All figures in this table are based on export statistics. "Wald Statistics" indicates statistics on the Wald test on the null hypothesis that the coefficient for Importers' COVID-19 severity is equal to that for Exporters' COVID-19 severity. Its p-value is reported in "Wald p-value." "COVID-19 measure" indicates the variable to measure the severity of the COVID-19 damage. Case and Death represent the numbers of confirmed cases and deaths, respectively. Immobility is defined as the percent change in visits to retail and recreational outlets multiplied by negative one for the importers' COVID-19 severity and the same measure but considering visits to workplaces for exporters' COVID-19 severity. Similarly, the Lockdown variable represents the share of days when stay-at-home orders were effective in the case of importers' COVID-19 severity and the share of days when workplace-closing orders were effective in the case of exporters' COVID-19 severity.

China reported only aggregated trade in January and February in 2020. Thus, we aggregate trade in these two months in this table.<sup>13</sup> Row "Total" shows that worldwide trade declined, particularly in April and May 2020. A similar drop in those months can also be observed at an industry-level. In particular, mineral products, leather products, footwear products, and transport equipment show a dramatic decrease. The trade values in transport equipment decreased by 60% in April and May 2020, compared with those in the corresponding months of 2019. In contrast, there are few effects in vegetable products, animal or vegetable fats, food products, chemical products, and precious metals.

Table 2 reports the exports according to importers' and exporters' continents. Note that exporting countries in the Pacific include only Australia, while there are four importing countries in the region.<sup>14</sup> There are some noteworthy findings. First, exports from Africa experienced a drastic decrease of more than 50% in April 2020. Imports to Africa also decreased significantly. Second, exports from Europe decreased more than those from the Americas, except for the case of intra-American trade. By contrast, the decrease in exports from Asia looks less severe. In this case, exports had already returned to the same level as the previous year by August 2020.

Next, we report our estimation results.<sup>15</sup> We first estimated Eq. (1). We clustered the standard errors by country pairs. The results of the baseline estimation are shown in Table 3. The extent of the damage was measured by the logs of the numbers of the cases in column (I), the logs of the numbers of deaths in column (II), the immobility percentages in

column (III), and the shares of dates with lockdown orders in column (VI). All coefficients in both the exporting and importing countries were found to be significant and had the expected sign. More confirmed cases, more deaths, more immobility in retail or workplace, and more days with lockdown orders led to a significant decrease in international trade. To compare the magnitude of the margin effects, we conduct the Wald test on the null hypothesis that the coefficient for Importers' COVID-19 effects is equal to that for Exporters' COVID-19 effects. Except for the case of (III), we did not find a significant difference.<sup>16</sup>

Then, we investigated the time-series changes of the coefficients for the COVID-19 variables. To this end, we estimated the following equation:

$$Trade_{ijm} = \exp\{COVID_{ijm}D'_m\alpha + COVID_{ijm}D'_m\beta + \delta_{ij} + \delta_{ijm} + \delta_{ym}\} \cdot \epsilon_{ijm} \quad (2)$$

D is a vector of dummy variables indicating months. We again

**Table 4**  
Estimation results according to months.

	(I)	(II)	(III)	(IV)
Importers' COVID-19				
* 1 for January	-0.015***	-0.025***		-0.545***
* 1 for February	-0.019***	-0.025***		-0.163***
* 1 for March	-0.012	-0.014***	-0.407***	-0.121***
* 1 for April	-0.022***	-0.019***	-0.394***	-0.232***
* 1 for May	-0.027***	-0.018***	-0.329***	-0.113***
* 1 for June	-0.015***	-0.009***	-0.111	-0.041**
* 1 for July	-0.007**	-0.002	-0.047	-0.031*
* 1 for August	-0.006	-0.001	-0.046	-0.062***
Exporters' COVID-19				
* 1 for January	0.004			
* 1 for February	0.019***	0.049***		0.122
* 1 for March	-0.006	-0.023***	-0.564***	-0.206***
* 1 for April	-0.041***	-0.030***	-0.554***	-0.164***
* 1 for May	-0.035***	-0.027***	-0.453***	-0.194***
* 1 for June	-0.013***	-0.010***	-0.122	0.106**
* 1 for July	-0.013***	-0.011***	-0.204	0.015
* 1 for August	-0.019***	-0.018***	-0.118	-0.070**
COVID-19 measure	Case	Death	Immobility	Lockdown
Log pseudolikelihood	-8.5.E+10	-8.5.E+10	-4.6.E+10	-8.7.E+10
Pseudo R-squared	0.9978	0.9978	0.9976	0.9977
Number of observations	84,474	84,416	46,666	84,474

Notes: This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors are not reported to save space, but were clustered by country pair for the analysis. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. All figures in this table are based on export statistics. "COVID-19 measure" indicates the variable to measure the severity of the COVID-19 damage. Case and Death represent the numbers of confirmed cases and deaths, respectively. Immobility is defined as the percent change in visits to retail and recreational outlets multiplied by negative one for the importers' COVID-19 severity and the same measure but considering visits to workplaces for exporters' COVID-19 severity. Similarly, the Lockdown variable represents the share of days when stay-at-home orders were effective in the case of importers' COVID-19 severity and the share of days when workplace-closing orders were effective in the case of exporters' COVID-19 severity.

<sup>13</sup> This table is based on the export statistics. The figures based on the import statistics are available in Table B1 in Appendix B and indicate a similar trend.

<sup>14</sup> The figures based on the import statistics are available in Table B2 in Appendix B.

<sup>15</sup> As mentioned above, China only reported aggregated trade in January and February in 2020. Thus, in our regression analyses, we drop observations of China's exports in these two months. In addition, we report the estimation results based on the export statistics. Those based on the import statistics are available in Appendix B.

<sup>16</sup> The results with one-month lagged variables of COVID-19 damages are available in Table B6 in Appendix B. Their coefficients are mostly insignificant.

**Table 5**  
Impacts of importers' cases by industries.

Month	1	2	3	4	5	6	7	8
Live animals	0.017**	-0.012***	-0.014**	-0.039***	-0.024**	-0.001	-0.001	0.000
Vegetable products	-0.012	-0.040***	-0.008	-0.029***	-0.039***	-0.015*	-0.023*	-0.033**
Animal/vegetable fats	-0.008	-0.012	0.031**	0.024	-0.014	-0.002	0.031	0.001
Food products	-0.007	-0.023***	-0.021***	-0.002	-0.018***	-0.010*	-0.001	-0.011**
Mineral products	-0.032***	-0.030**	-0.017	-0.043***	-0.077***	-0.055***	-0.020*	-0.008
Chemical products	-0.017***	-0.003	0.013	-0.005	0.003	-0.008	-0.003	-0.007
Plastics and rubber	-0.013***	-0.027***	-0.033***	-0.034***	-0.037***	-0.019***	-0.013***	-0.004
Leather products	-0.020***	-0.038***	-0.055***	-0.075***	-0.051***	-0.037***	-0.038***	-0.035***
Wood products	-0.008	-0.024***	-0.011	-0.026***	-0.037***	-0.023***	-0.006	0.017
Paper products	0.002	-0.005	-0.012**	-0.022***	-0.013**	-0.009*	-0.017**	-0.01
Textiles	-0.012	-0.009	-0.046***	0.003	0.014	-0.002	-0.011	-0.001
Footwear	-0.035***	-0.006	-0.016	-0.016	-0.027***	-0.021**	-0.012	-0.007
Plastic/glass products	-0.026***	-0.014**	-0.015**	-0.024***	-0.036***	-0.024***	-0.017***	-0.008
Precious metals	0.083**	-0.104***	0.028	0.108**	0.105**	0.111***	0.099***	0.059
Base Metal	-0.023***	-0.029***	-0.022***	-0.022***	-0.025***	-0.023***	-0.023***	-0.006
Machinery	-0.017***	-0.012***	-0.022**	-0.022***	-0.030***	-0.012***	-0.005	-0.006
Transport equipment	-0.028**	-0.034***	-0.003	-0.091***	-0.081***	-0.045***	-0.030**	-0.034
Precision machinery	-0.023***	-0.014***	-0.004	-0.031***	-0.029***	-0.009**	-0.015***	-0.008*
Miscellaneous	0.002	-0.024***	-0.014	-0.025*	-0.027**	-0.002	-0.002	0.012

Notes: This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors are not reported to save space, but were clustered by country pairs in this analysis. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. All figures in this table are based on export statistics.

**Table 6**  
Impacts of exporters' cases by industries

Month	1	2	3	4	5	6	7	8
Live animals	0.013	0.01	-0.001	-0.007	-0.012	-0.026***	-0.020***	-0.024***
Vegetable products	0.028	0.012	-0.019	-0.002	-0.006	0.004	-0.004	0.012
Animal/vegetable fats	0.019	0.016	-0.014	-0.011	0.014	-0.048	-0.082**	-0.038
Food products	0.015	0.023***	0.023**	-0.011	0.004	0.003	0.003	0.006
Mineral products	-0.002	0.025	-0.002	-0.018	-0.012	0.002	0.008	-0.024*
Chemical products	0.013	0.029	-0.005	-0.013	-0.005	-0.001	-0.007	-0.009
Plastics and rubber	0.006	0.014**	0.014**	-0.007	-0.004	0.000	-0.003	-0.009**
Leather products	0.037	0.012	-0.027**	-0.086***	-0.026**	0.018	0.023**	0.01
Wood products	0.01	0.014	-0.009	-0.015	0.000	0.000	0.008	-0.001
Paper products	0.003	0.006	-0.003	-0.011	0.011	0.012**	0.009	0.004
Textiles	-0.003	0.024**	-0.005	-0.106***	-0.066***	-0.013	-0.008	-0.007
Footwear	0.01	-0.009	-0.096***	-0.114***	-0.007	-0.009	-0.041***	-0.028**
Plastic/glass products	0.009	0.001	0.019*	-0.016*	-0.011	-0.009	-0.012*	0.000
Precious metals	-0.101	-0.031	-0.046	-0.018	0.034	0.06	0.036	0.049
Base Metal	0.021*	0.029***	-0.003	-0.034***	-0.008	0.007	0.002	0.000
Machinery	-0.014	0.013**	0.007	-0.038***	-0.032***	-0.001	-0.003	-0.015***
Transport equipment	-0.025	-0.013	-0.061**	-0.140***	-0.099***	-0.042***	-0.037**	-0.041**
Precision machinery	-0.033***	0.001	0.005	-0.012	-0.022***	-0.010*	-0.011**	-0.017***
Miscellaneous	-0.027	0.000	0.009	-0.055***	-0.054***	-0.045***	-0.027**	-0.042***

Notes: This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors are not reported to save space, but were clustered by country pairs in the analysis. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. All figures in this table are based on export statistics.

applied four measures of COVID-19 damages. The results are shown in Table 4.<sup>17</sup> Many coefficients for the importers' damages are significant. However, they were less likely to be significant in the third quarter of

2020. This result may indicate the gradual penetration of online shopping. Besides that, increased demand for the machinery products related to online shopping and teleworking may be other factors behind the insignificant effect in the third quarter. On the other hand, we observe the significant results in terms of exporters' damages until August 2020 when the numbers of cases and deaths are applied as the measure of COVID-19 severity. Nevertheless, the absolute magnitude in the third quarter has become much smaller than that in the second quarter. This is

<sup>17</sup> In January, we observed deaths only in China. However, since we do not include China's exports in January and February, the result for exporters' COVID-19 severity in January 2020 is missing in column (II).



probably because lockdown measures lifted in May 2020 in many countries, and the COVID-19 situations become better since June 2020. The gradual success of telecommuting systems might also have contributed to mitigating the negative effects. In sum, these results indicate that the negative effects of COVID-19 on international trade were, to some extent, accommodated after the first wave.<sup>18</sup>

Finally, we estimated Eq. (2) by industry. We focused on using the number of confirmed cases as the measure of COVID-19. The coefficients for the importers' cases are reported in Table 5. There are some interesting results. Consistent with the trend found in Table 1, COVID-19 decreased demand for mineral products, leather products, and transport equipment, especially in April and May 2020. In particular, the negative effects in the leather and plastic/glass industries still existed until August 2020. This result would be because they are relatively non-essential, "postpone-able" goods. In addition, it might be considered difficult to make online purchases in these industries. The insignificant coefficient for machinery products since July 2020 may reflect the increased demand for IT-related machinery products, such as PCs, smartphones, cameras, to conduct online shopping and teleworking.

On the other hand, we observe positive coefficients in some products, including chemical products, textiles, and precious metals, even during March-May 2020, though some of them are insignificant. As discussed in Section 2, the former two types of product include medical products, such as masks or protective garments for surgical/medical use. As for precious metals, COVID-19 can be related to increased demand for "safe-haven" assets, such as gold and silver. Nevertheless, we did not find positive coefficients for precision machinery, which includes many medical devices and equipment, perhaps because of the demand decrease of other products.

The coefficients for exporters' cases are reported in Table 6. Interestingly, while we obtained positive coefficients for importers' cases in textiles, similar results were not found for exporters' cases (except for February 2020). This contrast is natural because the demand for medical products, such as textile face masks, would be expected to rise in the importing countries with serious damage caused by COVID-19. In addition, labor-intensive industries such as textiles are likely to suffer

from the negative effects of workplace-closure or work-from-home orders. In addition, we found negative coefficients for leather products and footwear. In particular, the negative effect in the footwear industry stayed evident until August 2020. This result might be because the development of alternative methods (e.g., remote operation) to produce footwear products has been relatively difficult or delayed. Transport equipment again has significantly negative coefficients for exporters' cases, especially in April and May 2020. Thus, the decrease in trade in transport equipment was driven by both the demand and the supply side.

## 5. Conclusion

This study investigated the effects of COVID-19 on international trade and how these effects changed over time. To do that, we explored the monthly data on worldwide trade from January to August in 2019 and 2020. Specifically, we estimated the gravity equation employing various variables as a proxy for COVID-19 damage. Our findings can be summarized as follows: First, regardless of which measure is applied to estimate the severity of COVID-19, we found significantly negative effects of COVID-19 on the international trade of both exporting and importing countries. Second, those effects, especially the effects of COVID-19 in importing countries, tended to become insignificant since July 2020. Although the negative effects of COVID-19 in exporting countries persisted until August 2020, their magnitude decreased over time. These results imply that the harmful impacts of COVID-19 on international trade were accommodated to some extent after the first wave of the pandemic. Third, a more detailed analysis considering individual industries revealed heterogeneous effects across industries. For example, labor-intensive industries were observed to be more likely to suffer from the negative effects of COVID-19 in exporting countries. In particular, a negative effect in the footwear industry prevailed until August 2020. The transport equipment industry showed the negative effects of COVID-19 damage in both exporting and importing countries, especially in April and May 2020. In industries providing medical products, the positive effects of COVID-19 on imports were observed.

## Appendix A. Study Countries

### Africa

AO, BF, BI, BJ, BW, CF, CG, CI\*, CM, CV, DJ, DZ, EG, ER, ET, GA, GH, GM, GN, KE\*, KM, LR, LS, LY, MA, MG, ML, MR, MU, MW, MZ, NA, NE, NG, RW, SC, SD, SL, SN, SO, SZ, TD, TG, TN, TZ, UG, ZA\*, ZM, ZW

### The Americas

AI, AR\*, AW, BB, BM, BO, BR\*, BZ, CA\*, CL, CO, CR, CU, DM, DO, EC, FK, GL, GT, GY, HN, HT, JM, KY, MS, MX\*, NI, PA, PE, PR, PY, SR, SV, TC, TT, US\*, UY, VE, VG

### Asia

AE, AF, AZ, BD, BH, BN, BT, CN\*, GE, ID\*, IL\*, IN, IQ, IR, JO, JP\*, KG, KH, KR\*, KW, KZ, LA, LB, LK, MM, MN, MY\*, NP, OM, PH\*, PK, QA, RU\*, SA, SG\*, SY, TH\*, TJ, TW\*, UZ, VN, YE

### Europe

AD, AL, AT\*, BA, BE\*, BG, BY, CH\*, CY, CZ, DE\*, DK\*, EE, ES\*, FI, FR\*, GB\*, GI, GR\*, HR, HU, IE\*, IS, IT, LT, LU\*, LV, MD, NL\*, NO, PL, PT\*, RO, SE\*, SI, SK, SM, TR, UA

### Pacific

AU\*, FJ, NZ, PG

Note: Countries with \* are the 34 countries that reported their exports and imports in the Global Trade Atlas.

## Appendix B. Additional Tables

Tables B1–B8.

<sup>18</sup> It might be worth noting that the coefficients for importers' COVID-19 severity in January and February 2020 are significantly negative, while those for exporters' COVID-19 severity in January and February 2020 are positive (and significant in some cases). The negative results in importers' COVID-19 severity in January and February 2020 would be because China, which is one of the major importers in the world, was most severely hit by COVID-19 in these months. On the other hand, there would be at least two reasons for the positive results in exporters' COVID-19 severity in January and February. One is that our study of exporting countries does not include China. The other is that most countries had not suffered from COVID yet.

**Table B1**  
Exports in 2020 relative to exports in 2019 by months and industries.

	1&2	3	4	5	6	7	8
Live animals	1.1	1.1	0.9	0.9	1.0	1.0	1.0
Vegetable products	1.0	1.1	1.0	1.0	1.2	1.1	1.0
Animal/vegetable fats	1.1	1.1	1.2	1.1	1.1	1.1	1.2
Food products	1.0	1.0	0.9	0.9	1.0	1.0	1.0
Mineral products	1.0	0.8	0.6	0.5	0.6	0.6	0.7
Chemical products	1.0	1.0	1.0	0.9	1.1	0.9	1.0
Plastics and rubber	0.9	0.9	0.8	0.8	0.9	0.9	1.0
Leather products	0.9	0.8	0.5	0.5	0.7	0.7	0.8
Wood products	0.9	0.9	0.8	0.8	1.0	1.0	1.0
Paper products	0.9	0.9	0.8	0.8	0.9	0.9	0.9
Textiles	0.9	0.9	0.9	0.9	1.0	0.9	1.0
Footwear	1.0	0.8	0.7	0.6	0.8	0.8	0.9
Plastic/glass products	1.0	0.9	0.8	0.7	0.9	0.9	0.9
Precious metals	1.1	1.2	1.2	1.3	1.1	1.0	1.1
Base Metal	0.9	0.9	0.7	0.7	0.9	0.9	0.9
Machinery	1.0	1.0	0.9	0.8	1.0	1.0	1.0
Transport equipment	0.9	0.8	0.4	0.4	0.7	0.8	0.9
Precision machinery	1.0	1.0	0.8	0.8	1.0	0.9	1.0
Miscellaneous	0.9	0.9	0.7	0.7	0.9	0.9	1.0
Total	1.0	0.9	0.8	0.7	0.9	0.9	0.9

Notes: This table represents import statistics. The smallest values are shaded with darker colors.

Source: Authors' compilation.

**Table B2**  
Exports in 2020 relative to exports in 2019 by month and continent-pair.

Exporter	Importer	1&2	3	4	5	6	7	8
Africa	Africa	1.1	0.8	0.6	0.6	0.5	0.7	0.8
Africa	America	1.0	0.8	0.8	0.6	0.6	0.8	0.8
Africa	Asia	0.9	1.0	0.6	0.5	0.7	0.7	0.8
Africa	Europe	1.0	0.9	0.6	0.5	0.7	0.8	0.8
Africa	Pacific	0.8	0.7	0.8	0.8	1.0	0.6	1.5
America	Africa	1.0	0.9	0.7	0.6	0.8	0.7	0.6
America	America	1.0	0.9	0.6	0.5	0.8	0.8	0.9
America	Asia	1.0	1.0	0.9	0.8	1.0	0.9	0.9
America	Europe	1.0	1.0	0.8	0.7	0.8	0.8	0.9
America	Pacific	1.0	1.1	0.9	0.7	0.9	1.2	0.9
Asia	Africa	0.9	0.8	0.7	0.7	0.7	0.7	0.8
Asia	America	0.9	0.9	0.9	0.8	0.9	0.9	0.9
Asia	Asia	1.0	1.0	0.9	0.8	0.9	0.9	0.9
Asia	Europe	1.0	0.9	0.8	0.9	1.0	0.9	1.0
Asia	Pacific	0.9	0.8	0.9	0.8	1.0	1.0	1.0
Europe	Africa	0.9	0.9	0.7	0.6	0.6	0.7	0.8
Europe	America	1.0	1.1	0.9	0.8	0.9	0.9	0.9
Europe	Asia	1.0	1.0	0.8	0.8	1.0	0.9	0.9
Europe	Europe	0.9	0.9	0.7	0.7	0.9	0.9	1.0
Europe	Pacific	0.9	0.8	0.8	0.8	0.9	0.9	1.1
Pacific	Africa	0.8	0.7	0.5	0.6	0.7	1.1	0.6
Pacific	America	1.0	1.1	1.7	1.2	1.0	1.4	1.0
Pacific	Asia	1.0	1.0	0.9	0.8	0.9	0.8	0.7
Pacific	Europe	0.8	1.4	0.6	0.7	1.3	1.1	0.6
Pacific	Pacific	1.0	0.9	0.8	0.6	0.9	0.9	0.8

Notes: This table represents import statistics. The smallest values are shaded with darker colors.

Source: Authors' compilation.

**Table B3**  
The ranking and shares of exports in 2020 (%).

	1st	2nd	3rd	4th	5th
Live animals	US 12	NL 11	DE 10	BR 6	ES 6
Vegetable products	US 17	BR 14	NL 10	CN 7	CA 6
Animal/vegetable fats	ID 26	MY 17	NL 7	ES 6	AR 6
Food products	DE 10	US 10	NL 10	FR 8	CN 6
Mineral products	US 18	RU 16	AU 13	CA 9	BR 6
Chemical products	DE 13	US 11	CN 9	CH 9	BE 8
Plastics and rubber	CN 18	DE 13	US 12	KR 6	JP 5
Leather products	CN 44	FR 14	DE 6	US 5	NL 5
Wood products	CN 16	CA 13	DE 11	RU 9	US 9
Paper products	US 15	DE 14	CN 13	CA 7	SE 6
Textiles	CN 56	DE 7	US 5	NL 4	ES 3
Footwear	CN 51	DE 10	BE 7	ID 6	NL 4
Plastic/glass products	CN 38	DE 12	US 8	ES 6	JP 5
Precious metals	CH 22	US 14	GB 11	RU 6	CA 6
Base Metal	CN 21	DE 12	US 7	JP 6	KR 5
Machinery	CN 27	DE 11	US 10	JP 6	KR 6
Transport equipment	DE 19	US 16	JP 10	CN 8	FR 6
Precision machinery	US 16	DE 14	CN 14	JP 7	NL 7
Miscellaneous	CN 36	US 13	DE 11	AU 8	CA 5

Notes: This table represents export statistics.  
Source: Authors' compilation.

**Table B4**  
Baseline estimation results.

	(I)	(II)	(III)	(IV)
Importers' COVID-19	-0.009** [0.004]	-0.008** [0.004]	-0.340*** [0.069]	-0.075*** [0.019]
Exporters' COVID-19	-0.026*** [0.003]	-0.026*** [0.004]	-0.458*** [0.072]	-0.179*** [0.053]
COVID-19 measure	Case	Death	Immobility	Lockdown
Wald Statistics	7.82	7.66	1.12	2.66
Wald p-value	0.005	0.006	0.291	0.103
Log pseudolikelihood	-1.0.E+11	-1.0.E+11	-5.5.E+10	-1.1.E+11
Pseudo R-squared	0.9974	0.9974	0.9971	0.9974
Number of observations	82,926	82,872	46,362	82,926

Notes: This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors reported in parentheses are those clustered by country pairs. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. This table represents import statistics. "Wald Statistics" indicates statistics on the Wald test on the null hypothesis that the coefficient for Importers' COVID-19 severity is equal to that for Exporters' COVID-19 severity. Its p-value is reported in "Wald p-value." "COVID-19 measure" indicates the variable to measure the severity of the COVID-19 damage. Case and Death represent the numbers of confirmed cases and deaths, respectively. Immobility is defined as the percent change in visits to retail and recreational outlets multiplied by negative one for the importers' COVID-19 severity and the same measure but considering visits to workplaces for exporters' COVID-19 severity. Similarly, the Lockdown variable represents the share of days when stay-at-home orders were effective in the case of importers' COVID-19 severity and the share of days when workplace-closing orders were effective in the case of exporters' COVID-19 severity.

**Table B5**  
Estimation results according to months.

	(I)	(II)	(III)	(IV)
Importers' COVID-19				
* 1 for January	-0.015*			
* 1 for February	-0.003	0.024*		0.282**
* 1 for March	-0.015**	-0.019***	-0.454***	-0.097***
* 1 for April	-0.021**	-0.027***	-0.426***	-0.236***
* 1 for May	-0.014*	-0.010**	-0.340***	-0.124***
* 1 for June	-0.008	-0.007**	0.024	-0.019
* 1 for July	-0.004	-0.003	-0.203**	-0.036*
* 1 for August	-0.004	-0.004	-0.317**	-0.112***
Exporters' COVID-19				
* 1 for January	-0.018***	-0.034***		-1.293***
* 1 for February	-0.030***	-0.046***		-0.436***
* 1 for March	-0.016***	-0.021***	-0.352***	-0.214***
* 1 for April	-0.036***	-0.020***	-0.491***	-0.160***
* 1 for May	-0.044***	-0.032***	-0.456***	-0.142***
* 1 for June	-0.023***	-0.015***	-0.326***	0.005
* 1 for July	-0.019***	-0.010**	-0.159	0.016
* 1 for August	-0.015***	-0.009**	0.015	-0.048
COVID-19 measure	Case	Death	Immobility	Lockdown
Log pseudolikelihood	-1.0.E+11	-1.0.E+11	-5.4.E+10	-1.0.E+11
Pseudo R-squared	0.9975	0.9975	0.9972	0.9975
Number of observations	82,926	82,872	46,362	82,926

Notes: This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors are not reported to save space, but were clustered by country pairs for the analysis. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. This table represents import statistics. "COVID-19 measure" indicates the variable to measure the severity of the COVID-19 damage. Case and Death represent the numbers of confirmed cases and deaths, respectively. Immobility is defined as the percent change in visits to retail and recreational outlets multiplied by negative one for the importers' COVID-19 severity and the same measure but considering visits to workplaces for exporters' COVID-19 severity. Similarly, the Lockdown variable represents the share of days when stay-at-home orders were effective in the case of importers' COVID-19 severity and the share of days when workplace-closing orders were effective in the case of exporters' COVID-19 severity.

**Table B6**  
Lagged effects.

	(I)	(II)	(III)	(IV)
Importers' COVID-19 ( <i>t</i> )	-0.015*** [0.002]	-0.017*** [0.003]	-0.250*** [0.084]	-0.074*** [0.017]
Importers' COVID-19 ( <i>t</i> -1)	-0.002 [0.003]	0.004 [0.003]	-0.061 [0.069]	-0.014 [0.016]
Exporters' COVID-19 ( <i>t</i> )	-0.006* [0.004]	-0.016*** [0.003]	-0.557*** [0.079]	-0.054 [0.047]
Exporters' COVID-19 ( <i>t</i> -1)	-0.011*** [0.003]	-0.002 [0.003]	0.117 [0.098]	-0.029 [0.035]
COVID-19 measure	Case	Death	Immobility	Lockdown
Log pseudolikelihood	-8.7.E+10	-8.7.E+10	-3.6.E+10	-8.9.E+10
Pseudo R-squared	0.9977	0.9977	0.9977	0.9977
Number of observations	84,474	84,416	38,706	84,474

*Notes:* This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors reported in parentheses are those clustered by country pairs. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. This table represents export statistics. "COVID-19 measure" indicates the variable to measure the severity of the COVID-19 damage. Case and Death represent the numbers of confirmed cases and deaths, respectively. Immobility is defined as the percent change in visits to retail and recreational outlets multiplied by negative one for the importers' COVID-19 severity and the same measure but considering visits to workplaces for exporters' COVID-19 severity. Similarly, the Lockdown variable represents the share of days when stay-at-home orders were effective in the case of importers' COVID-19 severity and the share of days when workplace-closing orders were effective in the case of exporters' COVID-19 severity.

**Table B7**  
Impacts of importers' cases by industries.

Month	1	2	3	4	5	6	7	8
Live animals	-0.041***	-0.016***	-0.031***	-0.031***	-0.017*	-0.008	0	0.015*
Vegetable products	0.011	0.019*	-0.004	0.008	-0.011	-0.018	-0.003	0.007
Animal/vegetable fats	0.021	0.012	0.013	0.001	0.012	-0.002	-0.022	0.009
Food products	0.001	-0.004	-0.014	-0.016**	-0.005	-0.021***	-0.017**	-0.004
Mineral products	-0.026	-0.007	-0.037**	-0.061***	-0.046***	-0.026	-0.031***	-0.004
Chemical products	-0.01	-0.002	0.012*	0.004	0.008	0.01	-0.011	-0.005
Plastics and rubber	-0.022**	-0.011	-0.028***	-0.019**	-0.022***	-0.027***	-0.014	-0.008
Leather products	-0.039**	-0.029*	-0.044***	-0.059***	-0.067***	-0.042***	-0.028***	-0.039***
Wood products	-0.032**	0.003	-0.025**	-0.006	0.001	-0.016***	-0.008	0.009
Paper products	-0.047***	-0.007	-0.035***	-0.011	0.004	-0.01	0.003	-0.006
Textiles	-0.011	-0.030**	-0.037**	-0.021	-0.006	-0.01	0.007	-0.001
Footwear	-0.067***	-0.040**	-0.040***	-0.012	-0.056***	-0.059***	-0.032***	-0.022**
Plastic/glass products	-0.027**	-0.004	-0.032***	-0.032***	-0.032***	-0.036***	-0.023***	-0.008
Precious metals	-0.037	0.013	0.012	0.048	0.042	0.096***	0.084***	-0.015
Base Metal	-0.016	-0.013*	-0.020**	-0.012	0.001	-0.012*	-0.019**	-0.017**
Machinery	-0.046***	-0.015	-0.018**	-0.026**	-0.019**	-0.004	0.003	-0.006
Transport equipment	-0.029	-0.03	-0.025*	-0.081**	-0.095***	-0.042**	-0.023	-0.023**
Precision machinery	-0.006	0.007	0.002	-0.034***	-0.022***	-0.013*	-0.007	-0.010*
Miscellaneous	-0.099***	-0.057***	-0.040**	-0.042**	-0.045***	-0.060***	-0.037***	-0.034***

*Notes:* This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors are clustered by country pairs. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. This table represents import statistics.

**Table B8**  
Impacts of exporters' cases by industries.

Month	1	2	3	4	5	6	7	8
Live animals	0.006	-0.004	-0.021***	-0.013*	-0.016**	-0.014*	-0.017**	-0.024***
Vegetable products	-0.018**	-0.017***	0.007	0.003	0.006	0.022	0.011	0.023**
Animal/vegetable fats	0.013	-0.003	-0.027	0.022	0.002	-0.016	-0.023	0
Food products	0.007*	-0.009	0.006	0.004	-0.006	0.008	0.005	0.016**
Mineral products	0.005	0.013	-0.003	-0.013	-0.019	-0.021	-0.022**	-0.019
Chemical products	-0.008	-0.009	-0.011	-0.006	-0.024***	-0.007	-0.010*	-0.020*
Plastics and rubber	-0.011**	-0.023***	-0.004	-0.024***	-0.024***	-0.011**	-0.013**	-0.017***
Leather products	0.012**	-0.018**	-0.082***	-0.136***	-0.060***	-0.033***	-0.015	-0.011
Wood products	0.016***	-0.007	-0.019**	-0.014	-0.006	-0.006	-0.014*	-0.023**
Paper products	0.013**	-0.004	-0.007	-0.015*	-0.012	-0.008	-0.001	0.001
Textiles	-0.056***	-0.070***	-0.076***	-0.076***	-0.118***	-0.056***	-0.021***	-0.002
Footwear	0.004	-0.017***	-0.056***	-0.082***	-0.033***	-0.026***	-0.028***	-0.015**
Plastic/glass products	0.008**	-0.012***	-0.014**	-0.039***	-0.026***	-0.018**	-0.014**	-0.014**
Precious metals	-0.033	-0.047**	0.025	0.064*	0.003	0.063*	0.048**	0.085***
Base Metal	-0.004	-0.020***	-0.003	-0.034***	-0.024***	-0.013*	-0.006	-0.008
Machinery	-0.015***	-0.031***	-0.009	-0.039***	-0.044***	-0.022***	-0.021***	-0.019***
Transport equipment	-0.004	-0.024***	-0.028*	-0.098***	-0.093***	-0.047***	-0.022	-0.028*
Precision machinery	-0.022***	-0.037***	-0.001	-0.015*	-0.022***	-0.017***	-0.018***	-0.007
Miscellaneous	-0.005	-0.025***	0.005	-0.050***	-0.044***	-0.017	-0.013	-0.011

*Notes:* This table reports the estimation results using the PPML method. \*\*\*, \*\*, and \* indicate the 1, 5, and 10% levels of statistical significance, respectively. The standard errors are clustered by country pairs. In all specifications, we controlled for country pair-year fixed effects, country pair-month fixed effects, and year-month fixed effects. This table represents import statistics.

## References

- Askatas, N., Tatsiramos, K., Verheyden, B., 2020. Lockdown strategies, mobility patterns and Covid-19. *Covid Econ.* 23, 263–302.
- Aum, S., Lee, S.Y.T., Shin, Y., 2020. COVID-19 Doesn't Need Lockdowns to Destroy Jobs: The Effect of Local Outbreaks in Korea. National Bureau of Economic Research, Inc., NBER Working Papers 27264.
- Baldwin, R.E., Tomiura, E., 2020. Thinking ahead about the trade impact of COVID-19. In: Baldwin, R.E., Di Mauro, B.W. (Eds.), *Economics in the Time of COVID-19*. CEPR Press, London, pp. 59–71.
- Cai, D., Hayakawa, K., 2020. Heterogeneous Impacts of COVID-19 on Trade: Evidence from China's Province-level Data. IDE, Chiba, Japan [Discussion Paper No. 803].
- Coibion, O., Gorodnichenko, Y., Weber, M., 2020. Lockdowns, macroeconomic expectations, and consumer spending. *Covid Econ.* 20, 1–15.
- Conyon, M.J., He, L., Thomsen, S., 2020. Lockdowns and COVID-19 Deaths in Scandinavia. *Covid Econ.* 26, 17–42.
- Dang, H.-A.H., Trinh, T.-A., 2020. Does the COVID-19 pandemic improve global air quality? New Cross-National Evidence on Its Unintended Consequences. IZA Institute of Labor Economics, Bonn [DP No. 13480].
- Deb, P., Furceri, D., Ostry, J.O., Tawk, N., 2020. The economic effects of Covid-19 containment measures. *Covid Econ.* 24, 32–75.
- Dingel, J.I., Neiman, B., 2020. How many jobs can be done at home? *J. Public Econ.* 189, 104235.
- Eaton, J., Kortum, S., Neiman, B., Romalis, J., 2016. Trade and the global recession. *Am. Econ. Rev.* 106 (11), 3401–3438.
- Dutcher, G.E., 2012. The effects of telecommuting on productivity: an experimental examination. The role of dull and creative tasks. *J. Econ. Behav. Org.* 84 (1), 355–363.
- Friedt, F.L., Zhang, K., 2020. The triple effect of Covid-19 on Chinese exports: first evidence of the export supply, import demand and GVC contagion effects. *Covid Econ.* 53, 72–109.
- Fuchs, A., Kaplan, L., Kis-Katos, K., Schmidt, S.S., Turbanisch, F., Wang, F., 2020. Mask Wars: China's exports of medical goods in times of COVID-19. *Covid Econ.* 42, 26–64.
- Ghosh, S., 2020. Lockdown, pandemics and quarantine: assessing the Indian evidence. *Covid Econ.* 37, 73–99.
- Hale, T., Webster, S., Petherick, A., Phillips, T., Kira, B., 2020. Oxford COVID-19 Government Response Tracker. Blavatnik School of Government, Oxford.
- Hayakawa, K., 2020. Departure Months and Discrepancy in Mirror Trade Data. IDE, Chiba, Japan [Discussion Paper No. 795].
- Hayakawa, K., Mukunoki, H., 2020a. Impacts of COVID-19 on Global Value Chains. IDE, Chiba, Japan [Discussion Paper No. 797].
- Hayakawa, K., Mukunoki, H., 2020b. Impacts of Lockdown Policies on International Trade. *Asian Economic Papers* forthcoming.
- Heiland, L., Ulltveit-Moe, K.H., 2020. An unintended crisis in sea transportation due to COVID-19 restrictions. In: Baldwin, R.E., Evenett, S.J. (Eds.), *COVID-19 and Trade Policy: Why Turning Inward Won't Work*. CEPR Press, London, pp. 151–163.
- Keola, S., Hayakawa, K., 2020. Does Lockdown Policy Reduce Human Activity? IDE, Chiba, Japan [Discussion Paper No. 800].
- Kong, E., Prinz, D., 2020. The impact of shutdown policies on unemployment during a pandemic. *Covid Econ.* 17, 24–72.
- Melitz, M.J., 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica* 71 (6), 1695–1725.
- Meier, M., Pinto, E., 2020. COVID-19 supply chain disruptions. *Covid Econ.* 48, 139–170.
- Telias, D., Urdinez, F., 2020. China's foreign aid determinants: lessons from a novel dataset of the mask diplomacy during the COVID-19 Pandemic. DOI: 10.13140/RG.2.2.27199.53929.
- Ullah, A., Ajala, O.A., 2020. Do lockdown and testing help in curbing Covid-19 transmission? *Covid Econ.* 13, 138–156.
- United Nations Conference on Trade and Development (UNCTAD), 2020. COVID-19 and E-Commerce: impact on businesses and policy responses. UNCTAD/DTL/STICT/I/NF/2020/2.
- Watanabe, T., Omori, Y., 2020. Online consumption during the COVID-19 crisis: evidence from Japan. *Covid Econ.* 32, 208–241.