The effect of COVID-19 on international trade: global empirical evidence using a gravity approach

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Abstract

This study examines the effect of COVID-19 on international trade, using data on bilateral trade between 19 major countries from 2019 to 2020. A standard gravity model with the Poisson pseudo maximum likelihood (PPML) method was employed. We found that the measures of the severity of COVID-19 have significantly positive effect on the export values only for the importing countries. While the result cannot be seen in exporting countries. The variances of the number of cases of and deaths from COVID-19 for the importing countries are also significantly positive.

JEL classification

F10; F12; F14

Keywords

COVID-19, Gravity model, Export.

1. Introduction

The COVID-19 pandemic caused an unprecedented disruption to people's lives, the global economy, and world trade. According to the World Trade Statistical Review 2021 published by the WTO, the global trade in goods and services has experienced a deep slump since the coronavirus outbreak. It amounted to 22 trillion US dollars in 2020, a 12% decline compared with 2019. The effect of COVID-19 on goods differed from that on services, with services being more severely affected. The pandemic led to the merchandise trade declining by 8%, and the trade in commercial services, by 21%, from those in 2019. While people refrained from working at their organizations and enjoying cultural/recreational activities due to lockdowns and movement restrictions, the demand for essential goods including medical products and food was insulated from the pandemic. The impact of COVID-19 on international trade is very high. However, not enough empirical research has been carried out on this impact yet. We used the data on bilateral trade between 19 major countries from 2019 to

2020, and examined the effect of COVID-19 on international trade based on a gravity model.

There has been substantial research on the impact of the coronavirus outbreak on international trade. In an early influential study, Hayakawa and Mukunoki (2021a) combine the data on bilateral trade between 34 countries and their 173 trading partners for year 2019 and first 8 months of 2020 (January–August) with the data on the number of Covid-19 infections and deaths. A standard gravity equation model based on the Poisson pseudo-maximum likelihood method was used to estimate the Covid-19 impact on the exporting and importing countries. They found that Covid-19 had a negative effect on the value of trade of both exporting and importing countries. The result indicates that the Covid-19 damage lowered exports from the exporting country by lowerting production, whereas it lowered imports by lowering the demand in the importing country. Hayakawa and Mukunoki (2021b), however found that the intra-Asia trade in machinery was not affected significantly by the Covid-19 pandemic, unlike other regions. They argue that the reason for this was that the Asian machinery firms had sufficient inventories of their products.[1] The difference between the current study and previous studies is the analysis period: the literature considers the period up to the year 2020, whereas we use the data of the year 2020.

The remainder of the paper is organized as follows. Section 2 describes the types of data used and data sources. Section 3 explains the methods and models employed in the study. Section 4 explains the results, and section 5 concludes the paper.

2. Data

Our analysis uses three data sources. The first is the Direction of Trade Statistics data released by IMF. The database provides export and import values both by commodity and country. This data were extracted on the values of exports between two countries that belong to the G20 excluding European Union.[2] Our data on bilateral trade is on trade between 19 countries and their 214 trading partners from 2019 to 2020. Figures 1 and 2 show the change in export value from 2005 to 2020 for the sample. Although all countries experienced a significant decline in 2020, the magnitude of the drop varies from country to country. Only the United States, Australia and Argentina saw a much decline compared to 2008 when global financial crisis occurred.

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[1]   Other studies on the impact of COVID-19 on international trade include Kimura (2021) and Bonadio et al. (2021).

[2]   The countries in our sample include Australia, Canada, Saudi Arabia, United States, India, Russia, South Africa, Turkey, Argentina, Brazil, Mexico, France, Germany, Italy, United Kingdom, China, Indonesia, Japan, South Korea.
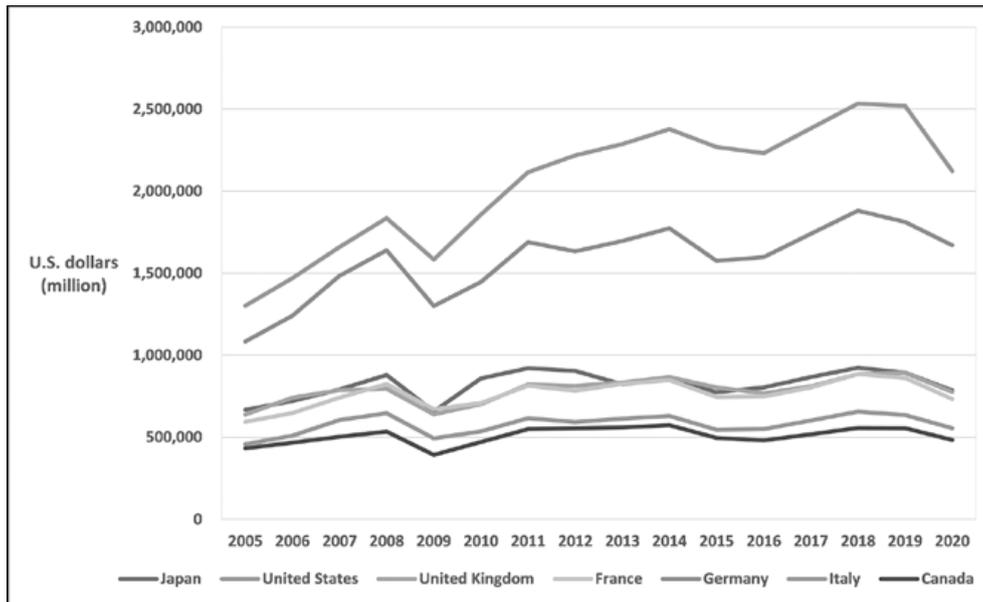
Figure 1. The change in export value from 2005 to 2020 (G7 countries)

The second data source is the COVID-19 data releused by the WHO. This database provides extensive data on the COVID-19 pandemic. We obtained the daily number of cases and deaths of COVID-19 for each of the countries in the sample. We then calculated the average number of cases and deaths and variances of the number of cases and deaths in 2020 for each of the countries.

The third data source is the World Bank Open Data. We obtained data on the gross domestic products for the sample countries. The GDP is used as a standard variable for economic outcome in the gravity model.
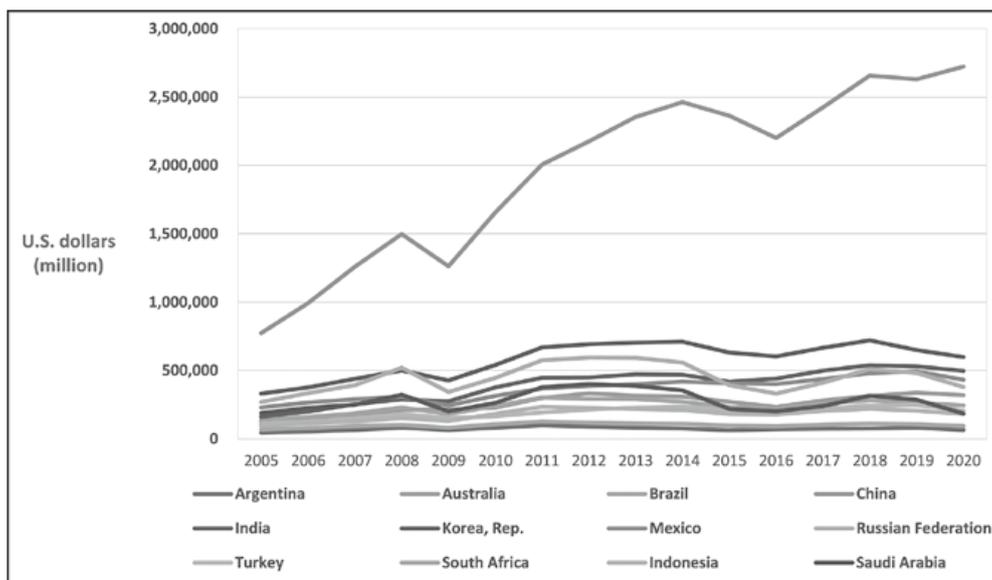

Figure 2. The change in export value from 2005 to 2020 (other G20 countries excluding EU)

3. Method

To examine the total effect of COVID-19, we regress the trade values on respective country-level damage by COVID-19. Our baseline model is as follows:

$$Export_{ijt} = \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 COVID_{it} + \beta_4 COVID_{jt} + \delta_i + \delta_j + ($$
$$+ \delta_{it} + \delta_{jt} + \varepsilon_{ijt} \tag{1}$$

where i refers to an exporting county, j denotes an importing county, and the time period is indexed by t. $Export_{ijt}$ is the value of exports from countries i to j in year t. $ln\ GDP$ is the log of gross domestic products. The variables of interest, $COVID$ are the extent of COVID-19, damages in exporting and importing countries including the average number of cases and deaths and variances of the number of cases and deaths in 2020. We controlled for five kinds of fixed effects, country, year, and their interaction terms. ϵ is a disturbance term. We estimated this equation employing the Poisson pseudo maximum likelihood (PPML) method.

4. Results

Table 1 displays the results of regressions for the sample of G7 countries. The following findings are worth noting. First, no significant results were obtained for the GDP in exporting countries, which differs from the usual results of the gravity model. This might be due to the fact that the U.S. and Germany, which have larger GDPs in the sample, experienced large decreases in the export value. Second, the two measures of the severity of COVID-19 were positive and significant only for the importing countries. This result was not observed in exporting countries. It differs from the findings of Hayakawa and Mukunoki (2021a), but it suggests that COVID-19 in exporting countries did not have a significant impact on exports when we use the data for the entire year of 2020. Third, the variances of the number of cases and deaths in 2020 for the importing countries were also significantly positive. We consider this to be a result of the increased imports as policy uncertainty about COVID-19 increased in the importing countries.

Table 2 displays the results for G20 countries, which include the developing countries. The results imply that there are structural differences in COVID-19 impacts between the developed and the developing countries. Especially, the export value in China increased in 2020. These Asian countries with low infection rates might have influenced the estimation results.

Table 1. Estimation results (G7 countries)

	Dependent variable: Export values						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln ($GDP\,i$)	1.1597	1.1589	1.158	1.1577	1.1592	1.1578	1.1579
	(0.741)	(0.743)	(0.747)	(0.748)	(0.743)	(0.748)	(0.748)
ln ($GDP\,j$)	0.4964	0.4775	0.4534	0.4441	0.4834	0.4453	0.4501
	(0.0582)***	(0.0558)***	(0.0597)***	(0.0600)***	(0.0585)***	(0.0610)***	(0.0579)***
Cases i		4.7798	9.1637	12.316			
		(50.640)	(82.331)	(280.951)			
Cases j		20.3061	15.7300	12.7118			
		(5.2169)***	(5.0123)***	(5.3601)**			
Death i					107.2642	230.373	42.3663
					(1243.491)	(816.527)	(1569.993)
Death j					773.8014	654.9972	339.2964
					(139.8550)***	(146.6404)***	(205.0238)*
Variance of cases i / population i				-0.0183			
				(4.408)			
Variance of cases j / population j				0.1074			
				(0.0521)**			
Variance of death i / population j							99.0709
							(1810.152)
Variance of death j / population j							665.4807
							(233.0474)***
Year effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-37.5415	-37.0059	-36.3247	-36.0637	-37.1726	-36.097	-36.2309
	(20.8653)*	(20.9199)*	(20.9337)*	(20.9611)*	(20.8913)*	(20.9423)*	(20.9760)*
Pseudo R2	0.3628	0.3817	0.3861	0.3895	0.3849	0.3944	0.3954
N	2268	2268	2268	2268	2268	2268	2268

Note: Robust standard errors clustered at the firm level are in parentheses. Statistical significance is shown by *** 1%, ** 5%, and * 10%.

Table 2. Estimation results (G20 countries excluding EU)

	Dependent variable: Export values						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln (GDP i)	-0.5366	-0.5379	-0.5413	-0.5419	-0.5375	-0.5419	-0.5411
	(0.363)	(0.362)	(0.360)	(0.360)	(0.362)	(0.360)	(0.360)
ln (GDP j)	0.5055	0.4885	0.4473	0.4411	0.4941	0.4408	0.4503
	(0.0438)***	(0.0408)***	(0.0431)***	(0.0434)***	(0.0429)***	(0.0441)***	(0.0411)***
Cases i		-43.6845	-29.3755	-56.6487			
		(67.092)	(45.718)	(87.807)			
Cases j		15.0745	5.5544	2.0606			
		(4.1223)***	(3.499)	(3.802)			
Death i					-3592.3253	-1433.9367	-3349.6459
					(5292.074)	(2198.663)	(4951.787)
Death j					548.8797	310.6607	-61.8336
					(111.9636)***	(113.6776)***	(149.716)
Variance of cases i / population i				3.3614			
				(5.302)			
Variance of cases j / population j				0.1494			
				(0.0328)***			
Variance of death i / population i							8010.9124
							(11847.702)
Variance of death j / population j							825.2538
							(159.6505)***
Year effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8.6633	9.1647	10.3853	10.5684	8.9991	10.5775	10.2938
	(10.0806)	(10.0437)	(10.0131)	(10.0105)	(10.0595)	(10.0134)	(10.0062)
Pseudo R2	0.4441	0.4539	0.4657	0.4686	0.4534	0.4694	0.4689
N	5926	5926	5926	5926	5926	5926	5926

Notes: See notes to Table 2.

5. Conclusion

This study investigates the effect of COVID-19 on international trade, using data on bilateral trade between 19 major countries from 2019 to 2020. A standard gravity model with the Poisson pseudo maximum likelihood (PPML) method was employed. We found that the measures of the severity of COVID-19 are positive and significant only for the importing countries. This result was not observed in exporting countries. The variances of the number of cases and deaths in 2020 for the importing countries are also significantly positive.

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