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**Article**

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# Can trade help with fighting the pandemic? Evidence from imports of Chinese medical products

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*To contain the COVID-19 pandemic, medical products play an important role around the world. This paper studies the relationship between trade and pandemic control by testing the impact of importing medical products from China on COVID-19 cases and deaths. Using a fixed-effects model, we find that there is a significant negative correlation between imports of medical products from China and COVID-19 cases; for every 1 percent increase in protection equipment imported from China, new COVID-19 cases per day drop by 0.24 percent, and COVID-19-related deaths decrease by 0.13 percent in two weeks. The evidence suggests that trade can play a vital role in fighting the pandemic.*

**Keywords:** *COVID-19, medical products, trade, China*

**JEL codes:** *F18, F64, H12*

## 1 INTRODUCTION

The COVID-19 pandemic has caused unprecedented global economic and social disruption. Since the outbreak at the end of 2019, all the world's major economies have been seriously affected. By the middle of 2020, the ten nations hit hardest by COVID-19 are almost identical to the list of the ten largest economies in the world. East Asia, West Europe, North America, and South America have become the most infected areas by COVID-19. Undoubtedly, the global economy and trade have been severely affected as well. Taking just the major infected countries – the US, China, Japan, Germany, the UK, France, and Italy – into account, they account for 60 percent of world supply and demand (GDP), 65 percent of world manufacturing production, and 41 percent of world manufacturing exports (Baldwin/di Mauro 2020). World trade is expected to fall by between 13 percent and 32 percent in 2020 as the COVID-19 pandemic disrupts normal economic activity and life around the globe (World Trade Organization 2020a). Both the demand side and the supply side are deeply affected due to various containment efforts, disruptions in the global supply chain, and reduction in consumption as well as investment. According to the 'World Trade Statistical Review 2020' published by the World Trade Organization, global container throughput dropped by 8 percent during the first quarter of 2020, while new export orders declined by as much as 50 percent for both goods and services over the same time period (World Trade Organization 2020b).

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To slow the spread of the disease, governments around the world have imposed numerous restriction measures to contain the pandemic. Restrictions on economic, personal, and social lives – measures that would have been absolutely unthinkable just a few months before – are viewed as normal and necessary. Quite simply, the pandemic has changed the world faster than most expected and in ways few anticipated (Baldwin/di Mauro 2020). Studies show that social distancing and restrictions on international traveling have effectively prevented the spread and flattened the COVID-19 curve (Arshed et al. 2020).<sup>1</sup> The latest research also shows that wearing a mask is one of the non-pharmaceutical intervention (NPI) measures that can be effectively implemented at the lowest cost without significantly disrupting social practice (Li et al. 2020). With the rapid spread of COVID-19 to Europe, the Middle East, and the Americas, more governments started to suggest their medical staff and citizens properly use personal protective equipment (PPE) such as face masks and disinfectants. Therefore, from the beginning of the pandemic, the global demand for PPE products has been soaring. The World Health Organization (2020) estimated that output of PPE needs to rise by at least 40 percent globally to equip medical staff with the kit they need to care for COVID-19 patients, without even mentioning whether the mask is required for ordinary people. The numbers are enormous: per month, 89 million masks, 76 million examination gloves, and 1.6 million protective goggles are needed globally (Baldwin/di Mauro 2020). It became clear that a shortage of PPE would be inevitable (Allam et al. 2020).<sup>2</sup>

In addition to PPE, testing and therapeutic equipment is also widely used to fight COVID-19. Test results for COVID-19 can lead to the initial steps in identifying the scale of the pandemic and the start of medical treatment. Reverse-transcription polymerase chain reaction (RT-PCR) tests were often used for patients infected by the SARS-CoV-2 virus (Allam et al. 2020). Chest CT was used to compare findings across the disease course with COVID-19 pneumonia (Shi et al. 2020). Therapeutic equipment such as extracorporeal membrane oxygenation (ECMO) and mechanical ventilators play a key role in saving COVID-19 patients' lives. ECMO is mainly used to provide continuous extracorporeal breathing and circulation for patients with severe cardiopulmonary failure to maintain their lives. Research suggests that ECMO may play a vital role in reducing mortality rates (Liew et al. 2020). Ventilators are mechanical breathing-assistance devices that use mechanical pressure to pump air into and out of the lungs. These devices can be used when patients cannot breathe independently. During the COVID-19 surge, the demand for ventilators exceeded capacity in most countries (Allam et al. 2020). One of the largest constraints for effective care was the lack of ECMO and ventilators (IHME/Murray 2020). An increase in medical supply can ease shortages of essential medical devices and PPE and reduce fear among frontline health workers (Bhaskar et al. 2020).

China is a leading supplier of many medical products, including PPE, ECMO, and ventilators, and plays a central role in the global supply chain of medical products. For example, the United States imported US\$22 billion of such products from other countries before the outbreak of COVID-19 in 2019, and approximately 26 percent of these products from China (Gereffi 2020). As China itself was the first to be severely affected by COVID-19, China's production and supply of medical products reduced almost to zero at the beginning of the pandemic.

According to the statistical data from the General Administration of Customs of the People's Republic of China (GACC), the total value of China's exports in the first two

1. Nevertheless there are still arguments and doubts about whether containment efforts are necessary and good enough to offset their economic and social costs.
2. At least up to the middle of 2020.

*Table 1 Cumulative growth (percent) of China's medical exports compared to the same period in 2019*

Month 2020	Total export value	Chapter 38	Chapter 63	Chapter 90
January & February 2020	-17.2	-5.2	-22.6	-12.9
March 2020	-13.3	7.3	-8.4	-11.0
April 2020	-9.0	20.4	86.0	-5.3
May 2020	-7.7	23.5	187.8	-0.8
June 2020	-6.2	24.8	214.6	2.1
July 2020	-4.1	26.5	219.3	4.5
August 2020	-2.3	27.3	216.8	5.8
September 2020	-0.8	28.5	206.5	6.6
October 2020	0.5	28.3	192.6	7.5
November 2020	2.5	28.8	182.1	9.2

*Note:* General Administration of Customs of China combined exports in January and February 2020 as a single month.

*Source:* General Administration of Customs of China.

months of 2020 was only US\$292.8 billion, a year-on-year decrease of 17.2 percent (Table 1). At the same time, the sudden surge in demand for masks and other medical products in the whole of East Asia led to a global shortage, which in turn interrupted the supply to global healthcare providers (Fuchs et al. 2020). The shortage has also caused further panic and threatened effective control measures (Gereffi 2020). Starting from April 2020, as China's domestic epidemic had been brought under control, China has slowly resumed manufacturing activities, and production and foreign trade has begun to recover. Since the third quarter of 2020, China's manufacturing sectors have recovered robustly, and with them the export of anti-epidemic products and equipment.

Since the COVID-19 pandemic began in the 'world's factory,' China, some voices are using the crisis to argue for breaking up global value chains and relocating production closer to home countries (Stellinger et al. 2020). This argument raises a series of other questions: have we gone too far with global supply chains? What is the role of trade in the global pandemic, particularly the trade in PPE and medical products? Should governments turn radically inward to reduce their dependency on imports, particularly those from China? In this article, we try to answer some of those questions. We study the relationship between trade and the COVID-19 pandemic by testing the impact of medical supply from China on COVID-19 cases using the data from January to November 2020.

At present, there is limited literature available for discussing the relationship between trade and COVID-19. This is mainly because the COVID-19 pandemic is not yet over. The data are updating continuously and so are restriction measures taken by countries. Baldwin/Freeman (2020) as well as Baldwin/Tomiura (2020) develop a conceptual framework that closely considers the specific mechanisms driving these trade effects. The authors argue that the pandemic has the potential to cause a 'triple hit' on manufacturing sectors, including direct supply disruption, supply-chain contagion, and decline in global demand. McKibbin/Fernando (2020a) used epidemiological outcomes across countries and recent data on sectoral shutdowns and economic shocks to estimate the likely impact of the COVID-19 pandemic on the global economy in future years under six scenarios. Friedt/Zhang (2020) estimate the overall impact of the COVID-19 pandemic on Chinese exports.

Most trade economists believe it is critical to keep borders open (Baldwin/di Mauro 2020). The COVID-19 crisis requires a global market, as do the long-term health prospects of people throughout the world. Trade can help us in fighting the pandemic, so it is dangerous to suggest that countries should radically reduce their dependency on imports and embark on a path towards deglobalization (Stellinger et al. 2020). This paper adds to the literature by highlighting the positive effect of Chinese PPE and medical products imports on COVID-19 detection and treatment.

The paper is arranged as follows. Section 2 describes the development of China's medical products exports during the pandemic. Section 3 explains the econometric approach in detail and Section 4 provides the results of the empirical analysis. Section 5 concludes.

## 2 CHINA'S MEDICAL EXPORTS DURING THE PANDEMIC

Most research predicts that the world's trade shrinkage will continue beyond the end of 2020 (McKibbin/Fernando 2020b; Vidya/Prabheesh 2020), which is proven to be true by the data available to date. Since China was the 'first in, first out' country during the pandemic, China's total exports have turned into positive growth since the third quarter of 2020, thanks to the shift of demand from countries which are still in the middle of pandemic and the demand for medical supplies. Data from the Chinese customs office show that due to the strong demand of COVID-19-related products, the number of China–Europe freight trains and the volume of goods delivered increased by 24 percent and 27 percent in the first four months of 2020, and a total of 660 000 packages of PPE and medical equipment were transported to Europe.<sup>3</sup>

According to the International Convention for Harmonized Commodity Description and Coding System (HS2012) classification, there are three types of export products most relevant to the pandemic: Chapter 38, 'Miscellaneous chemical products,' where the disinfectant is located; Chapter 63, 'Other made up textile articles, sets, worn clothing and worn textile articles, rags,' where the medical mask is located; and Chapter 90, 'Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof,' where ventilators and other therapeutic equipment are located. After the initial decline from January to February in 2020, all three export types have shown a strong increasing trend, particularly the products in Chapter 63. From 1 March to 31 May 2020, China exported epidemic prevention products, including more than 70.6 billion masks, 340 million protective suits, 115 million pairs of protective goggles, 96 700 ventilators, 225 million test kits, and 40.29 million infrared thermometers to 200 countries and regions.<sup>4</sup> As can be seen in Table 1, even though total export value kept decreasing until October 2020, exports of medical supplies have recovered much earlier and more strongly. Exports of Chapter 38 had already started to increase in March 2020, Chapter 63 in April, and Chapter 90 in June. Compared with exports for drugs and therapeutic equipment (Chapter 90), which recorded a mild recovery, medical-related textiles (Chapter 63) and disinfectants (Chapter 38) both had a very robust increase after April 2020.

3. White Paper, 'Fighting COVID-19: China in action,' 2020, issued by China's State Council Information Office.

4. White Paper, 'Fighting COVID-19: China in action,' 2020, issued by China's State Council Information Office.

### 3 EMPIRICAL MODEL AND DATA

#### 3.1 Model setting and variable description

In order to investigate the effect of trade in medical supplies on curbing the pandemic, we formulate the following empirical model to test the correlation between the medical imports from China on COVID-19 cases or the death toll:

$$\begin{aligned} Covid_{it} = & \alpha_0 + \alpha_1 Covid_{i,t-l} + \beta Medical_{i,t-n} + \alpha_2 GDPper_i + \alpha_3 Health_i \\ & + v_i + v_t + \varepsilon_{it}, \end{aligned} \quad (1)$$

where  $Covid_{i,t}$  is the main dependent variable, which denotes the number of COVID-19 cases or deaths in country  $i$  at time  $t$ . The right-hand side of the equation includes the explanatory variable of COVID-19 cases or deaths lagged in time by  $l$  days to reflect the inherent persistence of the disease transmission mechanism ( $Covid_{i,t-l}$ ).  $Medical_{i,t-n}$  is the primary explanatory variable, which indicates the medical imports of country  $i$  from China;  $t-n$  means lagged by  $n$  days for the main explanatory variables. The reason for lagging the data by  $n$  days is that it takes a certain amount of time for the imported products to reach customs and frontline health workers before they are actually used (Laudares/Gagliardi 2020). Based on the World Health Organization (WHO) statement that the incubation period of the COVID-19 is, on average, 5 to 6 days, but can be anything up to 14 days,<sup>5</sup> we categorize medical imports from China into three types: the first is testing equipment, which is mainly used for infection case detection and monitoring, such as testing reagents and thermometers; the second is protective equipment, such as masks and alcohol disinfectants; and the third is therapeutic equipment, such as ventilators and ECMO. The classifications of medical imports and the Harmonized System (HS) six-digit code levels are shown in Appendix 1, Table A1.

In addition to the aforementioned variables, we denote  $GDPper_i$  to represent the GDP per capita and  $Health_i$  to represent the health index, which is an indicator to measure the local medical and health conditions of the importing country. For the above variables, except for the health index, the natural logarithm is used. We also control country fixed effect  $v_i$  and time fixed effect  $v_t$ ;  $\varepsilon_{it}$  represents the unobserved error term.

#### 3.2 Data and descriptive statistics

Data for the number of affected people and deaths caused by COVID-19 from January to November 2020 comes from the World Health Organization.<sup>6</sup> The WHO receives the data for confirmed cases and deaths from COVID-19 from national authorities. Counts of new cases and deaths are calculated by subtracting previous cumulative total counts from the current count. These counts are updated incrementally throughout each day as more information becomes available.

The data of medical imports from China used in the analysis is obtained from the United Nations Comtrade Database.<sup>7</sup> At the international level, the harmonized system for classifying goods is a six-digit code system. The health data comes from the Global Health Security (GHS) Index,<sup>8</sup> which is the first comprehensive assessment and benchmarking of

5. World Health Organization, 'Coronavirus disease 2019 (COVID-19) Situation Report – 73.'

6. See <https://covid19.who.int>.

7. See <https://comtrade.un.org>.

8. See <https://www.ghsindex.org>.

*Table 2 Descriptive statistics*

Variables	Number	Mean	SD	Min.	Max.
Daily panel data					
COVID-19 cases	81 914	881.381	5 892.672	0.000	243 209
COVID-19 deaths	81 914	19.863	114.521	0.000	6 409
Monthly panel data					
Testing equipment (million dollars)	578	8.059	29.667	0.000	330.084
Protective equipment (million dollars)	536	159.644	611.723	0.017	7 129.457
Therapeutic equipment (million dollars)	561	10.098	36.418	0.000	444.468
Cross-section data					
GDP per capita in 2019 (thousand dollars)	237	15.220	22.289	2.718	185.741
Health Index in 2019	195	40.225	14.511	16.200	83.500

*Notes:* This table displays the descriptive statistics of the key variables used in the panel-data estimations. We removed the negative number of COVID-19 cases and deaths due to technical adjustments to data. In this table,  $N$  represents the number of observations in this panel, or the total number of samples. *Source:* WHO, UN Comtrade Database, and GHS.

health security and related capabilities across the 195 countries that make up the states parties to the International Health Regulations (IHR). The GDP per capita (current US\$) data is sourced from the World Development Indicators Database provided by the World Bank.<sup>9</sup> The panel data are matched according to the country name and time label, and the descriptive statistical results of the variables are shown in Table 2.

There are certain potential concerns in a panel data set that we want to point out. The first issue is that the data frequency is inconsistent. The frequency of COVID-19 data is daily, and medical imports are monthly data. To solve this problem, we convert monthly data into daily data so that each day of the month has a value for a specific month. Furthermore, we sum up daily data each month to form a new monthly panel data robustness check. The second possible issue is the endogeneity of the model, that is, there is a correlation between the independent variables and the residual term of the model. The endogeneity problem may be due to missing variables or the causal relationship between explanatory variables and explained variables. To solve the endogeneity problem, we lagged the main explanatory variables behind the corresponding number of periods.

## 4 EMPIRICAL RESULTS

### 4.1 Baseline results

In this section, we present the baseline results of the empirical model in Table 3. The explanatory variables in columns 1 to 3 are the daily cases of COVID-19 reported by the WHO. Columns 4 to 6 are the number of daily deaths. In columns 1 and 4, we focus on the impact of the three main explanatory variables, and then we add control variables such as GDP per capita and health index in columns 2 and 5. Finally, country fixed effects and monthly fixed effects are included in columns 3 and 6.

9. See <https://www.worldbank.org>.

Table 3 Panel data results: medical imports from China and COVID-19

	COVID-19 cases			COVID-19 deaths		
	Pooled OLS (1)	Pooled OLS (2)	Fixed effects (3)	Pooled OLS (4)	Pooled OLS (5)	Fixed effects (6)
Covid cases <sub><i>t-14</i></sub>	0.8444*** (0.0044)	0.8491*** (0.0047)	0.6979*** (0.0064)	—	—	—
Covid deaths <sub><i>t-14</i></sub>	—	—	—	0.8678*** (0.0045)	0.8600*** (0.0050)	0.7703*** (0.0057)
Testing equipment <sub><i>t-14</i></sub>	0.1722*** (0.0114)	0.1671*** (0.0119)	0.1019*** (0.0136)	0.1009*** (0.0068)	0.0875*** (0.0071)	0.0547*** (0.0085)
Protective equipment <sub><i>t-14</i></sub>	-0.1247*** (0.0099)	-0.1591*** (0.0124)	-0.2374*** (0.0165)	-0.0691*** (0.0060)	-0.0654*** (0.0075)	-0.1316*** (0.0103)
Therapeutic equipment <sub><i>t-14</i></sub>	0.0802*** (0.0078)	0.0842*** (0.0080)	-0.0113 (0.0108)	0.0460*** (0.0047)	0.0438*** (0.0048)	0.0013 (0.0067)
GDP per capita	—	0.0081*** (0.0014)	-0.0465*** (0.0178)	—	0.0038*** (0.0009)	-0.0188* (0.0111)
Health	—	-0.0229* (0.0137)	-0.6460*** (0.0715)	—	-0.0437*** (0.0083)	-0.1766*** (0.0445)
Constant	-0.5799*** (0.0881)	-0.2293* (0.1196)	7.6445*** (0.8900)	-0.6096*** (0.0554)	-0.2364*** (0.0715)	2.6767*** (0.5566)
<i>N</i>	14212	13274	13274	14223	13287	13287
<i>R</i> <sup>2</sup>	0.8182	0.8097	0.8526	0.8219	0.8011	0.8327
Country fixed effects	No	No	Yes	No	No	Yes
Monthly fixed effects	No	No	Yes	No	No	Yes

Notes: Columns 3 and 6 present fixed-effects estimation at country and month level. The remaining columns are OLS estimations. The standard errors are in parentheses, where \* refers to  $p < 0.1$ , and \*\* to  $p < 0.05$ , \*\*\* to  $p < 0.01$ , respectively.



Table 3 shows there is a significant positive interaction term between the medical imports of testing equipment from China and COVID-19 cases or deaths. After adding the control variables and fixed effects, for every 1 percent increase in testing equipment imported from China during the  $t = 1$  period, new COVID-19 cases will increase by 0.1 percent, and the number of deaths will increase by 0.05 percent after 14 days ( $t = 15$ ) based on specifications in columns 3 and 6 in Table 3. Increasing the imports of testing equipment can effectively improve the ability to find the people infected by COVID-19, although they are in the incubation period. Figures A1 and A2 in Appendix 1 show the relationship between the number of tests and confirmed cases. It shows that more cases were detected as deaths associated with COVID-19, due to the improvement of detection capabilities.

We can also see that, for every 1 percent increase in protective equipment imports from China, the number of new cases per day reduced by 0.24 percent and the death toll dropped by 0.13 percent in two weeks (Table 3). The results show that imports of protective equipment from China result in fewer COVID-19 cases and deaths in the importing countries. It also shows that protective measures such as wearing masks and increasing the frequency of disinfection are useful measures to reduce the infection rate and mortality, before mass vaccination and the formation of herd immunity prevail.

Table 3 also reflects that the impact of therapeutic equipment depends on the specification of the econometric model. Without accounting for fixed effects, therapeutic equipment increases the number of COVID-19 cases. Yet using the model with fixed effects for country and time yields contrary results: therapeutic equipment decreases the number of cases in countries. If the dependent variable is the incidences of COVID-19 death, the coefficient for the equipment loses its significance when fixed effects are controlled for. The results imply that we must be cautious in evaluating the impact of therapeutic equipment on COVID-19.

## 4.2 Robustness check

Although we set the lag period of the main explanatory variables to 14 days when we benchmarked the results, it may take more time for medical imports to be used by hospitals, doctors, and the public. Meanwhile, travel suspensions have also been implemented across Asia, Europe, America, and Africa (Nicola et al. 2020). Lockdown measures will also affect the speed of material distribution. So we set the lag period to 30 days to get more robust results. Table 4 reports the results using 30 days ( $t = 31$ ) lagged main independent variables. The third and sixth columns report fixed effects estimations, while the others exhibit pooled OLS results. As can be seen in Table 4, results support the conclusions following the baseline results presented in Table 3. Similarly to Table 3, the coefficients of therapeutic equipment again changes the sign once we add fixed effects for the countries and for time effects. Therapeutic equipment and the health index only decrease COVID-19 cases once country and time effects are controlled for.

A potential explanation for this effect is that the life-saving effect of therapeutic equipment depends on the overall medical ability and medical capacity of each country. China's experience shows that the regional disparities in healthcare resource availability and accessibility might partly explain the different mortality rates in China (Ji et al. 2020).

The second method of robustness check is to consider the impact of cumulative cases. The number of previous cumulative COVID-19 cases is a vital variable employed as inputs for COVID-19 forecasting models (da Silva et al. 2020). Since COVID-19 is a highly contagious infectious disease, if a country has accumulated many cases, that country will tend

Table 4 Robustness check: independent variables are lagged in 30 days

	COVID-19 cases			COVID-19 deaths		
	Pooled OLS (1)	Pooled OLS (2)	Fixed effects (3)	Pooled OLS (4)	Pooled OLS (5)	Fixed effects (6)
Covid cases <sub>t-14</sub>	0.8327*** (0.0045)	0.8343*** (0.0047)	0.6790*** (0.0066)	—	—	—
Covid deaths <sub>t-14</sub>	—	—	—	0.8747*** (0.0045)	—	—
Testing equipment <sub>t-30</sub>	0.1333*** (0.0117)	0.1201*** (0.0122)	0.0630*** (0.0141)	0.0757*** (0.0071)	0.8686*** (0.0049)	0.7529*** (0.0057)
Protective equipment <sub>t-30</sub>	-0.0868*** (0.0101)	-0.1082*** (0.0125)	-0.2082*** (0.0185)	-0.0660*** (0.0061)	0.0636*** (0.0073)	0.0226** (0.0088)
Therapeutic equipment <sub>t-30</sub>	0.0763*** (0.0080)	0.0760*** (0.0082)	-0.0409*** (0.0112)	0.0549*** (0.0048)	-0.0719*** (0.0076)	-0.1243*** (0.0115)
GDP per capita	—	-0.0580*** (0.0140)	-0.7084*** (0.0754)	—	-0.0499*** (0.0049)	-0.2339*** (0.0070)
Health	—	0.0105*** (0.0015)	-0.0773*** (0.0183)	—	0.0085 (0.0009)	-0.0466 (0.0114)
Constant	0.1333*** (0.0117)	0.1201*** (0.0122)	0.0630*** (0.0141)	-0.4092*** (0.0561)	0.0021 (0.0728)	3.5697*** (0.5980)
N	14216	13278	13278	14222	13286	13286
R <sup>2</sup>	0.8071	0.7981	0.8422	0.8208	0.8011	0.8342
Country fixed effects	No	No	Yes	No	No	Yes
Monthly fixed effects	No	No	Yes	No	No	Yes

Notes: Columns 3 and 6 present fixed-effects estimation at country and month level. The remaining columns are OLS estimations. The standard errors are in parentheses, where \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01, respectively.

Table 5 Robustness check: cumulative cases and deaths

	COVID-19 cases			COVID-19 deaths		
	Pooled OLS (1)	Pooled OLS (2)	Fixed effects (3)	Pooled OLS (4)	Pooled OLS (5)	Fixed effects (6)
Cumulative Covid cases <sub><i>t-14</i></sub>	0.4237*** (0.0062)	0.4034*** (0.0065)	0.5425*** (0.0128)	—	—	—
Cumulative Covid deaths <sub><i>t-14</i></sub>	—	—	—	0.2505*** (0.0068)	0.2286*** (0.0068)	0.4372*** (0.0112)
Testing equipment <sub><i>t-14</i></sub>	0.5422*** (0.0172)	0.4135*** (0.0184)	0.1860*** (0.0185)	0.3928*** (0.0140)	0.2290*** (0.0147)	0.1380*** (0.0140)
Protective equipment <sub><i>t-14</i></sub>	-0.4060*** (0.0150)	-0.2872*** (0.0189)	-0.3357*** (0.0226)	-0.2017*** (0.0123)	0.0031 (0.0151)	-0.2177*** (0.0170)
Therapeutic equipment <sub><i>t-14</i></sub>	0.2852*** (0.0117)	0.2479*** (0.0120)	-0.0499*** (0.0161)	0.1885*** (0.0099)	0.1260*** (0.0098)	0.0197 (0.0122)
GDP per capita	—	-0.4061*** (0.0222)	-0.7267*** (0.0919)	—	-0.3947*** (0.0186)	0.2695*** (0.0660)
Health	—	0.0255*** (0.0022)	0.1394*** (0.0071)	—	0.0050*** (0.0019)	0.0529*** (0.0052)
Constant	-3.8215*** (0.1327)	-0.7530*** (0.2009)	4.8156*** (1.0295)	-4.3697*** (0.1254)	-0.9775*** (0.1770)	-2.5392*** (0.6095)
<i>N</i>	11149	10362	10362	9843	9157	9157
<i>R</i> <sup>2</sup>	0.5619	0.5413	0.7329	0.4829	0.4551	0.7408
Country fixed effects	No	No	Yes	No	No	Yes
Monthly fixed effects	No	No	Yes	No	No	Yes

Notes: Columns 3 and 6 present fixed-effects estimation at country and month level. The remaining columns are OLS estimations. The standard errors are in parentheses, where \* refers to  $p < 0.1$ , and \*\* to  $p < 0.05$ , \*\*\* to  $p < 0.01$ , respectively.

Table 6 Robustness check: monthly data

	COVID-19 cases			COVID-19 deaths		
	Pooled OLS (1)	Pooled OLS (2)	Fixed effects (3)	Pooled OLS (4)	Pooled OLS (5)	Fixed effects (6)
Covid cases <sub><i>t-1</i></sub>	0.6655*** (0.0268)	0.6741*** (0.0282)	0.5735*** (0.0406)	—	—	—
Covid deaths <sub><i>t-1</i></sub>	—	—	—	0.7400*** (0.0307)	0.7550*** (0.0329)	0.6508*** (0.0383)
Testing equipment <sub><i>t-1</i></sub>	0.2497*** (0.0915)	0.2256** (0.0965)	0.1168 (0.0734)	0.2130*** (0.0747)	0.1873** (0.0765)	0.0647 (0.0737)
Protective equipment <sub><i>t-1</i></sub>	-0.1889** (0.0797)	-0.2800*** (0.1000)	-0.3145*** (0.0959)	-0.1989*** (0.0649)	-0.2708*** (0.0811)	-0.2874*** (0.0967)
Therapeutic equipment <sub><i>t-1</i></sub>	0.1704*** (0.0626)	0.1776*** (0.0649)	-0.0198 (0.0580)	0.1738*** (0.0510)	0.1760*** (0.0517)	-0.0207 (0.0583)
GDP per capita	—	-0.1362 (0.1105)	-1.2820*** (0.3956)	—	-0.1199 (0.0889)	-0.8527** (0.3928)
Health	—	0.0312*** (0.0117)	-0.2136** (0.0936)	—	0.0257*** (0.0093)	-0.1077 (0.0944)
Constant	0.5315 (0.6872)	1.8445* (0.9609)	18.4610*** (4.9600)	-0.5797 (0.6073)	0.6483 (0.7840)	12.0097** (4.9854)
<i>N</i>	471	440	440	471	440	440
<i>R</i> <sup>2</sup>	0.7155	0.7052	0.9167	0.7332	0.7264	0.8767
Country fixed effects	No	No	Yes	No	No	Yes
Monthly fixed effects	No	No	Yes	No	No	Yes

Notes: Columns 3 and 6 present fixed-effects estimation at country and month level. The remaining columns are OLS estimations. The standard errors are in parentheses, where \* refers to  $p < 0.1$ , and \*\* to  $p < 0.05$ , \*\*\* to  $p < 0.01$ , respectively.

to have more new cases and deaths. Therefore, we add the past cumulative cases to the regression equation to check the impact of cumulative cases on the number of new infections and deaths. Results are shown in Table 5, which are in line with our previous findings.

We perform a third robustness check using monthly data. We sum up daily cases and deaths each month to form new panel data in order to avoid problems due to inconsistencies in data frequency. This robustness check method can eliminate mismatches of variables in different time dimensions. Corresponding to monthly data, we set the lag period to one month, and the results are similar to the baseline estimations results (Table 6). As can be seen in the tables, protective equipment is robust in reducing the number of confirmed cases and deaths, regardless of whether daily or monthly data are used.

## 5 CONCLUDING REMARKS AND PROSPECTS

There is no doubt that COVID-19 has become one of the most serious global pandemics and that it requires the international community to fight together. In this paper, we have tried to identify the role of medical equipment on COVID-19 infections and incidences of death. Due to restricted data availability, we only tested the effect of medical imports from China on daily COVID-19 infection cases and number of deaths. Our empirical results show that importing more testing products can improve importing countries' capability to detect infection cases and treat the COVID-19 patients. There is a significantly negative interaction term between medical imports of protective equipment from China and COVID-19 cases or deaths. For every 1 percent increase in testing equipment imported from China, the number of new COVID-19 cases per day decreases by 0.24 percent, and the number of COVID-19-related deaths decreases by 0.13 percent in two weeks. Furthermore, we found that the impact of therapeutic equipment depends on the specification of the econometric model. Different methods were adopted to check the robustness of the baseline results.

Yet it has to be acknowledged that we cannot control for the simultaneous increase of domestic production of medical equipment in the countries in the sample. Domestic production may have increased in line with imports, therefore leading to a potential correlation between domestic production and imports. As we cannot control for it due to missing data, this may lead to an omitted variable bias.

Furthermore, it must be highlighted that China is only one key supplier in the global value chain of medical products. Some other countries play important roles in the production and supply chain of key medical equipment too. For example, most of the core components for ventilators and ECMOs come from Germany, Italy, and the United States. Many Southeast Asian countries supply large parts of medical face masks and other personal protective equipment. Although our paper only discusses the impact of importing medical equipment from China on COVID-19, the results complement empirical research based on traditional trade theory. They echo the statements by many mainstream trade economists: 'Turning inward won't help today's fight against COVID-19. Trade is not the problem; it is part of the solution' (Baldwin/Evenett 2020: 1).

One other limit of our research approach is the relatively short time range due to the nature of a pandemic and the availability of data. The pandemic is still developing, and the virus has even mutated. Therefore, in the future, once the data are available, it is necessary to use data with longer time series to evaluate the trade impact of the COVID-19 pandemic. Furthermore, China's foreign trade is characterized by seasonal fluctuations, which are mainly because of the Chinese New Year. Later studies should control for seasonal effects in Chinese foreign trade in detail.

Another prospect for further research is to consider the entrepot trade. In China's foreign trade, some transactions need to pass through a third party, such as Singapore, to reach their final destination. Although the goods for entrepot trade are produced in China, in the trade statistics of the final destination they do not count as imports from China. This factor should be considered and estimated in future studies.

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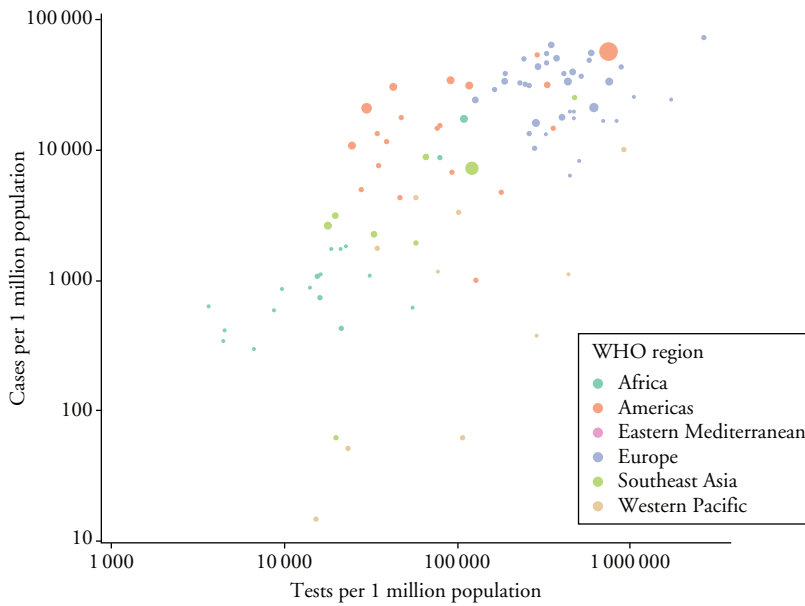
## APPENDIX 1

*Table A1 Medical imports and the Harmonized System (HS) six-digit classification codes*

Classification	Medical products	HS six-digit code
Testing equipment	COVID-19 nucleic acid detection kit (fluorescent PCR method)	382200
	Liquid thermometer	902511
Protective equipment	Infrared temperature instrument	902519
	Protective screen	392690
	Medical chemical fiber protective clothing	621010
	Mask	630790
	Protective glasses	900490
	Disinfectant wipes	380894
	Peracetic acid disinfectant	380894
	Hands-free disinfectant	380894
	Retail fungicides	380892
	Non-retail packaging of medical fungicides	380892
	Medical disinfectant	380894
Therapeutic equipment	Steam sterilizer	841920
	Ultrasonic CT	901812
	Electrical impedance tomography (ET)	901819
	Extracorporeal membrane oxygenation (ECMO) equipment	901819
	Patient monitor	901819
	Ventilator	901920
	X-ray whole body tomograph	902212

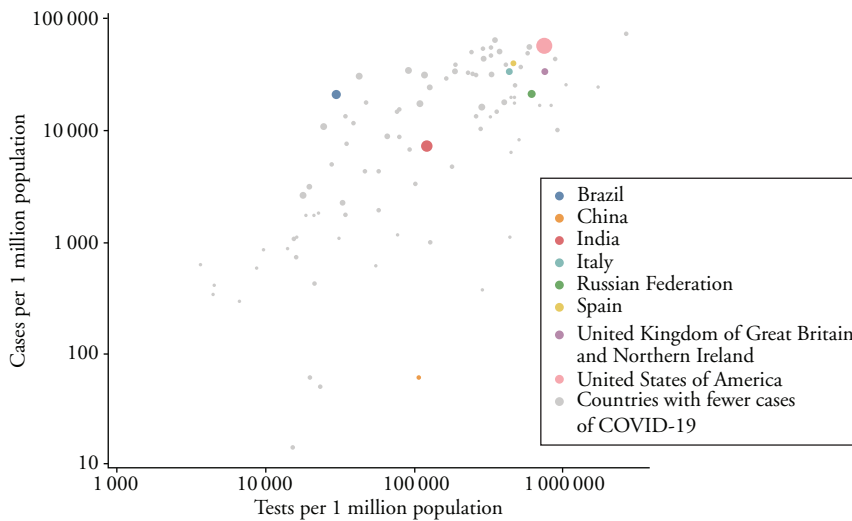
*Source:* General Administration of Customs of China.





Notes: Point size denotes the total number of cases. Shades denote different regions.  
 Source: <https://ourworldindata.org/coronavirus> (accessed 1 January 2021).

Figure A1 Cases in 1 million population with tests in 1 million population (shaded by different regions)



Notes: Point size denotes the total number of cases. Here, we only use different shades to mark the eight countries with the most COVID-19 infections and China.  
 Source: <https://ourworldindata.org/coronavirus> (accessed 1 January 2021).

Figure A2 Cases in 1 million population with tests in 1 million population (shaded by countries)