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Impacts of COVID-19 temporary trade measures on Viet Nam's trade efficiency with RCEP's partners

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IMPACTS OF COVID-19 TEMPORARY TRADE MEASURES ON VIET NAM'S TRADE EFFICIENCY WITH RCEP'S PARTNERS

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Abstract

Under the pressure of the COVID-19 pandemic, many countries responded with various trade measures to prevent shortages of essential goods and ensure product quality and safety. COVID-19 trade measures were used to facilitate or restrict trade performance across countries, then increase or decrease the gap between trade actual and trade potential. During the midst of the pandemic, the Regional Comprehensive Economic Partnership (RCEP), which is made up of the 10 member states of the Association of Southeast Asian Nations (ASEAN) plus five big partners (the People's Republic of China [PRC], Japan, the Republic of Korea, Australia, and New Zealand, excluding India) was signed in November 2020. The RCEP's enforcement also raises the question of regional integration's role in overcoming a crisis. Using the stochastic frontier gravity model (SFGM), the study examines how the COVID-19 pandemic affected Viet Nam's trade efficiency with that of RCEP country members. The paper also incorporates COVID-19 temporary trade measures as the explanatory variables that represent the presence of crisis and government response in front of a pandemic. The paper used panel data on Viet Nam's trade with RCEP members at a disaggregated level (HS6digit) in the period from 2017 to 2021, with a total of 376,530 observations. The study contributes to existing literature in a several ways. First, the results consolidate empirical literature about the effects of crisis on trade efficiency using evidence from Viet Nam to RCEP members at the detailed product level. Second, the study shows the heterogeneous effects of policy responses on trade efficiency across different types of trade measures. Most of the studies related to COVID-19 have used the Oxford policy stringency index as the proxy representing policy response to the pandemic with some limitations that do not reflect the varying responses across products. Thus, specific trade measures imposed on certain products were incorporated in the model to analyze the various effects on trade efficiency across products. Finally, the results provide trade policy implications to reduce trade inefficiency under the COVID-19 pandemic.

Keywords: COVID-19, trade measures, trade efficiency, RCEP, stochastic frontier gravity model

JEL Classification: F13, F14, F15

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1. INTRODUCTION

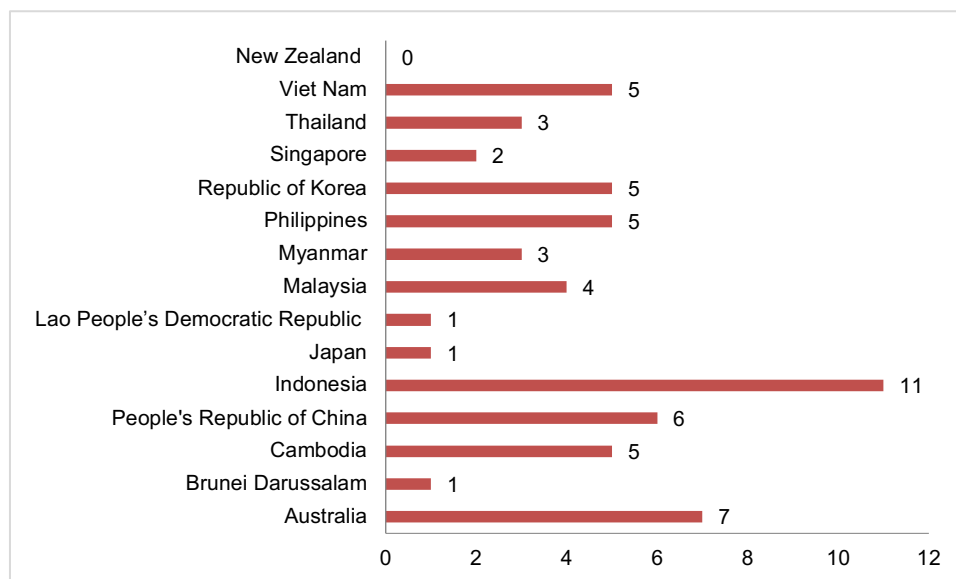
The spread of COVID-19 has disrupted global production and world trade. It has forced governments to respond to pandemic challenges through policy instruments. Statistically, trade measures have had direct impacts to facilitate and restrict trade performance in most nations. The increase in temporary trade measures during the pandemic (from 2020 to 31 August 2021) as collected by United Nations Trade and Development (UNCTAD) reflects governmental actions toward trade. Trade-facilitating measures relate to tax and duty exemptions, other financial incentives, and authorization requirements on essential imported goods, namely food products and medical goods. In comparison, trade-restricting measures involve quantitative measures, such as export prohibitions, licensing or permit requirements to export, and stricter technical requirements to control product quality and safety.

In the RCEP countries (Table 1), Indonesia and Australia responded most strongly to COVID-19 (11 trade measures recorded in Indonesia and seven measures in Australia). Viet Nam notified five temporary trade measures, including four measures related to exports (Chapter P) and one import prohibition for sanitary and phytosanitary reasons (Chapter A). In the region, Japan, the Lao People's Democratic Republic (Lao PDR), and Brunei Darussalam only enacted one trade-facilitating measure (tax exemption) for domestic consumption on imported goods related to medical and personal protective goods for donation. In the post-pandemic, 18 of 59 measures have been terminated, which include 13 trade-restricting measures (such as export prohibition or licensing requirements) and five trade-facilitating measures to ensure adequate essential goods supplies. Forty-one of the total trade measures notified in the COVID-19 pandemic have been activated post-pandemic. The measures account for 23 trade-facilitating measures imposed on essential goods and 18 trade-restricting measures that relate to export or quantitative-control measures due to sanitary and phytosanitary reasons. Thus, the sharp increase in the number of trade measures may demonstrate the trend in trade policy that led to fragmentation or higher protectionism in the world economy (*World Trade Report 2023: Re-Globalization for a Secure, Inclusive and Sustainable Future*, 2023). It also shows that global trade has stagnated post-pandemic. In global trade policymaking, some concerns have been raised about whether regional trade integration efforts have effectively motivated the world economy in the proliferation of trade tensions and in the post-pandemic timeframe. RCEP provides typical evidence of regional integration efforts that were implemented at the peak of the COVID-19 pandemic.

The study examines how COVID-19 trade measures affect trade efficiency in regional trade integration, as evidenced by Viet Nam's trade efficiency with RCEP's partners. Using the stochastic frontier gravity model (SFGM), the study also incorporates COVID-19 temporary trade measures as the explanatory variables that represent the presence of crisis and government response before a pandemic. The study contributes to existing literature in several ways. First, the results consolidate empirical literature about the effects of risk on trade potential and trade efficiency, with evidence from Viet Nam to RCEP members at the detailed product level. Most empirical studies calculate trade efficiency at the aggregated level (Ravishankar and Stack 2014; Ray et al. 2023; Zhu 2023) or specific sectors (Atif, Haiyun and Mahmood 2017; Jiang, Zhang, and Lin 2022; Xu et al. 2022). The study measures trade potential and trade actual at HS 6-digit to analyze government-responsive policy to COVID-19 and measures the integration of RCEP affecting trade efficiency at the product level. Second, the study shows the heterogeneous effects of policy responses on trade efficiency across trade measures. Most studies related to COVID-19 (Hayakawa and Mukunoki 2021; Liu, Ornelas, and Shi 2022) have used the number of COVID-19 cases and deaths or the

Oxford policy stringency index as the proxy representing the pandemic with some limitations that do not reflect the varying responses across products. Then specific trade measures imposed on certain products are incorporated into the model to analyze the various effects on trade efficiency across products. Finally, the results bring some policy implications for the government's trade policy activism to overcome the pandemic and reduce trade inefficiency under the shock. The remainder of the paper is organized as follows: Section 2 – Literature review; Section 3 – Methodology and data descriptions; Section 4 – Empirical findings; and Section 5 – Policy implications.

Figure 1: COVID-19 Temporary Trade Measures in RCEP



Note: A,B,C,D,E,F,G,L,P denote non-tariff measures by types; the International Classification of NTMs was used (UNCTAD, 2017).

Source: UNCTAD COVID-19 data set built from <https://unctad.org/topic/trade-analysis/non-tariff-measures/covid-19-and-ntms> on databases – *WTO COVID-19: Measures affecting trade in goods*; *WTO Quantitative restrictions*; *Global Trade Alert* and *ITC COVID-19 Temporary Trade Measures*, with additional UNCTAD research covering national government websites of laws and regulations as well as news media sources. Extracted from <https://unctad.org/topic/trade-analysis/non-tariff-measures/covid-19-and-ntms>.

2. LITERATURE REVIEW

Review of the Effects of COVID-19 on International Trade and Trade Policy Activism

COVID-19 is an unprecedented phenomenon in the world economy. The spread of the pandemic disrupted global trade and forced governments to undertake trade activism in response. Many studies have been carried out to assess various aspects of the effects of COVID-19. A study by Kersan-Škabić (2022) reviewed recent studies on international trade and production related to the COVID-19 pandemic. The review indicated that COVID-19 resulted in significant negative effects on total trade flows, accompanied by changes in trade policies in a variety of industries (Bekkers and Koopman 2022; Hayakawa and Mukunoki 2021; Vidya and Prabheesh 2020). The descriptive analysis of Evenett et al. (2022) provided a new dataset on trade policy changes imposed on medical goods and food products during the COVID-19 pandemic. The evidence revealed the increasing trade policy activism of governments implemented

under the pressure of COVID-19 during the pandemic. A study by Liu, Ornelas, and Shi (2022) evaluated the trade effects of COVID-19 deaths and lockdown policies in the PRC during 2020. The study was analyzed at the country–product level to investigate the heterogeneous effects across products, mainly between medical goods and non-medical goods. The results also showed that COVID-19 temporary import restriction measures adversely affected countries' imports. Regarding the effects on trade at the industry and product level, Arita et al. (2022) quantified that the COVID-19 outbreak decreased overall agricultural trade by 5% to 10% through import demand channels instead of export supply shocks. Across agricultural commodities, some particular non-food items, such as hides and skins, ethanol, rubber, and cotton, have suffered a high trade reduction as well as meat products. Ridley, Akhundjanov, and Devadoss (2023) analyzed the demand and supply sides of food and agricultural trade. The results indicated the causes of supply-side impacts from labor reduction, especially in labor-intensive sectors such as agricultural processing sectors. However, most empirical studies have used the Oxford policy stringency index or dummy variable of COVID-19 as the proxy representing policy response to a pandemic instead of the particular trade measures as non-tariff measures related to imports and exports. Previous studies have explained the trade effects of COVID-19. Nevertheless, whether the pandemic affected the potential trade from regional trade agreements post-crisis is unclear. According to Ridley, Akhundjanov, and Devadoss (2023), the pandemic has slowed down the progress of international trade initiatives or trade liberalization by regional trade agreements. In contrast, RCEP, also known as ASEAN and 5 big trading partners, has entered into force in times of crisis. It reflects the efforts of regional integration or intergovernmental cooperation to promise to overcome the crisis.

Review on Trade Efficiency

Ravishankar and Stack (2014) used the stochastic frontier approach to project the expected trade flows in Eastern European countries, which accounted for unprecedented events associated with abnormal trade flows, such as the transformation phase from communism to European Union (EU) accession and the global financial crisis in 2007. The study captured the effect of European intraregional integration by the exchange rate index. Jiang, Zhang, and Lin (2022) employed the stochastic frontier gravity model to calculate the PRC's export potential and trade efficiency at the industry level. The results indicated the increasing trade resistance of the PRC's exports to partners along the Belt and Road, while the vast trade potential varies from industry to industry. The empirical study of Dinh Ho et al. (2018) indicated that the trade efficiency of Viet Nam has decreased from 63% to 60.5% since RCEP entered into force. Viet Nam has benefited from exporting to the Republic of Korea, Australia, and India more than to Japan, New Zealand, and the PRC.

The current study provides some new contributions to the literature and discusses policy implications. First, the empirical study contributes to the literature on the effects of policy responses to the COVID-19 pandemic to trade efficiency in the regional integration. The study employs the Stochastic frontier gravity model to estimate the trade potential and trade actual of Viet Nam's trade with RCEP countries. Second, the use of specific trade measures incorporated in the model shows the heterogeneous effects of trade efficiency on the product categories and the income country group. Third, the study contributes to policy implications about government response actions in times of crisis and post-crisis. The analysis of trade efficiency at the product level fills the gap, whereas most previous studies were mainly conducted at the country level.

3. METHODOLOGY AND DATA DESCRIPTION

3.1 Stochastic Frontier Gravity Model

To estimate the effect of bilateral trade between Viet Nam and RCEP country members, the study employed an augmented gravity model that determines trade flows based on economic size, income per head, and other trade-influencing factors (Bergstrand, 1989). In the study, we examined responsive trade measures that hinder or promote trade flows and trade performance by incorporating COVID-19 temporary non-tariff measures into the gravity model. The form is as follows:

$$\ln exp_{kij}^t = \beta_0 + \beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln Dist_{ij} + \beta_4 \ln GDPPC_i^t + \beta_5 \ln GDPPC_j^t + \beta_6 \ln tariff_{kij}^t + \beta_7 ntm_covid_{kij}^t + \beta_8 rcep + \beta_9 contig + \beta_{10} comcol + \varepsilon_{ij}^t \quad (1)$$

$$\ln imp_{kij}^t = \beta_0 + \beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln Dist_{ij} + \beta_4 \ln GDPPC_i^t + \beta_5 \ln GDPPC_j^t + \beta_6 \ln tariff_{kij}^t + \beta_7 ntm_covid_{kij}^t + \beta_8 rcep + \beta_9 contig + \beta_{10} comcol + \varepsilon_{ij}^t \quad (2)$$

Where exp_{kij}^t is the bilateral actual export between Viet Nam (country i) to country j over a given time period t . imp_{kij}^t is the bilateral actual import from country j to Viet Nam (country i) over a given time period t .

GDP_i^t and GDP_j^t denote the economic scale of country i and j , as the decisive factor affecting the supply potential.

According to the Linder hypothesis, the bilateral per capita GDP ($GDPPC_i^t$ and $GDPPC_j^t$) capture to factor endowments in the exporting countries and measure the level of economic development as a factor affecting consumption patterns.

A set of time-invariant explanatory variables include the variable “Contig” – shared common land border; “comcol” – shared common colonizer.

$tariff_{kij}^t$ is the tariff applied by the importing country on specific product k in the year t .

$ntm_covid_{kij}^t$ is the number of trade measures notified by country i and j , which are imposed on the specific product k (at HS-6 digit) to respond to COVID-19 (in the year 2020).

$Rcep$ is a dummy variable to represent the year RCEP was in force.

To estimate the gravity model, the study used the stochastic frontier analysis (SFA) developed by Aigner, Lovell, and Schmidt (1977) and Meeusen and Van Den Broeck (1977), which was introduced in the gravity equation by Kalirajan (2007). The methodology observes trade performance deviating from maximum trade or trade potential on the frontier by decomposing disturbance terms into single-sided and two-sided error terms. The single-sided error term measures technical inefficiency between trade actual and trade potential and ranges from (0,1) with the assumption of half-normal or truncated normal distribution. The two-sided error is the statistical noise due to measurement error and is assumed to follow a normal distribution. Employing the stochastic frontier method, we modified the gravity model (equation 1) as follows:

$$\ln exp_{kij}^t = \beta_0 + \beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln Dist_{ij} + \beta_4 \ln GDPPC_i^t + \beta_5 \ln GDPPC_j^t + \beta_6 \ln tariff_{kij}^t + \beta_7 ntm_covid_{kij}^t + \beta_8 rcep + \beta_9 contig + \beta_{10} comcol + v_{ij}^t - u_{ij}^t \quad (3)$$

$$\ln imp_{kij}^t = \beta_0 + \beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln Dist_{ij} + \beta_4 \ln GDPPC_i^t + \beta_5 \ln GDPPC_j^t + \beta_6 \ln tariff_{kij}^t + \beta_7 ntm_covid_{kij}^t + \beta_8 rcep + \beta_9 contig + \beta_{10} comcol + v_{ij}^t - u_{ij}^t \quad (4)$$

Where v_{ij}^t represents the random error term, which reflects the estimation deviation caused by statistical error, and is assumed to follow the normal distribution with a mean value of 0.

u_{ij}^t represents a measure of trade inefficiency, independently with v_{ij}^t . It captures the effects of trade resistances (including tariff, COVID-19 temporary non-tariff measures in the model). It is assumed to have a half-normal distribution with mean μ and variance σ_u^2 or a truncated normal distribution. When $u_{ij}^t > 0$, it has the presence of trade inefficiency. It implies that the actual trade is less than the potential trade level. When $u_{ij}^t = 0$, TE = 1, the actual trade level is equal to the maximum trade level on the frontier. The stochastic frontier gravity model is obtained by maximum likelihood estimation to estimate the standard deviation of the composed error terms $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and the ratio of standard deviation $\gamma = \sigma_u / \sigma_v$. When the ratio is statistically significant, then it is appropriate to use the SFA approach.

The study also tested the presence of technical efficiency by likelihood ratio (LR) and employed the time-variant model with the one-step method proposed by Battese and Coelli (1995) to simultaneously regress explanatory factors and trade inefficiency term (u) in the stochastic frontier model. Trade inefficiency term (u) follows a truncated normal distribution and dependently with term (v). Trade inefficiency is assumed to be defined by the following equation:

$$u_{ij}^t = \beta_0 + \beta_1 \ln tariff_{kij}^t + \beta_2 ntm_covid_{kij}^t + \beta_3 rcep + \varepsilon_{ijt}$$

Following parameter estimation, the estimates of trade efficiency can be obtained as follows:

$$TE = \exp(-u_{ij}^t) = \frac{\exp_{kij}^t}{\exp_{kij}^{*t}}$$

3.2 Data Descriptions

The paper used panel data on Viet Nam's trade with RCEP members at a disaggregated level (HS6digit) in the period from 2017 to 2021, with a total of 376,530 observations. In the study, non-tariff measures in response to the pandemic were recorded from 2020 to August 2021. Bilateral trade data at the product level (HS-6 digit) and gravity variables (*comcol*, *contig*) were extracted from the CEPII database (due to some common characteristics, some traditional gravity variables were omitted in the regression). We collected trade data between Viet Nam and 14 RCEP members, namely Australia, Brunei Darussalam, Myanmar, Cambodia, the PRC, Indonesia, Japan, the Republic of Korea, the Lao PDR, Malaysia, New Zealand, the Philippines, Singapore, and Thailand, excluding India (because India joined RCEP later in 2022). GDP and GDP per capita are used in the World Bank statistics.

The applied tariff was extracted from the International Trade Center tariff database (ITC). The notification of COVID-19 temporary non-tariff measures is built on the global trade alert (extracted from the website: <https://www.globaltradealert.org/>) and the trade map of temporary COVID-19 trade measures (extracted from <https://www.macmap.org/covid19>).

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Lnexp	376,530	1.581	2.635	0	16.576
Lnimp	376,530	1.803	2.962	0	16.283
Lngdp_it	376,530	26.581	2.001	23.208	30.511
Ingdp_it	376,530	26.511	0.091	26.363	26.626
Ingdppc_it	376,530	9.294	1.334	7.069	11.260
Ingdppc_it	376,530	8.133	0.079	8.003	8.231
contig	376,530	0.214	0.410	0	1
comcol	376,530	0.143	0.350	0	1
dist	376,530	2,950.44	2,612.41	478.553	10,080.76
rcep	376,530	0.4	0.49	0	1
Intariff_it	376,530	0.314	0.790	0	6.686
Intariff_it	376,530	0.229	0.743	0	4.921
ntmcovid_it	376,530	0.003	0.054	0	1
ntmcovid_it	376,530	0.095	0.72	0	7
NtmP_i	376,530	0.002	0.049	0	1
NtmA_i	376,530	0.000	0.023	0	1
NtmP_j	376,530	0.002	0.050	0	2
NtmA_j	376,530	0.001	0.031	0	1
NtmB_j	376,530	0.000	0.008	0	1
NtmC_j	376,530	0.017	0.128	0	1
NtmE_j	376,530	0.000	0.011	0	1
NtmF_j	376,530	0.000	0.003	0	1
NtmG_j	376,530	0.000	0.006	0	1
NtmL_j	376,530	0.075	0.596	0	5

Note: *ntm(A/B/C/E/F/G/L/P)* = the number of non-tariff measures by chapter notified by country *i* or country *j* during the period of COVID-19. *ntm_A* = import prohibitions, Certification requirements for SPS reasons or multiple sanitary and phytosanitary measures; *ntm_B* = multiple TBT measures, *ntm_C* = pre-shipment inspection formalities; *ntm_E* = temporary relaxation of import licensing requirement; *ntm_F* = taxes and charges on imports; *ntm_G* = regulations concerning terms of payment for imports; *ntm_L* = tax and duty exemption, reductions; *ntm_P* = measures imposed on exports (export prohibition, export registration requirements, licensing).

3.3 Variable Correlation Analysis

Table 3 shows the correlation analysis of explanatory variables to test multicollinearity. It shows that a strong correlation exists between each variable and the dependent variables (export and import values). The maximum correlation was 0.7799, which was <0.8. Thus, it can be judged that there is no multicollinearity before each independent variable.

Table 3: Variable Correlation Analysis

	Inex	Inim	Ingdpi	Ingdpj	Ingdppci	Ingdppecj	Indist	Intariff_i	Intariff_j	contig	comcol	reep	ntmcovid_i	ntmcovid_j
Inex	1													
Inim	0.439	1												
Ingdpi	0.210	0.489	1											
Ingdpj	0.075	0.046	0.022	1										
Ingdppci	0.042	0.175	0.400	0.026	1									
Ingdppecj	0.076	0.046	0.022	0.999	0.026	1								
Indist	0.026	0.085	0.498	0.000	0.722	0.000	1							
Intariff_i	0.417	0.236	0.144	-0.005	-0.028	-0.004	0.018	1						
Intariff_j	0.225	0.330	0.236	-0.053	0.064	-0.056	0.066	0.184	1					
contig	0.038	0.062	-0.161	0.000	-0.450	0.000	-0.486	0.099	-0.000	1				
comcol	-0.029	-0.207	-0.569	-0.000	-0.519	-0.000	-0.590	0.002	-0.099	0.782	1			
reep	0.039	0.019	0.013	0.780	0.013	0.764	0.000	-0.009	0.028	0.000	0.000	1		
ntm_covid_i	0.011	0.004	-0.000	0.036	-0.001	0.035	0.000	0.001	0.001	-0.000	-0.000	0.066	1	
ntm_covid_j	0.007	-0.021	0.089	0.087	0.142	0.085	0.196	-0.019	0.006	-0.054	-0.050	0.162	0.058	1

4. ESTIMATION RESULTS

4.1 Impacts of COVID-19 Temporary Trade Measures on Viet Nam's Trade with RCEP Partners

Table 4 shows the estimation results of Viet Nam's exports and imports to RCEP partners using the Stochastic frontier gravity model (SFGM). To check the appropriateness of SFGM, the gamma values in both models are statistically significant (igtgamma) and highly valued at 0.832 and 0.843, respectively. In addition, Insigma2 represents highly statistically significant at 1% level, explaining the variation of the composed error terms. It implies the presence of technical inefficiency. The value of eta (-0.0485 and -0.0279) indicates that the degree of inefficiency increases over time. The statistical significance of μ indicates truncated normal distribution in the model. The results in Table 4 confirm the preference of the stochastic frontier gravity analysis in both models.

Regarding the effects on Viet Nam's exports (Column 1), GDP has the expected sign with a highly significant positive at the 1% level. GDP in Viet Nam is relatively lower than the GDP of exporting partners. The coefficient of GDP shows that a 1% increase in both Viet Nam's GDP and the GDP of its partners leads to an increase in exports of 0.4% and 20.17%, respectively. This suggests that the demand response with a change in the GDP of partners is larger than the supply response with a change in Viet Nam's GDP. However, the negative coefficient of GDP per capita for importing countries represents that Viet Nam's exports do not meet the increasing demand of importing countries. These results correspond to the results of Jiang et al. (2022) and Xu et al. (2022). It is noticeable that tariffs, known as trade resistance, have positive effects on both models. Hence, tariffs may not hinder the trade relationships among RCEP members. By incorporating the new non-tariff measures imposed on specific products during the COVID-19 pandemic, the measures have a negative and statistically significant impact at a 5% level on Viet Nam's exports with RCEP partners. The finding reveals that temporary COVID-19 measures created trade-restricting effects at the minimal rate of 0.02% compared with trade-facilitating effects of tariffs at 0.05%. In addition, the impact of the regional integration of RCEP (via the dummy variable rcep) remains positive and statistically significant at the 1% level.

Regarding Viet Nam's imports (Column 2), the remarkable point is that temporary non-tariff measures imposed by Viet Nam in the COVID-19 pandemic that were aimed to restrict imports and control product quality and safety have insignificantly impacted import flows from RCEP. In contrast, tariff and regional integration have had strong positive impacts on Viet Nam's imports. Furthermore, the coefficient of GDP and GDP per capita in the import model are higher than exports. It may reveal the higher sensitivity of import demands in Viet Nam. In general, although COVID-19 temporary trade measures negatively impacted Viet Nam's export flows to RCEP, they did not pose much of a challenge to Vietnamese exporters due to the benefit gained from tariff reduction.

Table 4: Estimation Stochastic Frontier Gravity Model (SFGM)

	(1)	(2)
	lnex	lnimp
Lngdp_it	0.416*** (66.76)	0.712*** (113.95)
Lngdp_jt	20.17*** (6.22)	-26.88*** (-11.12)
Lngdppc_it	0.0603*** (6.91)	0.402*** (45.64)
Lngdppc_jt	-11.44** (-3.29)	36.83*** (14.09)
Lndist	-0.295*** (-17.81)	-1.076*** (-64.32)
Ln(tariff+1)	0.0593*** (17.83)	0.0719*** (21.03)
Lnnmtm_covid	-0.0229** (-2.59)	-0.0101 (-0.20)
Rcep	0.143*** (9.07)	0.295*** (21.76)
Contig	-0.525*** (-13.53)	1.570*** (40.01)
Comcol	1.311*** (24.71)	-1.394*** (-26.05)
Insigma2	2.013*** (416.07)	1.893*** (388.49)
lgtgamma	1.607*** (251.02)	1.685*** (264.40)
mu	13.42*** (42.03)	12.95*** (38.55)
eta	-0.0485*** (-84.78)	-0.0279*** (-52.06)
Sigma2	7.485565	6.636013
Gamma	.8329952	.8435335
Sigma_u2	6.23544	5.597699
Sigma_v2	1.250126	1.038314
N	376,530	376,530

t statistics in parentheses *p<0.05, **p<0.01, *** p<0.001.

4.2 Robustness Test

Table 5 shows the regression results for both time-variant in columns (1) and (3) and time-invariant in columns (2) and (4). We found that the regression coefficients of each variable in the two models are basically the same, indicating that the regression results are robust. In addition, the time-variant parameter η can pass the hypothesis test at the 1% significance level, showing that trade inefficiency changes over time. Thus, a time-varying stochastic frontier gravity model should be selected.

In model (1), GDP_{it} and $GDP_{PC_{jt}}$ drove the supply and demand for Viet Nam's exports. Column (1) results show that GDP_{it} is significant at the 1% level with a positive sign, representing that the larger economies of scale promote the expansion of production and

Viet Nam's exports. $GDPPC_{jt}$ brings the negative and large elastic parameter (20.17), indicating that the volume of Viet Nam's exports does not correspond with the expansion of the economic scale of the RCEP partners. In addition, the coefficient of GDP for Viet Nam and the RCEP partners indicates the large disparity of economies of scale between country pairs. The other signs of the explanatory variables in each model are consistent and pass the significance test at the 1 and 5% levels, indicating that the model has good stability. In the time-varying model (column 1 and column 3), the key variables pass the significance test at the 1% level, which is higher than the time-invariant model (columns 2 and 4). Variable γ passed the significance testing in both time-variant and time-invariant models with a value above 80%. The results reveal that it was necessary to consider the factors of trade inefficiency to improve the trade potential.

Table 5: Robustness Check in Time-variant Model and Time-invariant Model

	<i>SFGM/tvd</i>	<i>SFGM/ti</i>	<i>SFGM/tvd</i>	<i>SFGM/ti</i>
	lnex	lnex	lnimp	lnimp
	(1)	(2)	(3)	(4)
lngdpit	0.416*** (66.76)	0.456** (70.14)	0.712*** (113.95)	0.724** (113.72)
lngdpjt	20.17*** (6.22)	-78.536** (40.96)	-26.88*** (-11.12)	-79.478** (46.77)
lngdppcit	0.0603*** (6.91)	0.096** (10.54)	0.402*** (45.64)	0.456** (51.14)
lngdppcjt	-11.44** (-3.29)	91.627** (42.54)	36.83*** (14.09)	91.335** (47.84)
Indist	-0.295*** (-17.81)	-0.368** (21.16)	-1.076*** (-64.32)	-1.161** (68.39)
Intariff_jt	0.0593*** (17.83)	0.050** (14.87)		
Intariff_it			0.0719*** (21.03)	0.070** (20.39)
lnntm_covid_jt	-0.0229** (-2.59)	-0.023** (2.58)		
lnntm_covid_it			-0.0101 (-0.20)	0.005 (0.10)
rcep	0.143*** (9.07)	0.324** (21.32)	0.295*** (21.76)	0.378** (28.42)
contig	-0.525*** (-13.53)	-0.635 (15.54)	1.570*** (40.01)	1.577** (39.28)
comcol	1.311*** (24.71)	1.568** (28.11)	-1.394*** (-26.05)	-1.449** (26.48)
_cons	-437.4*** (-7.62)	1343.23** (19.96)	412.4*** (9.67)	1365.075** (28.66)
lnsigma2	2.013*** (416.07)	1.862** (426.57)	1.893*** (388.49)	1.801** (403.02)
lgtgamma	1.607*** (251.02)	1.393** (229.31)	1.685*** (264.40)	1.564** (259.37)
gamma	.8329952	.8010369	.8435335	.8269514
mu	13.42*** (42.03)	15.276 (0.26)	12.95*** (38.55)	13.987 (0.37)
eta	-0.0485*** (-84.78)		-0.0279*** (-52.06)	
Log likelihood	-692,235.37	-695,789.8	-662,833.94	-664,177.86
N	376,530		376,530	

4.3 Estimation of the Effect of COVID-19 Temporary Trade Measures by Specific Types

According to the notification of trade measure responses to COVID-19 from countries, the study used UNCTAD's non-tariff measures classification and the World Customs Organization (WCO) HS classification reference for COVID-19 vaccines and medical supplies to incorporate the statistics in the panel data. Detailed measures by types and products can more accurately demonstrate the trade effects at the product level. Table 6 shows the estimated results of COVID-19 specific trade measures for Viet Nam's exports and imports.

In column 1, Viet Nam's exports are the subject of specific trade measures of chapters A, B,C,E,F,G,L imposed by partners and export-related measures (chapter P) imposed by Viet Nam. Among these measures, the temporary relaxation of import licensing requirements (ntm_E) and the tax and duty exemptions (ntm_L) also have significant positive effects at the statistical level of 1%, while pre-shipment inspection formalities (ntm_C) bring the negative sign. Export-related measures (ntm_P) positively affect export flows at the statistical level of 10%.

In column 2, Viet Nam imposed only one type of measure, an import prohibition (ntm_A) to control import flows during the COVID-19 pandemic. The minimal amount of trade measures imposed by Viet Nam on imports records a negative effect at the statistical level of 5%. It reveals that the small amount of temporary non-tariff measures notified by Viet Nam for certain products, such as medical supplies or wildlife products, did not significantly influence bilateral trade flows. Meanwhile, temporary non-tariff measures notified by RCEP countries predominantly remain to promote trade or facilitate the export of products from Viet Nam.

4.4 Trade Efficiency Across Countries and Products

Table 7 shows the results of Viet Nam's export and import efficiency to countries in RCEP. From the estimation results at the product level (HS 6 digits), the study aggregates the mean value by sectors (HS 2 digits). Regarding bilateral trade efficiency by RCEP partners, Viet Nam has the highest export efficiency with the three largest economies in the region, namely the PRC, the Republic of Korea, and Japan, with 0.15%, 0.12%, and 0.10%, respectively. The top three importing markets to Viet Nam are the Republic of Korea, Malaysia, and Thailand, with 0.13%, 0.076%, and 0.056%, respectively. It can be seen that Viet Nam takes advantage of exporting to large markets in East Asia due to the high complementarity between country pairs. With ASEAN economies, Viet Nam's imports from members outweigh exports. The high similarities of comparative advantage are the challenges for increasing export efficiency with the ASEAN market, but Viet Nam can benefit from supplying intermediate goods in the regional supply chain. Forming RCEP agreements may stimulate Viet Nam's export efficiency to large East Asian partners, such as the PRC, the Republic of Korea, Japan, Australia, and New Zealand. However, trade efficiency is minimal due to the disaggregate level of products and the small number of subjects imposed by COVID-19 temporary trade measures. Besides, the changes in trade inefficiency were only recorded in the short time of the crisis (in 2020).

Table 6: Stochastic Frontier Gravity Model of Trade Measures by Types

	(1)	(2)
	lnex	lnimp
lngdp_vn	0.416*** (66.79)	0.712*** (113.94)
lngdpj	19.77*** (6.10)	-27.02*** (-11.19)
lngdppc_vn	0.0607*** (6.94)	0.402*** (45.64)
lngdppcj	-11.00** (-3.16)	36.99*** (14.16)
Indist	-0.295*** (-17.84)	-1.075*** (-64.32)
ln(tariff + 1)	0.0594*** (17.86)	0.0719*** (21.03)
ntm_A	0.0440 (0.57)	-0.232** (-2.84)
ntm_P	0.106* (2.48)	
ntm_B	0.305 (0.77)	
ntm_C	-0.273*** (-5.90)	
ntm_E	0.890*** (4.83)	
ntm_F	0.299 (0.48)	
ntm_G	-0.432 (-0.86)	
ntm_L	0.0428*** (4.37)	
rcep	0.146*** (9.24)	0.296*** (21.95)
contig	-0.525*** (-13.52)	1.570*** (40.01)
comcol	1.311*** (24.72)	-1.394*** (-26.05)
lnsigma2	2.012*** (415.92)	1.892*** (388.49)
lgtgamma	1.607*** (250.92)	1.685*** (264.39)
mu	13.42*** (41.97)	12.95*** (38.49)
eta	-0.0484*** (-84.61)	-0.0279*** (-52.05)
N	376,530	376,530

t statistics in parentheses *p<0.05, **p<0.01, *** p<0.001.

Note: *ntm_A* = import prohibitions, Certification requirements for SPS reasons or multiple sanitary and phytosanitary measures; *ntm_B* = multiple TBT measures, *ntm_C* = pre-shipment inspection formalities; *ntm_E* = temporary relaxation of import licensing requirement; *ntm_F* = taxes and charges on imports; *ntm_G* = regulations concerning terms of payment for imports; *ntm_L* = tax and duty exemption, reductions; *ntm_P* = measures imposed on exports (export prohibition, export registration requirements, licensing).

Table 7: Bilateral Trade Efficiency by RCEP Partner

Exporting Country	Export Efficiency (%)	Import Efficiency (%)
PRC	0,150	0,018
Republic of Korea	0,128	0,132
Japan	0,100	0,034
Malaysia	0,055	0,076
Thailand	0,051	0,056
Australia	0,045	0,035
Cambodia	0,044	0,030
Indonesia	0,033	0,050
New Zealand	0,017	0,028
Myanmar	0,013	0,006
Philippines	0,009	0,004
Singapore	0,008	0,005
Lao PDR	0,006	0,021
Brunei Darussalam	0,001	0,002

The COVID-19 pandemic has also postponed and slowed down trade flows in the world. The estimation results indicate the significant effects of COVID-19 on bilateral trade between Viet Nam and RCEP partner countries, which then affected trade efficiency. By calculating trade efficiency in the absence of COVID-19 and in the period of COVID-19, the estimation reveals a reduction in Viet Nam's export efficiency to RCEP partners but no change in import efficiency. However, the change in export efficiency to trade partners is not far from zero, so temporary COVID-19 trade measures have not been a challenge for Vietnamese firms in the relationship with RCEP partners.

From the estimation results at the product level (HS 6 digits), the study aggregates the mean value of sectors at HS 2 digits (Table 8). Footwear (HS64), electrical machinery, and equipment (HS85), and mineral oil and fuel (HS27) obtain the largest export efficiency at 0.48, 0.28, and 0.23, respectively. Nevertheless, two sectors (H27 and HS85) also peak at the highest level of import efficiency. This reflects that Viet Nam's exports are still strongly dependent on intermediate imports from the intra-trade bloc. Footwear and furniture (HS94) are Viet Nam's most advantageous exporting products to RCEP based on the relatively high export efficiency score compared with import efficiency scores. In addition, some agricultural sectors, such as rice (HS10), fruits and nuts (HS08), coffee and spices (HS09), and other agricultural-processed products (HS21, HS11, and HS19) have performed in the top 20 main exporting sectors to RCEP. In another way, Viet Nam has a large potential to increase export efficiency and sector diversification in bilateral trade with RCEP partners. As a result, Viet Nam should stimulate exports in some advantageous products, including footwear, furniture, and agricultural products, while some manufacturing products, such as electrical machinery, mineral oil and fuel, apparel, and vehicles, ensure a trade surplus in bilateral trade flows.

Table 8: Top 10 Sectors (HS2-digit) Export Efficiency and Import Efficiency

HS	Product Category	Export Efficiency (%)	HS	Product Category	Import Efficiency (%)
64	Footwear	0,487	27	Mineral oil and fuel	0,396
85	Electrical machinery and equipment	0,286	04	Dairy products	0,189
27	Mineral oil and fuel	0,238	85	Electrical machinery, equipment	0,160
94	Furniture	0,137	24	Tobacco and tobacco substitutes	0,131
42	Articles of leather	0,112	17	Sugars and sugar confectionery	0,129
62	Articles of apparel and clothing accessories	0,108	22	Beverages, spirits, and vinegar	0,124
10	Cereals	0,105	76	Aluminum and articles	0,109
23	Residues and waste from the food industries	0,090	40	Rubber and articles	0,091
61	Apparel and clothing accessories	0,088	87	Vehicles and parts, accessories	0,088
21	Miscellaneous edible preparations	0,085	79	Zinc and articles	0,088

5. CONCLUSION AND POLICY IMPLICATIONS

The study used the Stochastic frontier gravity model to examine the influence of temporary COVID-19 trade measures on Viet Nam's export and import efficiency with RCEP partners at the product level (HS 6 digit). In the period, COVID-19 trade measures were recorded from 2020 to August 2021.

Estimated results show that COVID-19 responsive trade measures imposed by trade partners had a significantly negative effect on export flows from Viet Nam to RCEP partners. One import prohibition notified by Viet Nam has insignificant effects on import flows due to the high demands from domestic and foreign markets and the limited scope of application. Regarding types of trade measures, temporary import licensing and tax and duty exemptions create trade-facilitating effects, but pre-shipment inspection formalities bring negative effects. The paper also calculated the change in trade efficiency between pre-COVID-19 and post-COVID-19 periods. The results reveal a slight reduction in export efficiency. Apparently, the effects of temporary trade measures have been significant in the conditions of regional integration (the formation of RCEP). This reflects that regional integration (typically RCEP) seems to be an effective regional collaboration that contributes to trade-facilitating effects among member states while preventing the disruption of trade flows from the global pandemic.

The results bring contributions to the empirical literature. First, the study fills the gap on the stochastic frontier estimation at a disaggregated level to measure trade efficiency, then provides a comprehensive way to analyze the gap between trade potential and trade actual and evaluate the level of product diversification. Second, the study clarifies the effects of COVID-19 through the policy responses by incorporating temporary COVID-19 trade measures imposed on specific products, such as agricultural products, medical supplies, or COVID-19 vaccines, instead of using some intermediate explanatory variables as dummy variables for COVID-19 or social distancing, or some aggregate indicators that inaccurately calculate direct effects. Third, the findings show that tariffs in regional trade agreements, such as RCEP, obviously have a positive impact on trade efficiency. The results also correspond to the findings in the study by Jiang et al. (2022). RCEP, known as ASEAN + 6, was in force in 2020, but it is based on the concrete foundation of former trade relations among ASEAN and five large economies: the PRC (ACFTA), the Republic of Korea (AKFTA), Japan (AJCEP), Australia, and New Zealand (AANZFTA).

Facing the unprecedented severe pandemic, the government responded with multiple policies, such as social distancing, strict control at the border, and temporary trade measures. These various policy responses also brought diverse effects on different aspects of society, public health, and the economy. The study shows the direct negative effects of typical COVID-19 trade measures on export flows between Viet Nam and the RCEP partners but insignificant effects on import flows to Viet Nam. In detail, pre-shipment inspections and import prohibitions or multiple sanitary measures may be time-consuming and costly for firms, resulting in a decrease in export and import volume, while some trade measures, including tax and duty exemptions and relaxation of licensing requirements, represent trade-facilitating effects. However, the slight changes in export efficiency reveal that governments appropriately published trade measures and at the right time to prevent the COVID-19 virus from spreading to public health via export and import commodities. These measures may not be the influencing factors for the disruption of trade flows because they are applied to a small scope of commodities or focus only on certain products as essential commodities in the prevention of a pandemic. Furthermore, regional trade agreements should be considered as crucial solutions to enhance international and regional coordination to solve global issues. Consequently, the government needs a comprehensive approach to face crises, but specific policies that respond to crises should determine the scope of application to directly impact and restrict unexpected effects.

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ANNEX 1: COVID-19 TEMPORARY MEASURES BY CHAPTERS

Country	A	B	C	E	F	G	L	P	Total NTM
Australia	0	0	1	0	0	0	5	1	7
Brunei Darussalam	0	0	0	0	0	0	1	0	1
Cambodia	1	1	0	0	0	0	0	3	5
PRC	2	0	1	0	0	0	0	3	6
Indonesia	3	3	0	0	0	1	2	2	11
Japan	0	0	0	0	0	0	1	0	1
Lao People's Democratic Republic	0	0	0	0	0	0	1	0	1
Malaysia	0	0	0	0	0	0	3	1	4
Myanmar	0	0	0	0	1	0	1	1	3
Philippines	2	0	0	0	0	0	2	1	5
Republic of Korea	1	0	0	1	0	0	0	3	5
Singapore	0	0	0	1	0	0	1	0	2
Thailand	0	0	0	0	0	0	1	2	3
Viet Nam	1	0	0	0	0	0	0	4	5
New Zealand	0	0	0	0	0	0	0	0	0

Note: A,B,C,D,E,F,G,L,P denote non-tariff measures by types; the International Classification of NTMs was used (UNCTAD, 2017).

Source: UNCTAD COVID-19 data set built from <https://unctad.org/topic/trade-analysis/non-tariff-measures/covid-19-and-ntms> on databases – *WTO COVID-19: Measures affecting trade in goods*; *WTO Quantitative restrictions*; *Global Trade Alert* and *ITC COVID-19 Temporary Trade Measures*, with additional UNCTAD research covering national government websites of laws and regulations as well as news media sources. Extracted from <https://unctad.org/topic/trade-analysis/non-tariff-measures/covid-19-and-ntms>.

ANNEX 2: INTERNATIONAL CLASSIFICATION OF NON-TARIFF MEASURES BY UNCTAD (2019 VERSION)

Measures	Descriptions
Chapter A	Sanitary and phytosanitary measures (SPS)
Chapter B	Technical barriers to trade (TBT)
Chapter C	Pre-shipment inspection and other formalities
Chapter D	Contingent trade protective measures
Chapter E	Non-automatic import licensing, quotas, prohibitions, quantity-control measures, and other restrictions not including phytosanitary measures or measures relating to technical barriers to trade
Chapter F	Price-control measures, including additional taxes and charges
Chapter G	Finance measures
Chapter H	Measures affecting competition
Chapter I	Trade-related investment measures
Chapter J	Distribution restrictions
Chapter K	Restrictions on post-sales services
Chapter L	Subsidies and other forms of support
Chapter M	Government procurement restrictions
Chapter N	Intellectual property
Chapter O	Rules of origin
Chapter P	Export-related measures

Note: The descriptions of non-tariff measures by types used in the study were partly extracted from the full version of the international classifications of NTMs by UNCTAD (2019).

Source: <https://unctad.org/topic/trade-analysis/non-tariff-measures/NTMs-classification>.