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RESEARCH NOTE

Assessing the Impact of the COVID-19 Pandemic on North-American Trade

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In a very unique approach, this study utilized monthly Coronavirus Disease (COVID) government response measures in the gravity model of trade, to determine their impact on bilateral trade among three North American countries: the United States, Canada, and Mexico. The results show that closures and containment measurements have a negative impact on North American trade, while income support and debt relief measures have a significant positive impact.

The literature on trade economics largely utilizes the gravity model. The model originates from both physics and economics, positing that the flows of trade depend positively on country size, but negatively on the distance between the countries. The model has been bolstered by robust microeconomic theoretical foundations. For example, Anderson, (*The American Economic Review*, 1979) and Bergstrand (*The Review of Economics and Statistics*, 1985) demonstrated that the gravity model could be derived from a general equilibrium model. The model's use has now expanded into newer areas. For example, Kimura and Lee (*Review of World Economics*, 2006) applied the gravity model to trade in services, and Larson, et.al. (*Forest Products Journal*, 2018) applied the model to trade in forest products. Modern augmented gravity models include additional control variables, such as exchange rates, weighted price variables, common languages, and preferential trade agreements.

In our models, monthly bilateral trade data from the International Monetary Fund (https://data.imf.org) were used. Data for the COVID government response measures (from January 2020 to September 2021) were from the University of Oxford's COVID-

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19 Government Response Tracker (https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker). The dataset contains indicators that describe aspects of specific government responses to COVID, each of which is an ordinal variable. The data also contain broad summary indicators (stringency and economic support) of government response, which were calculated as raw averages of the indicators. These summary indicators and their one month-lagged terms were included in the gravity model using a Poisson Pseudo-Maximum Likelihood estimator:

$$X_{ijt} = \exp\left[\sum_k \left(\beta_{C1_k} C1_{k,it} + \beta_{C2_k} C2_{k,j,t} + \beta'_{C1_k} C1_{k,i,t-1} + \beta'_{C2_k} C2_{k,j,t-1}\right)\right] \eta_{ijt} \quad (1)$$

X_{ijt} is either the origin country i's export amount, or the destination country j's import amount, at time t. $C1_{k,it}$ is the kth COVID index for exporter country i at time t, and $C2_{k,jt}$ is that of the destination country j. Eq. (1) displays Model 1, which was estimated during the COVID period (January 2020 to September 2021). The results are presented in Online Supplemental Appendix (OSA) Tables 1 and 2, and indicate the following:

- The Stringency Index (the average of indicators describing closures and containment) for both the origin and destination countries had negative effects on the origin country's exports ($p = 0.065$ and 0.037 in OSA Table 1). There were similar negative effects on the destination country's imports ($p = 0.019$ and 0.095 in OSA Table 2). This index became insignificant when lags of the indexes were included in the model.
- The Economic Support Index (the average of indicators describing income support and debt relief) for both the origin and destination countries had significant positive effects on the origin country's exports ($p = 0.001$ and 0.000 in OSA Table 1). There were similar significant positive effects on the destination country's imports ($p = 0.000$ and 0.002 in OSA Table 2). This index became insignificant when lags of the indexes were included in the model.

The augmented gravity model considers the monthly normalized GDP index (for origin and destination countries) and the monthly Real Broad Effective Exchange Rate index (for the origin country) from the Federal Reserve Economic Database (https://fred.stlouisfed.org/). Due to the normalized nature of these indices, instead of log transformations, the monthly percentage change was examined. Paired-country fixed effects were also included.

$$X_{ijt} = \exp\left[\sum_k \left(\beta_{C1_k} C1_{k,it} + \beta_{C2_k} C2_{k,jt}\right) + \beta_{digdp1} \Delta igdp1_t + \beta_{digdp2} \Delta igdp2_t + \beta_{diexorg} \Delta iexchange_t + \mu_{ijt}\right] \eta_{ijt} \quad (2)$$

Equation (2) displays Model 2, and the results are presented in OSA Tables 3 and 4. Controlling for the monthly percentage change in the GDP index and exchange rate indexes and pair-country dummies, the augmented model was estimated for the COVID period of 2020–2021. The period was then extended to 2000–2021 (COVID indexes were set to zero before 2020).

- During the 2020–2021 period, the Stringency Index for the destination country had a significant negative effect on the exporting country ($p = 0.007$), while the Stringency Index for the origin country had a negative effect on the destination country's imports ($p = 0.011$).
- During the 2020–2021 period, the Economic Support Index for the destination country had a positive effect on the exporting country ($p = 0.018$), while the Economic Support Index for the origin country had a significant positive effect on the destination country's imports ($p = 0.008$).
- During the extended 2000–2021 period, as expected, the COVID indexes were no longer significant, but the percentage change in the origin and destination country GDP indexes and the percentage change in the origin country exchange rate index displayed the expected signs.

In conclusion, this study quantified the effect of COVID government response measures on North American trade. The finding is that closures and containment measurements negatively impact trade, while income support and debt relief measures positively impact trade.