Effect of COVID-19 Border Closures on Domestic Trade Patterns

A Spatial Autoregressive Approach to Estimate the Response of Colombian Trucking Flows

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RESEARCH QUESTION

Did geospatial trade exposure affect the trade patterns of Colombian municipalities in response to COVID-19 spread-mitigation measures?

ABSTRACT

I analyze and quantify the effects of exposure to international trade by considering the response in trade flow dynamics that took place within the Colombian domestic trucking network following the spread of COVID-19 and the implementation of spread-mitigation policies.

Using data on Colombian trucking for 2019 and 2020 along with geospatial trade exposure characteristics data, I implement a panel-data spatial autoregressive (SAR) model estimation to study how trade exposure affected the response of Colombian domestic trucking flows, measured as the value of goods traded between municipalities, to COVID-19 spread mitigation policies.

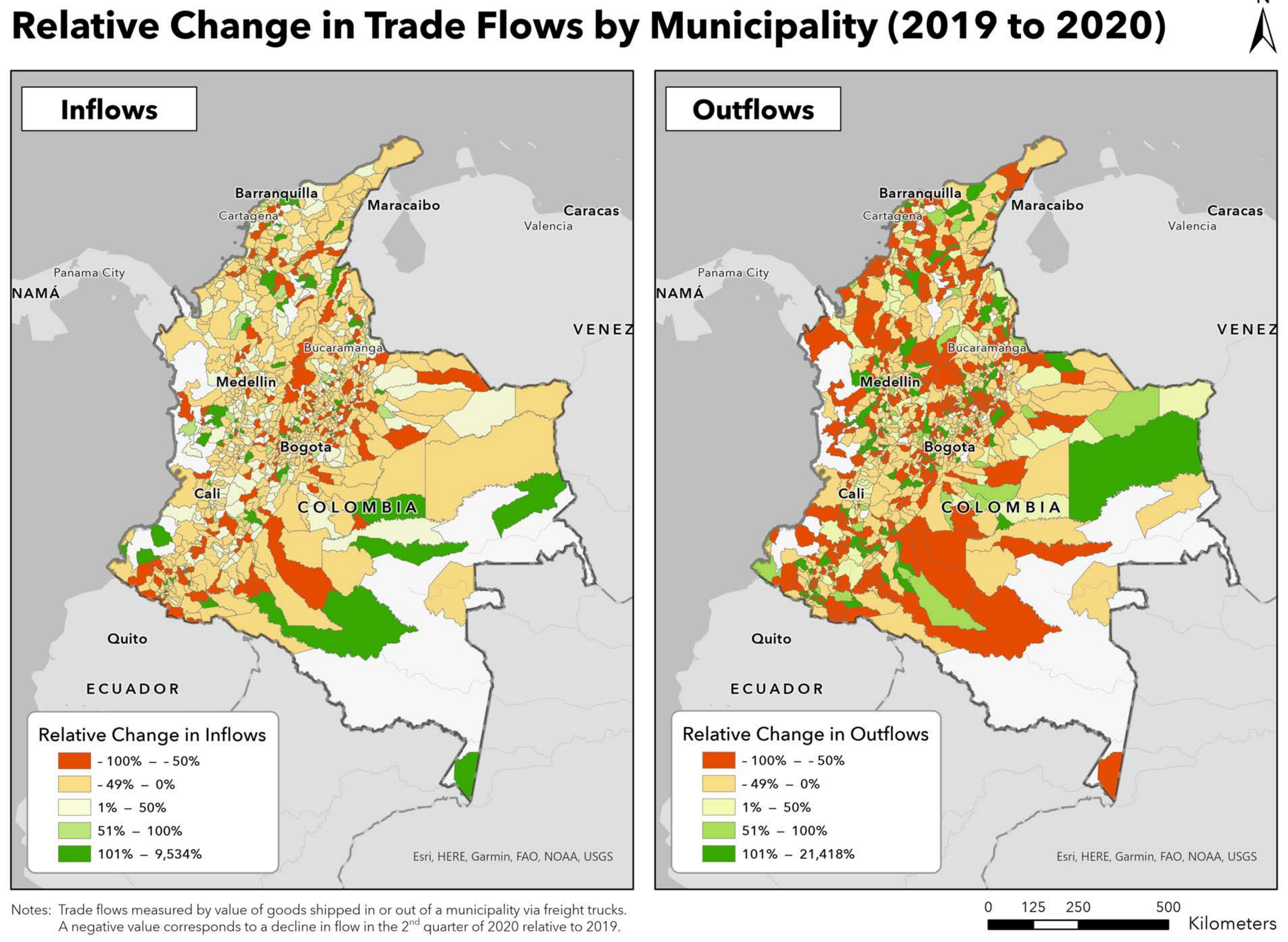
Overall, the results indicate that accounting for spatial autocorrelation matters when conducting trade flow analyses. Additionally, the results indicate that the trading role of the municipality prior to COVID-19 did influence how a municipality was affected by COVID-19 and the spread-mitigating policies.

MOTIVATION

COVID-19 affected supply chains on a global-scale.

- For Colombia, municipalities had to supplement foreign goods with domestic resources.
- In an open-economy situation, municipalities' trade behaviors depend on their position in the international market.

Relative Change in Trade Flows by Municipality (2019 to 2020)



Notes: Trade flows measured by value of goods shipped in or out of a municipality via freight trucks. A negative value corresponds to a decline in flow in the 2nd quarter of 2020 relative to 2019.

METHOD

I obtain trucking flows data from the National Registry of Cargo Dispatches (RNDC) and aggregate inflow and outflow values to the quarter-municipality level for 7 quarters (from January 2019 through September 2020).

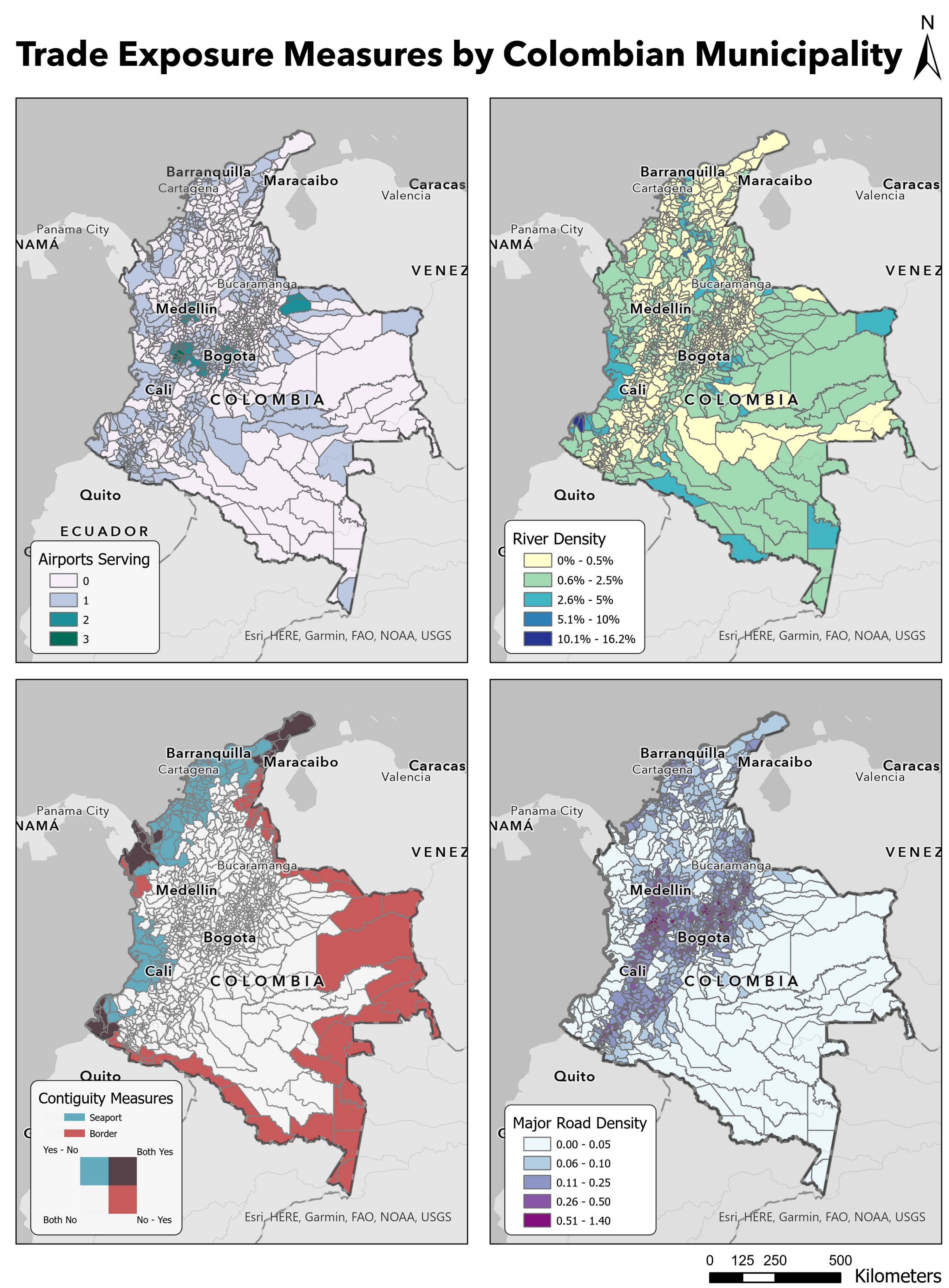
Using publicly available data, I compute five characteristics that are likely to capture the trade exposure of the 1,035 Colombian municipalities considered: border contiguity, seaport contiguity, airports serving, major road density, and river coverage.

I supplement the estimation by also incorporating VIIRS annual nightlights data by municipality as a proxy capturing municipality-level economic activity.

I estimate a pooled ordinary least squares (POLS) regression as a baseline model for comparison purposes.

(POLS results not presented here)

Trade Exposure Measures by Colombian Municipality



ESTIMATION

OLS Model:

$$\underbrace{Value_{it}}_{(1)} = \beta_1 + \beta_2 \underbrace{VIIRS_{it}}_{(2)} + \beta_3 \underbrace{Net\ Exporter_i}_{(3)} + \beta_4 \underbrace{COVID_t}_{(4)} + \beta_5 \underbrace{(Net\ Exporter_i \cdot COVID_t)}_{(5)} + \beta_6 \underbrace{X_i}_{(6)} + \varepsilon_{it} \quad (1)$$

where i: municipality and t: quarter.

(1) Log value of goods flowed. Dependent variables: Log(Outflows), Log(Inflows), Net Trade Flows [(Outflows - Inflows)/ (Outflows + Inflows)]

(2) Average annual nightlights by municipality measured in radiance ($nW/cm^2/sr$).

(3) Dummy equal to 1 if municipality is net exporter.

(4) Dummy equal to 1 if the observation is after COVID-19 hit (Q2 of 2020).

(5) Composite variable.

(6) Geospatial trade exposure characteristics: Border contiguity, seaport contiguity, airport buffer, road density, river coverage.

SAR Model:

$$\boldsymbol{y}_{it} = \rho \boldsymbol{W} \boldsymbol{y}_{it} + \boldsymbol{X}_{it} \boldsymbol{\beta} + \boldsymbol{\varepsilon}_{it} \qquad t = 1, 2, \ldots, T \quad (2)$$

where W: the spatial weighting matrix, generated by computing the inverse-distance between 2 municipalities.

	(1) log(Outflows)	(2) log(Inflows)	(3) Net Flows
MAIN			
VIIRS	0.35*** (0.06)	0.21*** (0.02)	0.01*** (0.00)
COVID-19	-0.41*** (0.12)	-0.01 (0.02)	-0.01* (0.01)
Net Exporter	3.40*** (0.22)	-0.59*** (0.04)	0.83*** (0.01)
COVID-19 × Net Exporter	0.81** (0.25)	-0.16** (0.05)	0.02 (0.01)
Border Contiguity	0.32 (0.79)	0.63 (0.32)	-0.02 (0.04)
Seaport Contiguity	0.96 (0.61)	0.60* (0.25)	0.04 (0.03)
Airport Buffer	1.30*** (0.26)	0.67*** (0.10)	0.06*** (0.01)
Road Density	0.15 (1.06)	0.34 (0.44)	-0.04 (0.05)
River Coverage	13.40 (14.65)	8.75 (6.04)	0.95 (0.76)
Constant	6.65*** (1.48)	3.90*** (0.91)	-0.40*** (0.06)

	(1) log(Outflows)	(2) log(Inflows)	(3) Net Flows
SPATIAL			
ρ	0.59*** (0.09)	0.79*** (0.05)	0.55*** (0.10)
VARIANCE			
θ_{t-1}	-0.89*** (0.03)	-1.85*** (0.03)	-0.94*** (0.04)
σ_e^2	12.24*** (0.22)	0.45*** (0.01)	0.03*** (0.00)
R^2	0.30	0.27	0.72
R^2_{within}	0.04	0.05	0.42
$R^2_{between}$	0.39	0.29	0.80
AIC	41,353.96	19,042.09	-2,092.18
BIC	41,657.04	19,345.17	-1,789.10
Observations	7,245	7,245	7,245

Notes: Standard errors in parentheses. Departmental fixed effects are included in all three estimations. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

CONCLUSION

Of the proposed measures to capture trade exposure, only airport buffers were statistically significant for all three dependent variables

Accounting for spatial autocorrelations is important when conducting trade flow analyses.

The role of a municipality (net exporter or net importer) prior to COVID-19 did influence how a municipality was affected by COVID-19 and the spread-mitigating policies.

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