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Núcleo de Economia Regional e Urbana da Universidade de São Paulo

The University of São Paulo Regional and Urban Economics Lab

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Crisis Monitor: Using High-Frequency Traffic Data in a Trade-Based Regional Economic Activity Index

COVID-19 Panel

Challenges and Perspectives for Regional Economics

REAL, University of Illinois at Urbana-Champaign,

July 17, 2020

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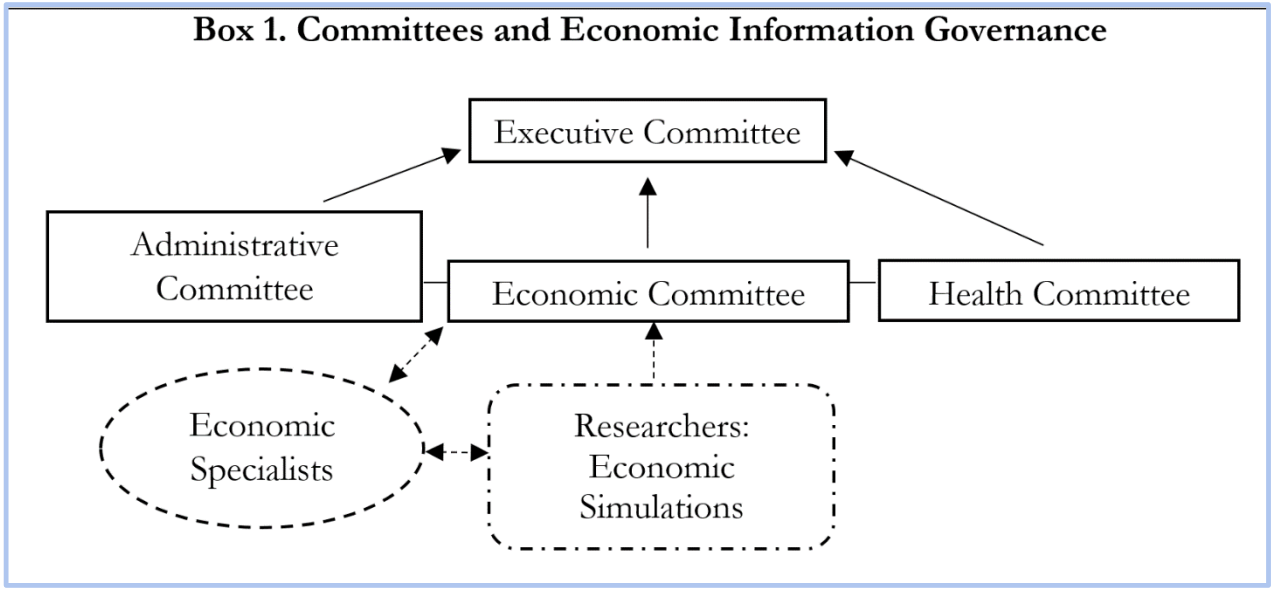
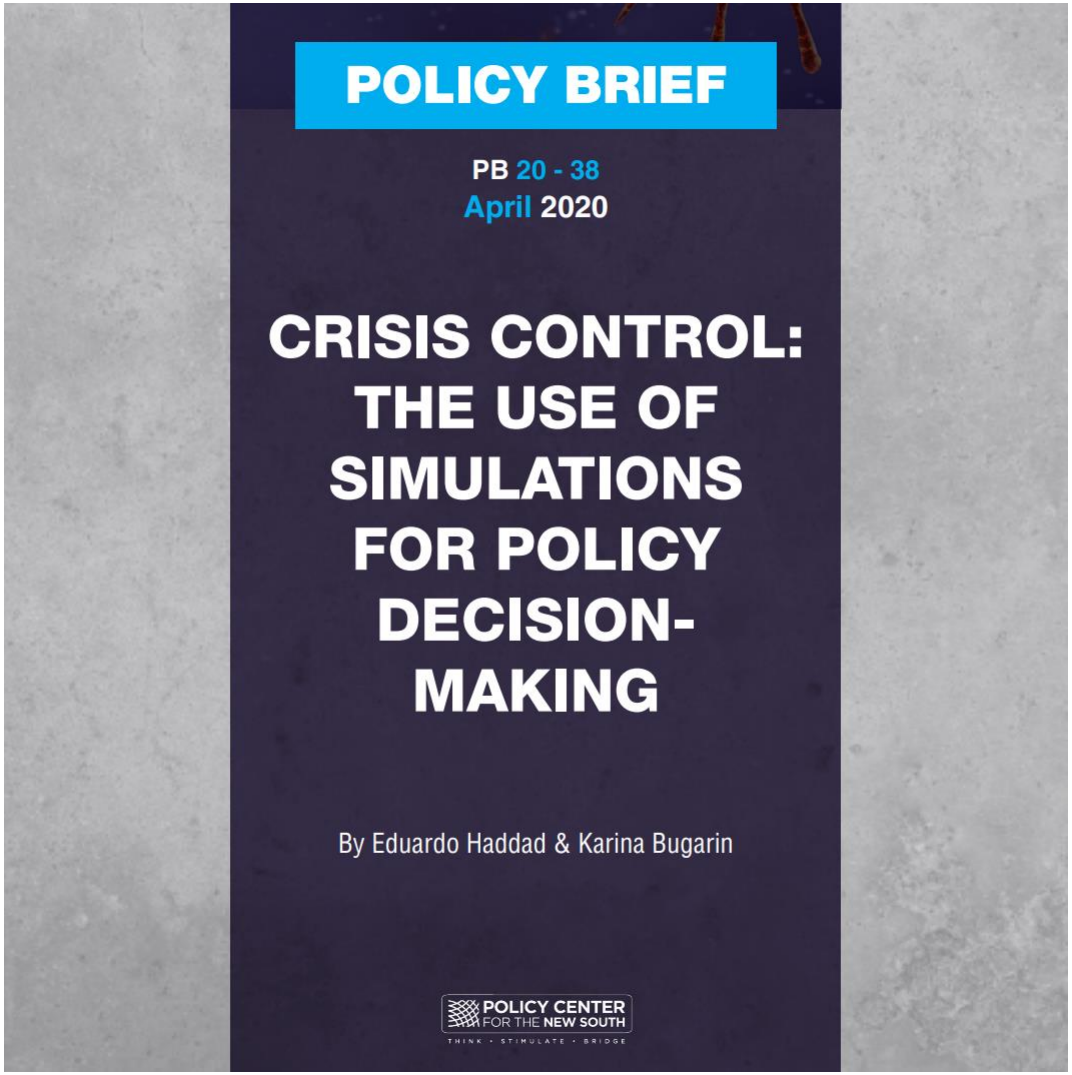
Renato Vieira Silvio Ichihara

Expert committees to examine initial control measures and define gradual relaxing of social restrictions

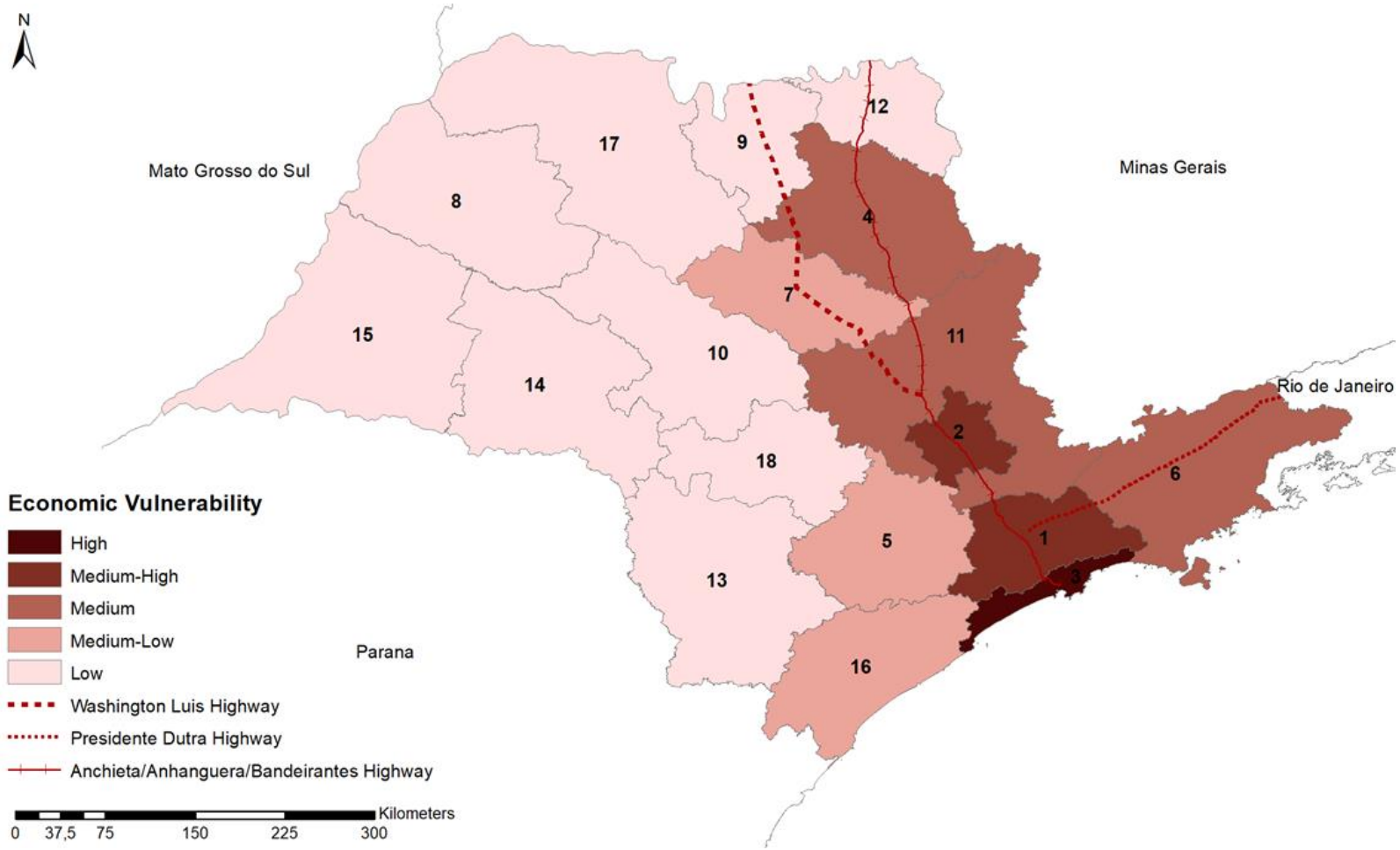
Up against enormous uncertainties, combining epidemiological and socioeconomic simulation-based scenarios to **assess and monitor impacts** is fundamental for informing officials before committing to a strategy



https://www.policycenter.ma/publications/crisis-control-use-simulations-policy-decisionmaking



Heterogeneous sectoral and regional costs



"São Paulo Plan": gradual relaxing of social restrictions as health indicators improve

SÃO PAULO
GOVERNO DO ESTADO

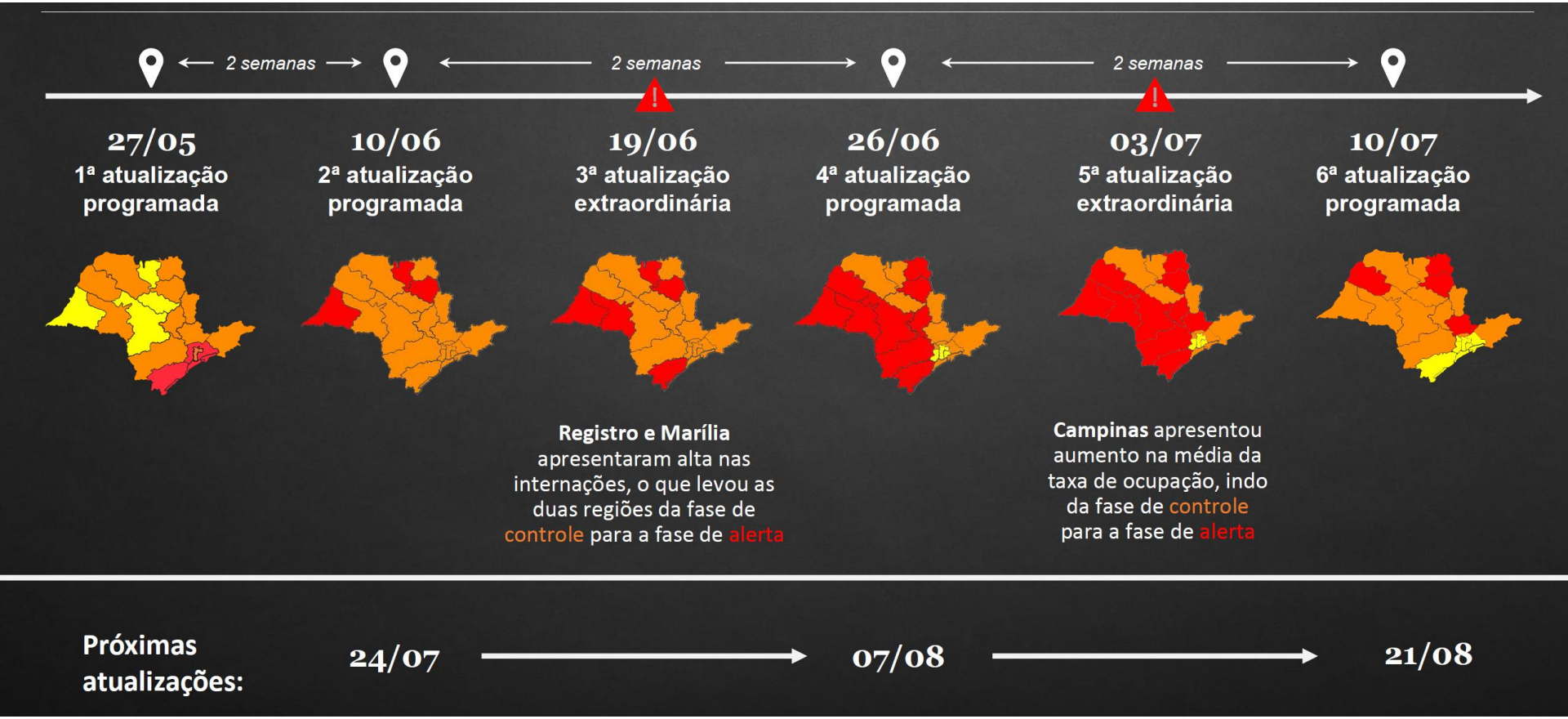
CRITERIA FOR THE PHASES CALCULATION

The criteria for the risk phases are currently defined by objective indicators and a weighting and rating methodology; The final classification is considered as the most restricted among the two sets of indicators

Set of indicators	Indicator	Weight	Phase 1 Maximum alert	Phase 2 Control	Phase 3 Flexibilization	Phase 4 Partial reopening	Phase 5 Controlled normal
Health System Capacity	Average occupancy rate of ICU COVID beds in the last 7 days (%)	4	Above 80%	Between 70% e 80%	Between 60% e 70%	Below 60%	*TBD*
	COVID ICU Beds / 100k habitants	1	Below 3.0	Between 3.0 e 5.0	-	Above 5.0[1]	*TBD*
Evolution of the epidemic	# of new cases in the last 7 days / # of new cases in the previous 7 days	1	Above 2.0	-	Between 1.0 e 2.0[2]	Below 1.0	*TBD*
	# of new hospital internments in the last 7 days / # of new hospital internments in the previous 7 days	3	Above 1.5	Between 1.0 e 1.5	Between 0.5 e 1.0	Below 0.5	*TBD*
	# of deaths by COVID in the last 7 days / # of deaths by COVID in the previous 7 days	1	Above 2.0	Between 1.0 e 2.0	Between 0.5 e 1.0	Below 0.5	*TBD*

1. In case the number of COVID ICU Beds is above 5.0, the indicator becomes automatically green; 2. In case the # of new cases in the last 7 days / # of new cases in the previous 7 days is below 2.0, the indicator becomes automatically yellow

Every two weeks, there is a reassessment of the regional classification based on health indicators



Próximas atualizações: 24/07 → 07/08 → 21/08

Monitor of regional economic activity

State Treasury follows daily value-added tax (VAT) collection and VAT-generating transactions

Partial coverage of the State economy

- Formal versus informal
- Restricted number of sectors (<30% of GRP)

Need to complement tax monitoring with a broader indicator of regional economic activity

- Same frequency and regionalization of health indicators
- Combine input-output analysis and traffic data

An Index of Regional Sectoral Economic Activity

We consider there are *n* domestic regions, *r* = 1, ..., n, and the rest of the world, *row*, which exhaust the space of the economy

Economic interactions take place inside and outside each region (intraregional, interregional and international trade)

In our multi-sectoral economy, there are *j* sectors, *s* = 1, ..., j, provided by *n+1* different sources

We then assume we can measure, for each sector *s* in region *r*, the value added contents embedded in trade flows associated with each regional origin-destination pair, such that we can complete the information in Table 1

Table 1. Regional Value Added in Trade Flows, by Sector

	Destination					
Origin	R_1	R_2	…	R_{n-1}	R_n	ROW
R_1	$va_{1,1}^{r,s}$	$va_{1,2}^{r,s}$	…	$va_{1,n-1}^{r,s}$	$va_{1,n}^{r,s}$	$va_{1,row}^{r,s}$
R_2	$va_{2,1}^{r,s}$	$va_{2,2}^{r,s}$	…	$va_{2,n-1}^{r,s}$	$va_{2,n}^{r,s}$	$va_{2,row}^{r,s}$
⋮	⋮	⋮		⋮	⋮	⋮
R_{n-1}	$va_{n-1,1}^{r,s}$	$va_{n-1,2}^{r,s}$	…	$va_{n-1,n-1}^{r,s}$	$va_{n-1,n}^{r,s}$	$va_{n-1,row}^{r,s}$
R_n	$va_{n,1}^{r,s}$	$va_{n,2}^{r,s}$	…	$va_{n,n-1}^{r,s}$	$va_{n,n}^{r,s}$	$va_{n,row}^{r,s}$
ROW	$va_{row,1}^{r,s}$	$va_{row,2}^{r,s}$	…	$va_{row,n-1}^{r,s}$	$va_{n,n}^{r,s}$	$va_{row,row}^{r,s}$

An Index of Regional Sectoral Economic Activity (cont.)

According to Table 1, a region's sectoral output is potentially associated with transactions involving economic agents located not only in the region, but also elsewhere

Define the sets of origins, *O*, and destinations, *D*, both comprising all domestic regions, *r*, add the rest of the world, *row.* Thus, we can compute total value added of sector *s* in region *r*,va^{rs}, as:

$$va^{rs} = \sum_{o \in O, d \in D} va_{o,d}^{r,s}$$

We also calculate region's *r* total value added, va^{r}, as:

$$va^{r} = \sum_{s} va^{rs}$$

An Index of Regional Sectoral Economic Activity (cont.)

In order to monitor sectoral regional economic activity, we would need to follow va^{rs} over time. This information, when available, is usually published with a delay and at a low frequency (annual).

To circumvent such informational constraint, we could track changes in trade flows for each regional origin-destination pair, and combine them with the information in Table 1 to calculate a trade-weighted index of regional economic activity.

Thus, if we can observe, in each period *t*, changes in values of flows from each origin *o*, to each destination *d*, $\Delta F_{t,o,d}$, a regional index of economic activity could be calculated as

An Index of Regional Sectoral Economic Activity (cont.)

Thus, if we can observe, in each period *t*, changes in values of flows from each origin *o*, to each destination *d*, $\Delta F_{t,o,d}$, a regional index of economic activity could be calculated as

$$EAI_t^{r,s} = \sum_{o \in O, d \in D} w_{o,d}^{r,s} \, \Delta F_{t,o,d}$$

where $EAI_t^{r,s}$ is the economic activity index for sector *s*, in region *r*, in time *t*, and the weights $w_{o,d}^{r,s}$ are calculated as

$$w_{o,d}^{r,s} = \frac{va_{o,d}^{r,s}}{\sum_{o \in O, d \in D} va_{o,d}^{r,s}} \text{ such that } \sum_{o \in O, d \in D} w_{o,d}^{r,s} = 1$$

Implementation

The implementation of the index depends on two pieces of information: first, we need to define an empirical strategy to estimate values in Table 1, so that we can define the weights, $w_{o,d}^{r,s}$; second, we have to collect timely information to estimate $\Delta F_{t,o,d}$.

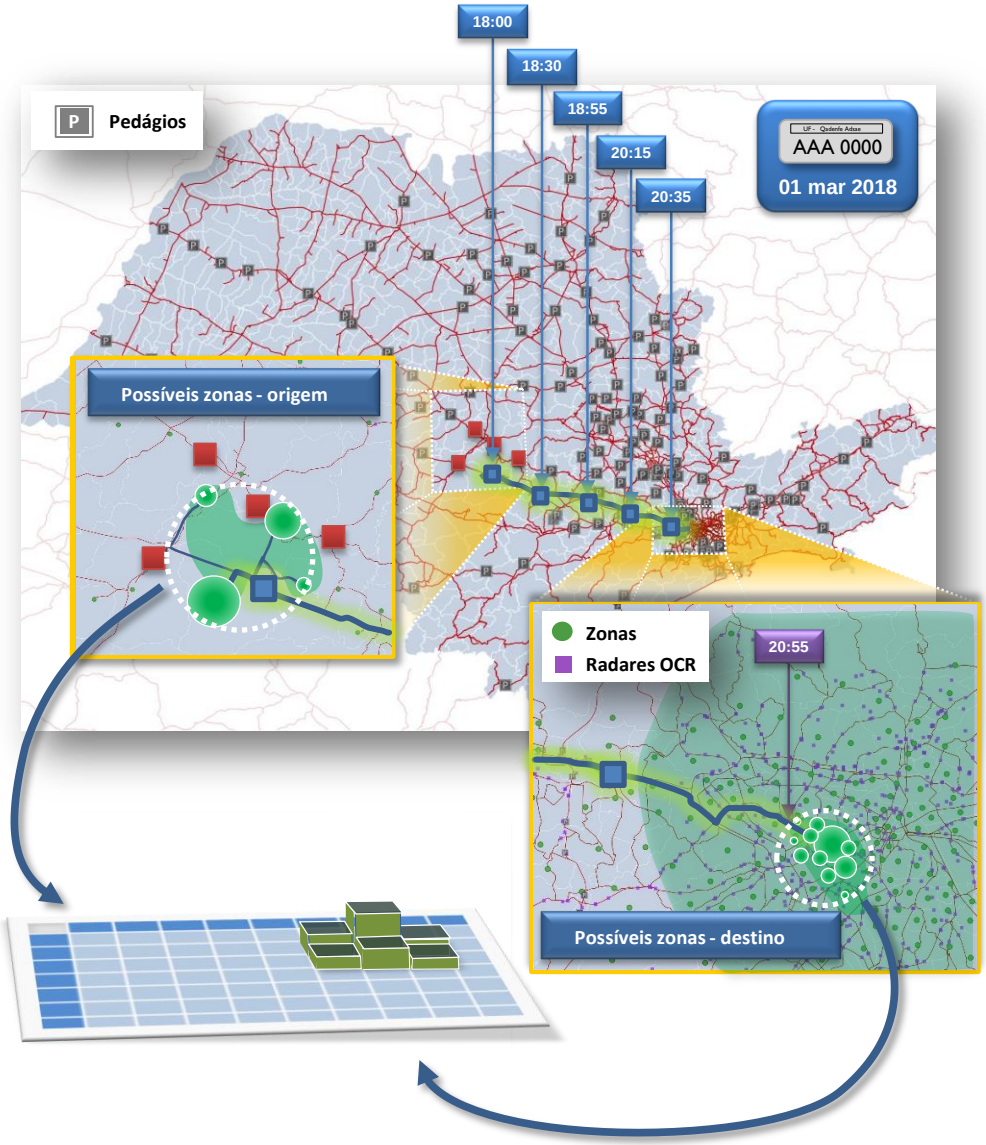
Measurement of domestic value added in trade flows

- Hypothetical extraction method

Traffic intensity indicators as a measure of change in trade volumes (341 toll stations and 4,870 smart cameras)

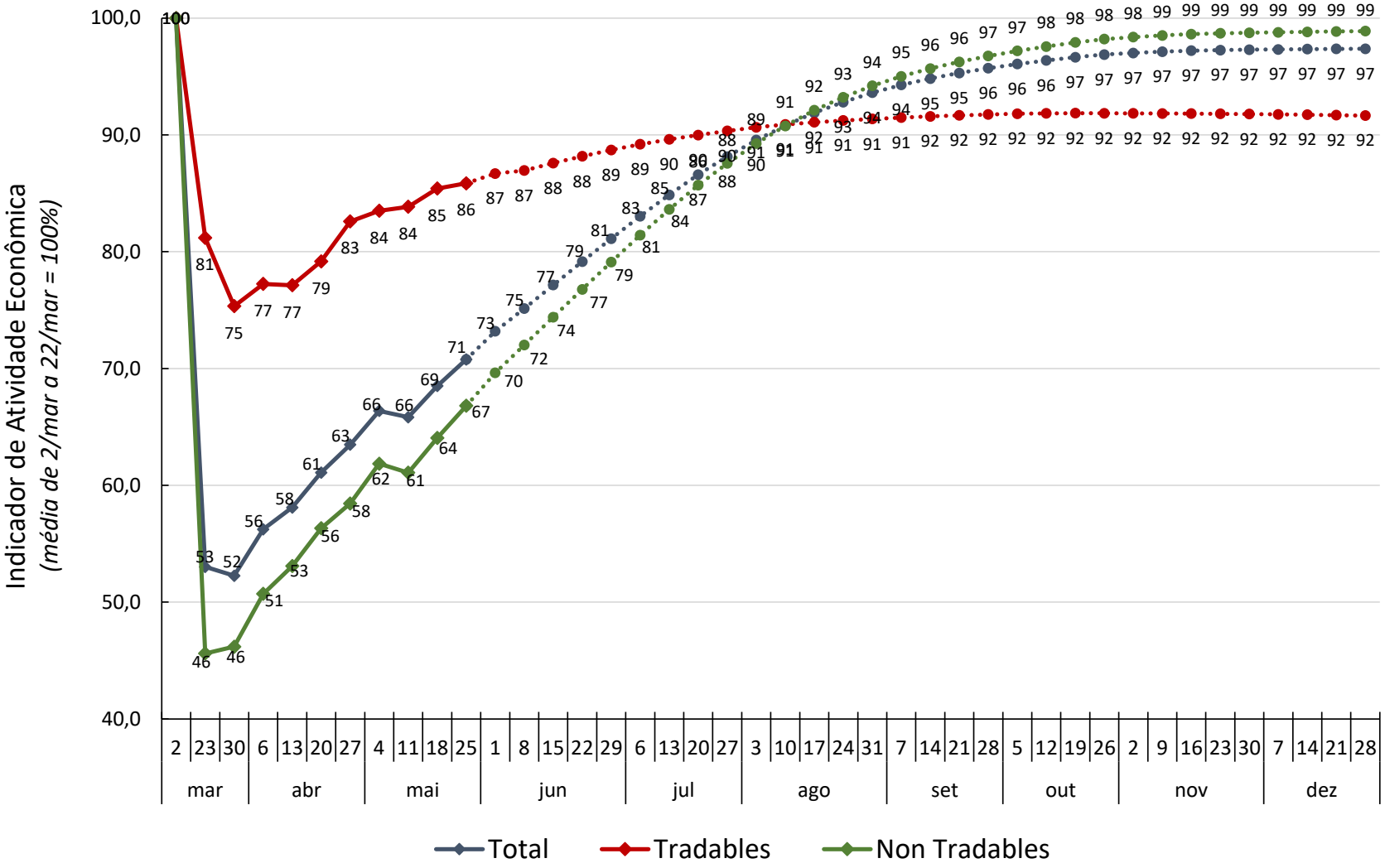
- Daily, OD pair, type of vehicle (trucks and cars)

Analysis of traffic flows



Economic Activity Indicator: State of São Paulo

Period: March 23 to June 07, 2020



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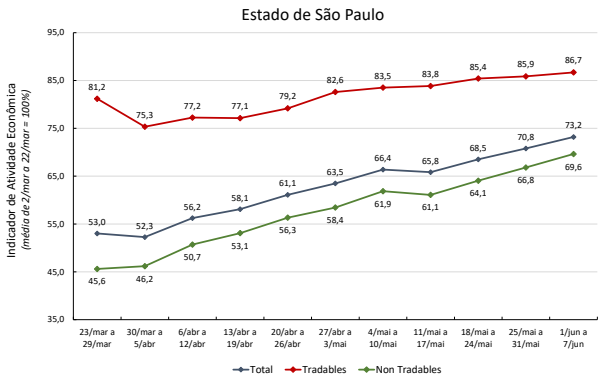

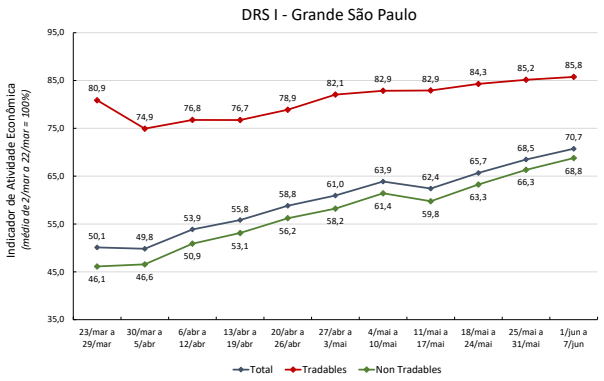

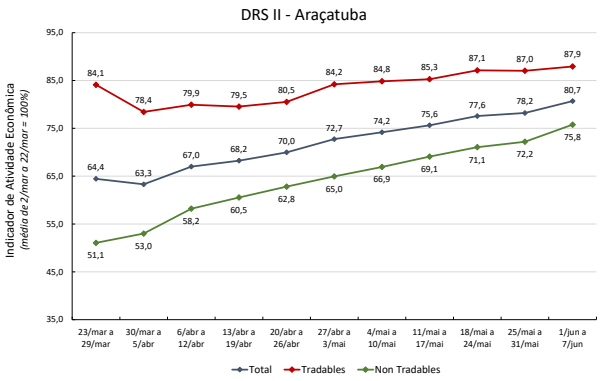

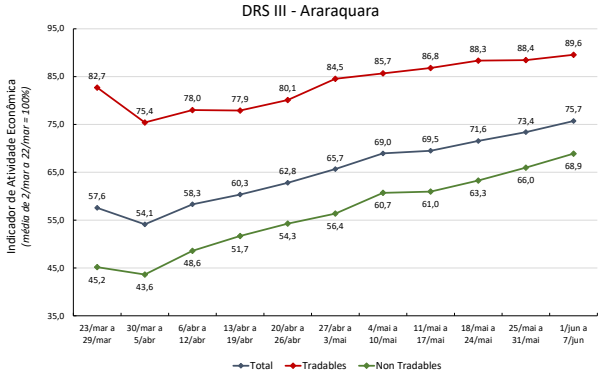

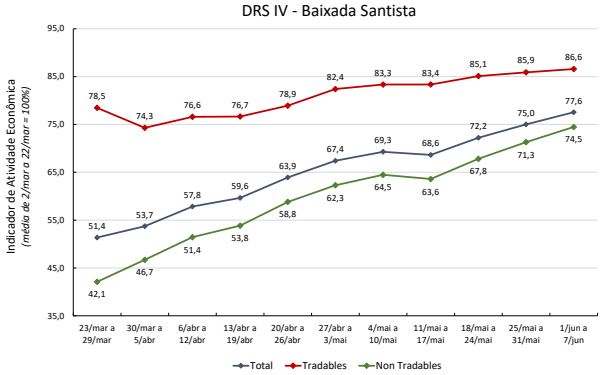

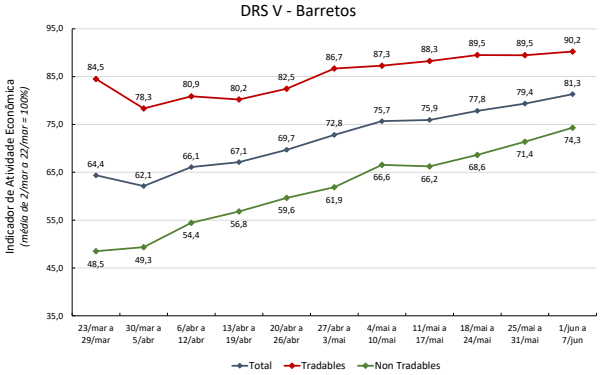

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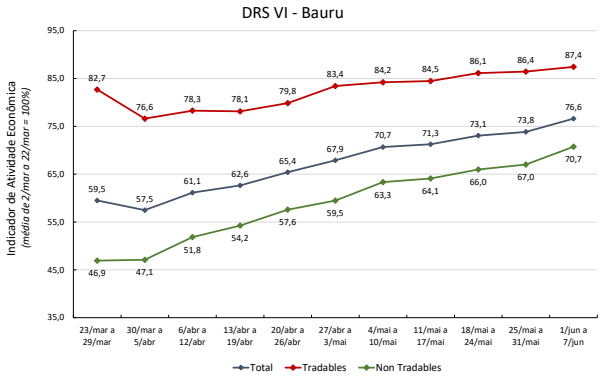

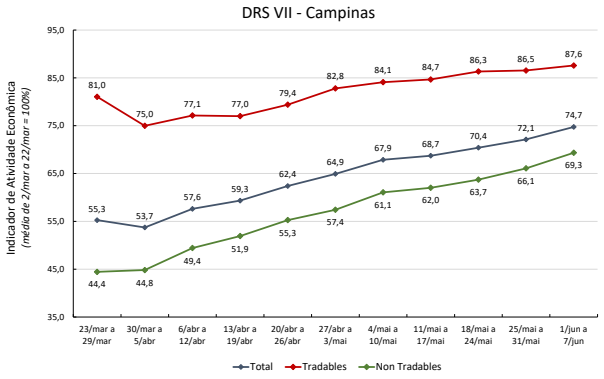

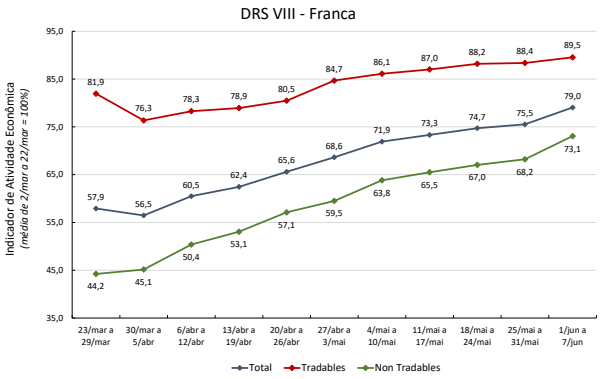

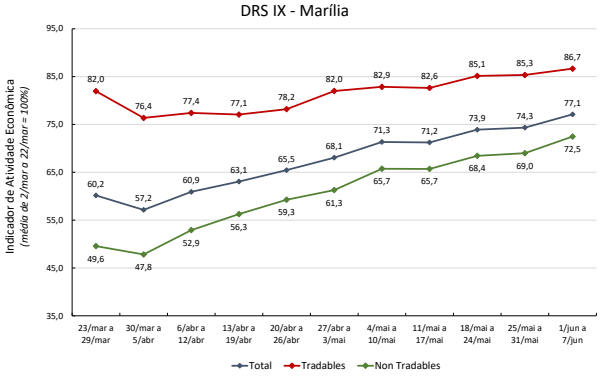

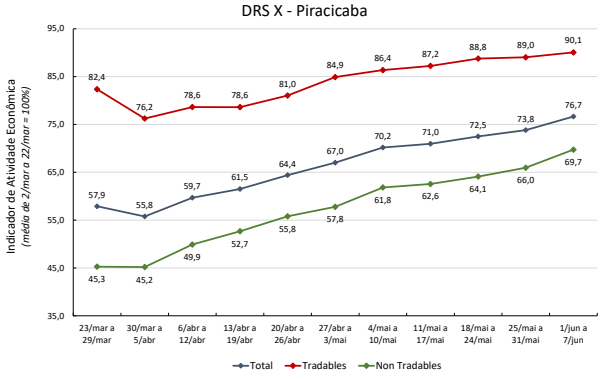

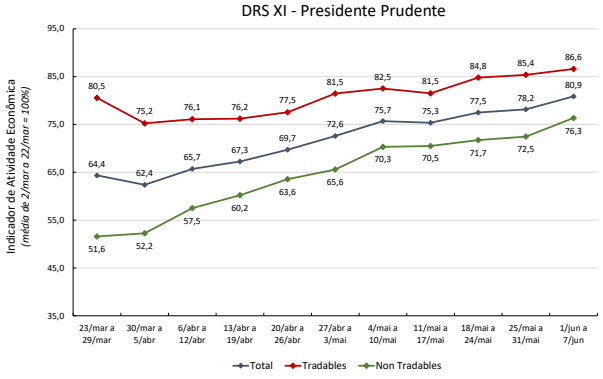

Economic Activity Indicator: State of São Paulo

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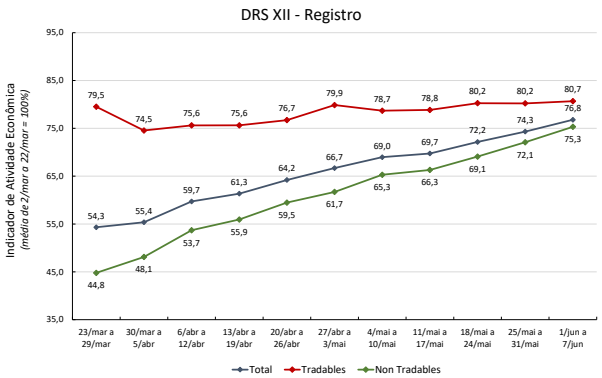
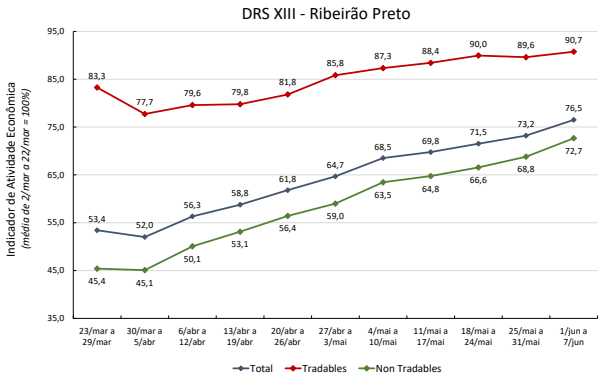
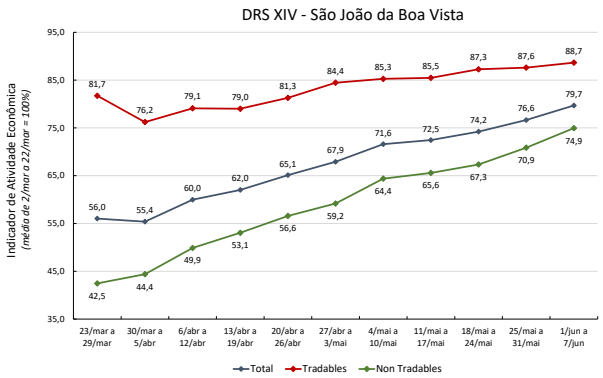
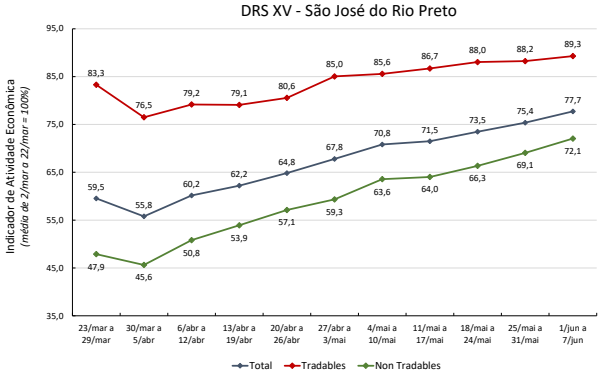
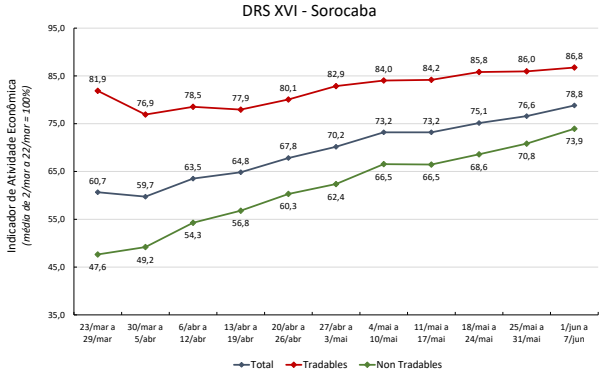
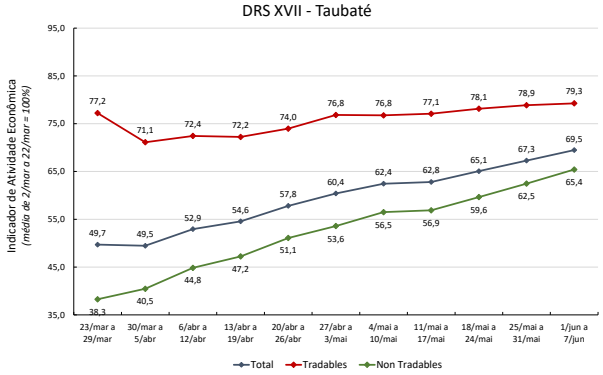






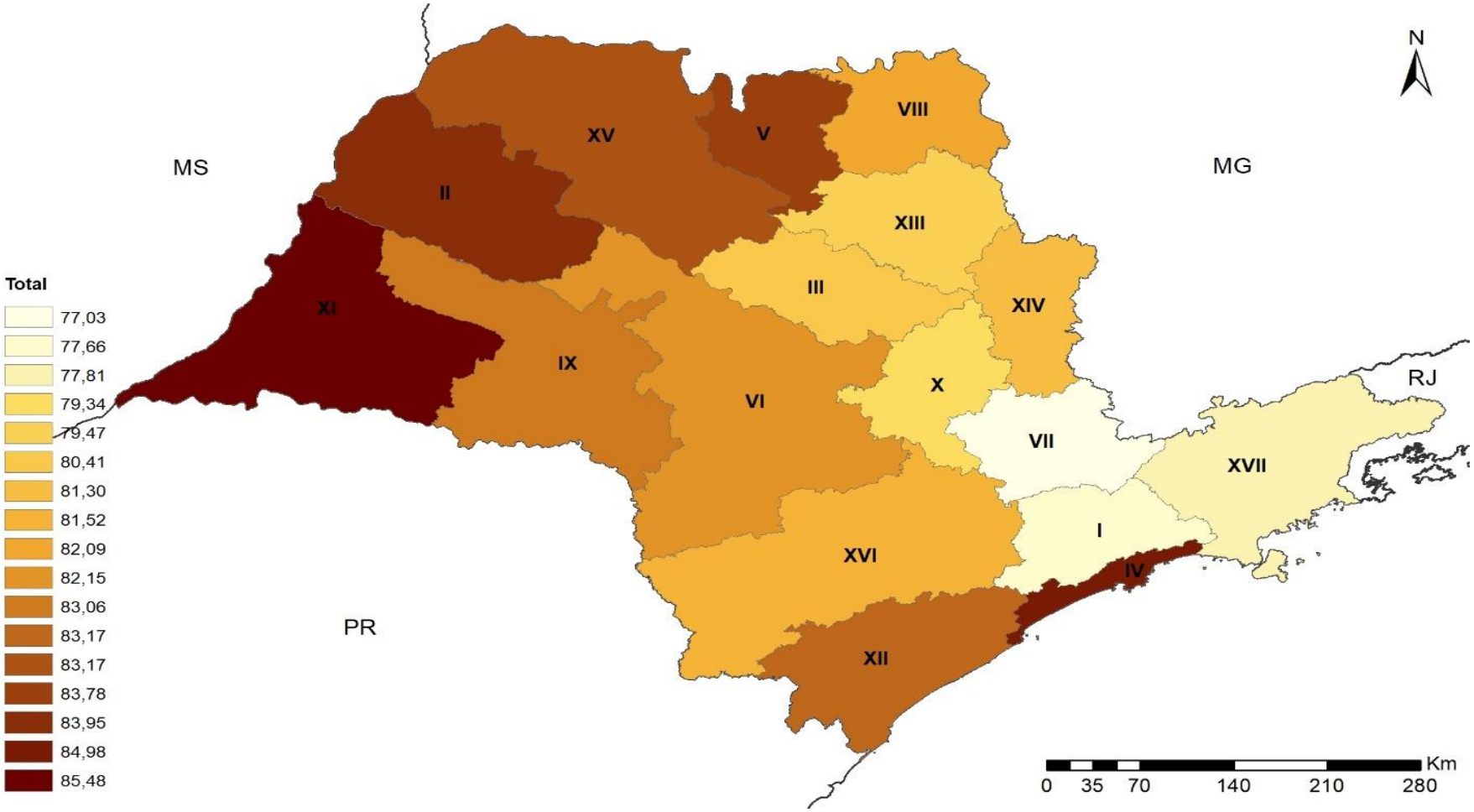






Economic Activity Indicator

July 11, 2020



Example: Is there a correlation between economic activity and the evolution of the pandemic?

Economic activity indicator (7-day moving average)

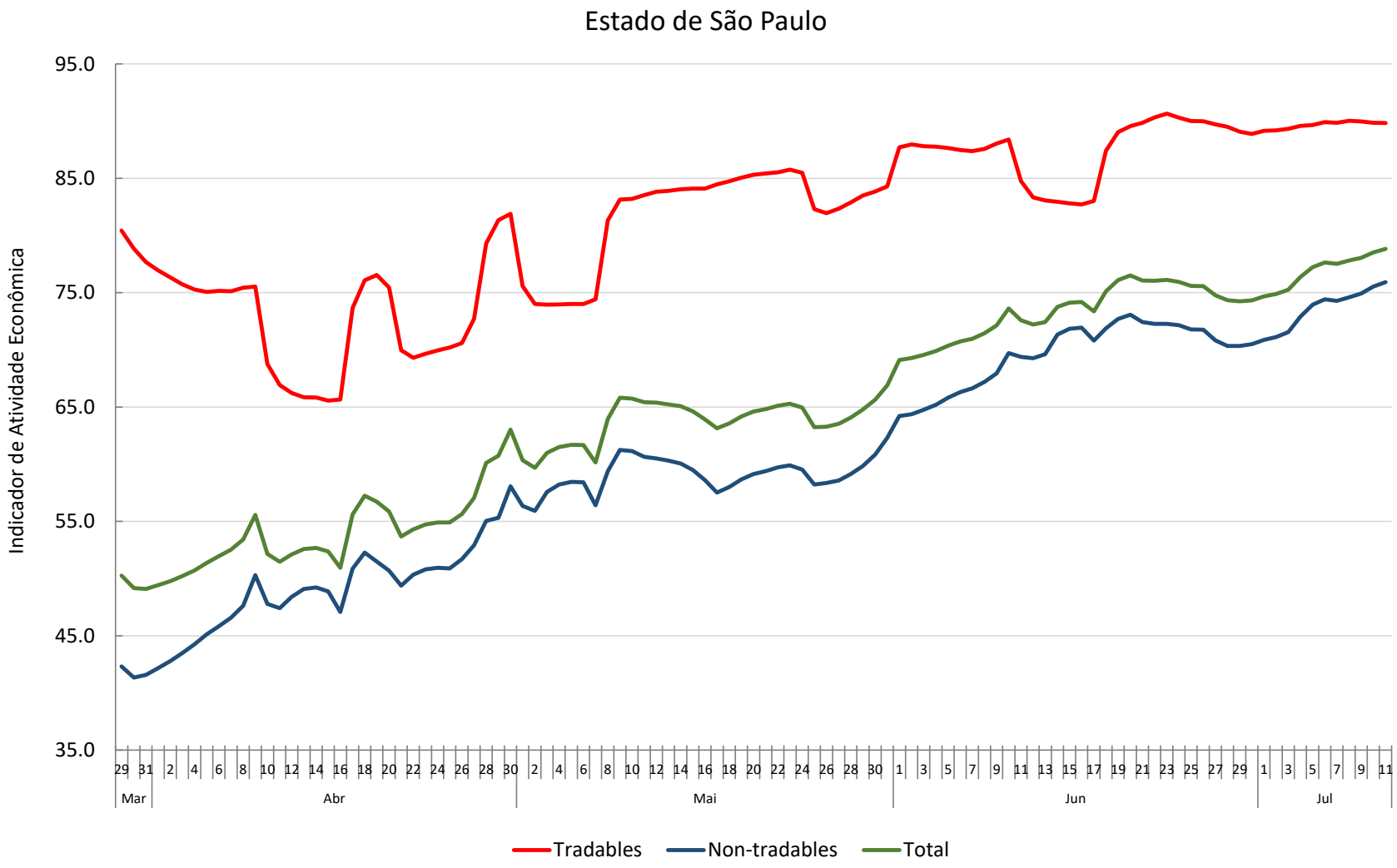
- 17 regions (DRS)
- Daily frequency: Mar-29 to Jun-18

Confirmed cases (7-day moving average)

- 17 regional (DRS)
- Daily frequency: Apr-21 to Jun-23

Economic Activity Indicator: State of São Paulo

Period: March 29 to July 11, 2020



Empirical strategy

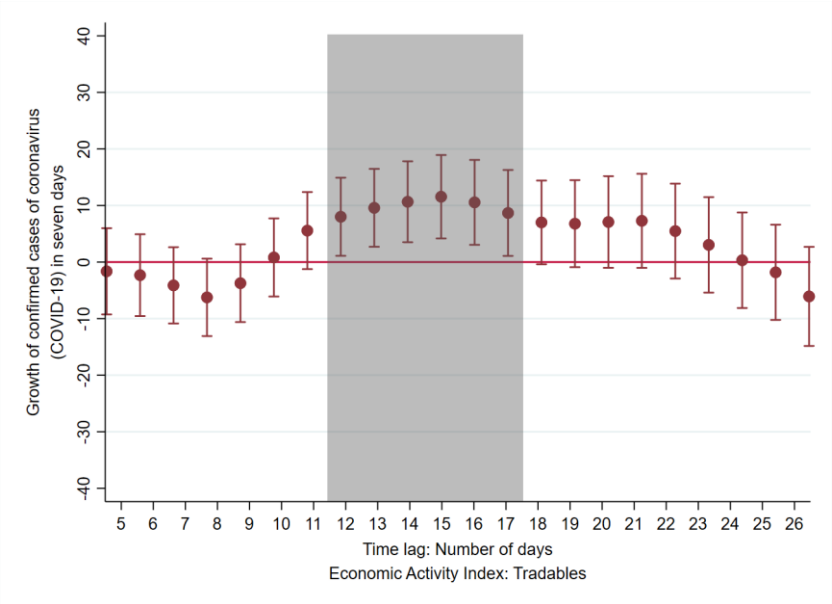
Let C_{rt} denote the number of reported cases of coronavirus (COVID-19) in region r in period t.

$$\Delta C_{rt} = \beta_j EAI_{rt-j} + \eta_r + v_{rt}$$

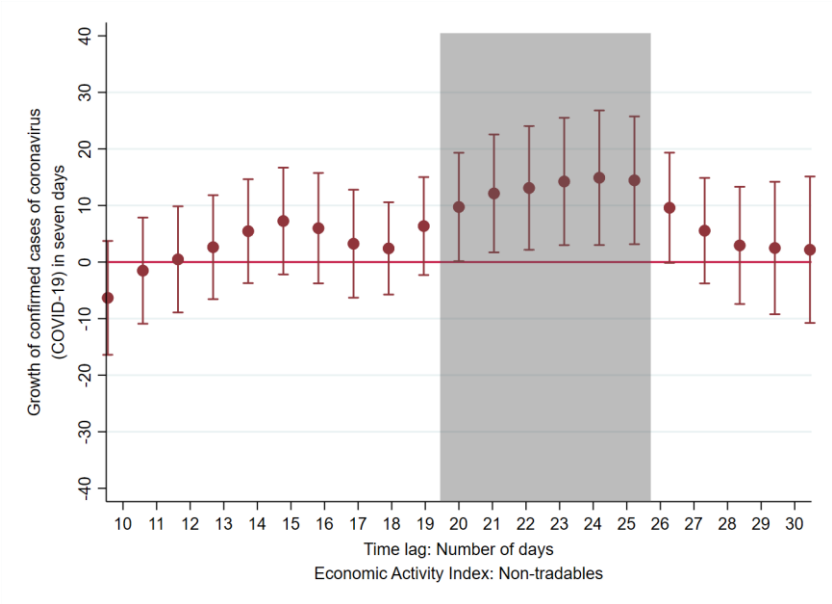
where Δ is the lag operator defined at the day level, hence, the dependent variable is the growth of confirmed cases of coronavirus in seven days, so that $\Delta C_{rt} = C_{rt} - C_{rt-7}$. EAI is the Economic Activity Index (Tradable and Non-tradable). The parameter β_j measures the effect of lagged explanatory variable with j lags on the growth in average C_{rt} between t and $t-7$. η_r is a set of region dummies that captures the influence of unobserved and time invariant attributes for each region, which absorb geographically restricted shocks affecting the outcomes of interest; v_{rt} is the idiosyncratic error term.

Growth of confirmed cases of coronavirus in seven days and temporal lag of Economic Activity Index

Tradable



Non-tradable



Note: Each marker represents the coefficient value and the robust standard errors of the Economic Activity Index (Tradable and Non-tradable) in an individual regress for each lag. Number of observations total on panel: 1,003 (59 days and 17 regions). The regresses controlling for regional fixed effects.

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