NEREUS
Núcleo de Economia Regional e Urbana da Universidade de São Paulo
The University of São Paulo Regional and Urban Economics Lab

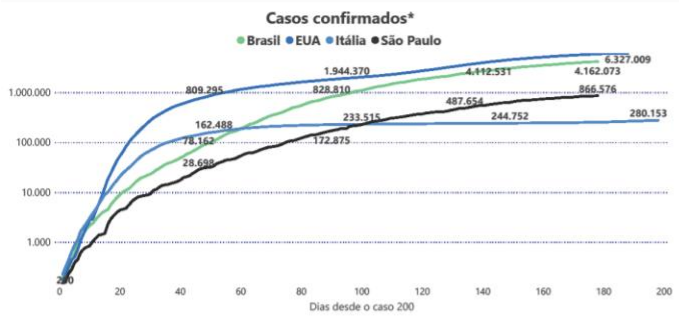
POLICY CENTER FOR THE NEW SOUTH
THINK • STIMULATE • BRIDGE

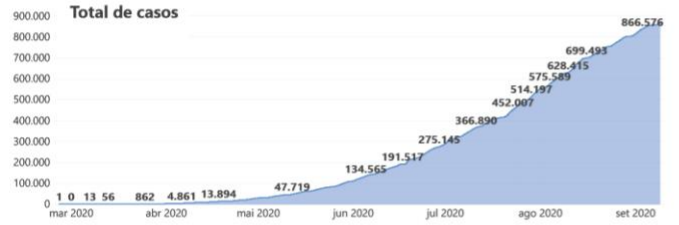
COVID-19 Crisis Monitor: Assessing the Effectiveness of Exit Strategies in the State of São Paulo, Brazil

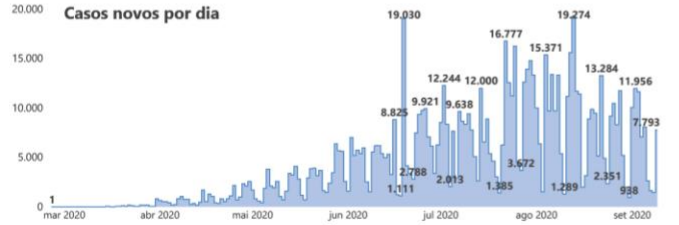
27th APDR Congress
September 10, 2020

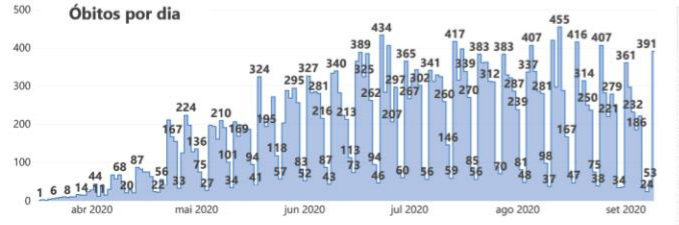
Eduardo A. Haddad Renato Vieira Inácio Araújo Silvio Ichihara
Fernando Perobelli Karina Bugarin

COVID-19 Daily Bulletin: State of São Paulo (09/10/2020)





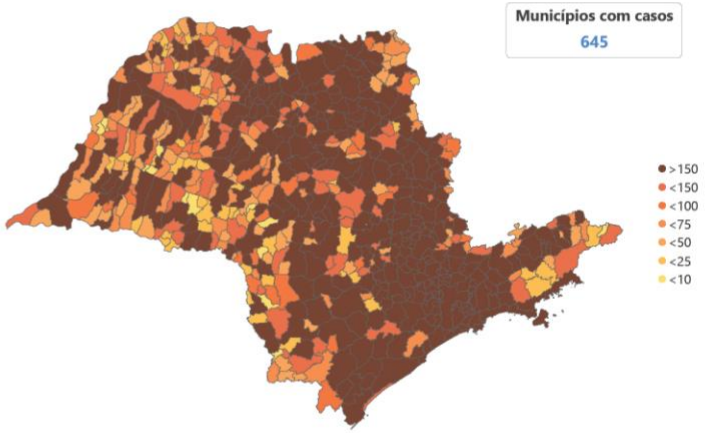




São Paulo	Casos	Variação diária	Óbitos	Variação diária	Letalidade
	866.576	1%	31.821	1%	3,7%

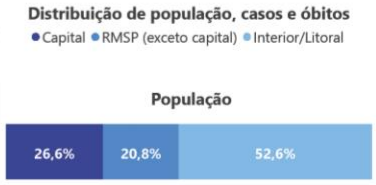
Brasil**	Casos	Variação diária	Óbitos	Variação diária	Letalidade
	4.162.073	0%	127.464	0%	3,1%

Mundo**	Casos	Variação diária	Óbitos	Variação diária	Letalidade
	27.570.742	1%	897.383	1%	3,3%



Casos por município

Cidade	Total de casos	Total de óbitos	Letalidade
São Paulo	270.000	11.856	4,4%
Campinas	28.742	1.098	3,8%
São Bernardo do Campo	23.079	824	3,6%
Santos	19.988	591	3,0%
Ribeirão Preto	18.969	622	3,3%
São José do Rio Preto	18.527	493	2,7%
Guarulhos	18.015	1.305	7,2%
Santo André	15.314	561	3,7%
São José dos Campos	14.349	375	2,6%
Sorocaba	14.019	362	2,6%



Understanding the economic impacts of the pandemic

1. Sectoral and regional interdependence (*"economic contagion"*)

How to measure?

Ex-ante assessment

Partial hypothetical extraction approach to input-output systems

2. Heterogeneous impacts (*informal labor market / public vs. private / occupations / regions / sectors*)

Message

There are workers and firms that are economically more vulnerable than others (sectors and regions)

Design of mitigation policies must take into account heterogeneity of impacts!

Sectoral Economic Vulnerability to Lockdown Measures in São Paulo

Rank	*Sector*	*Index*	*Vulnerability*
1	Rental and leasing activities	1.000	High
2	Others administrative and support service activities	0.993	High
3	Publishing activities	0.988	High
4	Arts, entertainment and recreation	0.980	High
5	Accommodation	0.979	High
6	Real estate activities	0.979	High
7	Activities of membership organizations; Other personal service activities	0.977	High
8	Activities of households as employers	0.974	High
9	Air transport	0.943	High
10	Construction	0.890	Medium-High
11	Public education	0.887	Medium-High
12	Land transport	0.882	Medium-High
13	Mining of coal and lignite	0.870	Medium-High
14	Printing and reproduction of recorded media	0.865	Medium-High
15	Warehousing and support activities for transportation	0.863	Medium-High
16	Manufacture of other non-metallic mineral products	0.842	Medium-High
17	Other professional, scientific and technical activities	0.841	Medium-High
18	Motion picture, video and television program production	0.840	Medium-High
19	Legal and accounting activities; Activities of head offices	0.820	Medium-High
20	Water transport	0.809	Medium-High
21	Manufacture of coke and refined petroleum products	0.807	Medium-High
22	Wholesale and retail trade	0.806	Medium-High
23	Manufacture of chemicals; plastics and synthetic rubber in primary forms	0.787	Medium-High
24	Manufacture of fertilizers and pesticides and other agrochemical products	0.787	Medium-High
25	Manufacture of wood	0.778	Medium-High
26	Repair and installation of machinery and equipment	0.761	Medium-High
27	Manufacture of rubber and plastics products	0.757	Medium-High
28	Mining of iron ores	0.756	Medium-High
29	Food and beverage service activities	0.754	Medium-High
30	Architectural and engineering activities; Scientific research and development	0.746	Medium-High
31	Manufacture of fabricated metal products, except machinery and equipment	0.727	Medium-High
32	Manufacture of basic iron and steel	0.714	Medium-High
33	Manufacture of textiles	0.678	Medium
34	Manufacture of parts and accessories for motor vehicles	0.677	Medium
35	Manufacture of paper and paper products	0.654	Medium

Regional Economic Vulnerability to Lockdown Measures: Brazilian States

Rank	*Região*	*Índice*	*Vulnerabilidade*
1	Ceará	1,000	Alta
2	Amazonas	0,986	Alta
3	Pernambuco	0,977	Alta
4	Santa Catarina	0,974	Alta
5	Maranhão	0,924	Alta
6	Rio de Janeiro	0,895	Média-Alta
7	Paraíba	0,889	Média-Alta
8	São Paulo	0,847	Média-Alta
9	Piauí	0,845	Média-Alta
10	Bahia	0,839	Média-Alta
11	Pará	0,825	Média-Alta
12	Espírito Santo	0,807	Média-Alta
13	Rio Grande do Sul	0,791	Média-Alta
14	Paraná	0,771	Média-Alta
15	Minas Gerais	0,735	Média-Alta
16	Sergipe	0,724	Média-Alta
17	Acre	0,689	Média
18	Alagoas	0,654	Média
19	Mato Grosso do Sul	0,644	Média
20	Mato Grosso	0,601	Média
21	Rio Grande do Norte	0,531	Média
22	Amapá	0,507	Média
23	Goiás	0,473	Média-Baixa
24	Rondônia	0,448	Média-Baixa
25	Tocantins	0,416	Média-Baixa
26	Roraima	0,106	Baixa
27	Distrito Federal	0,000	Baixa

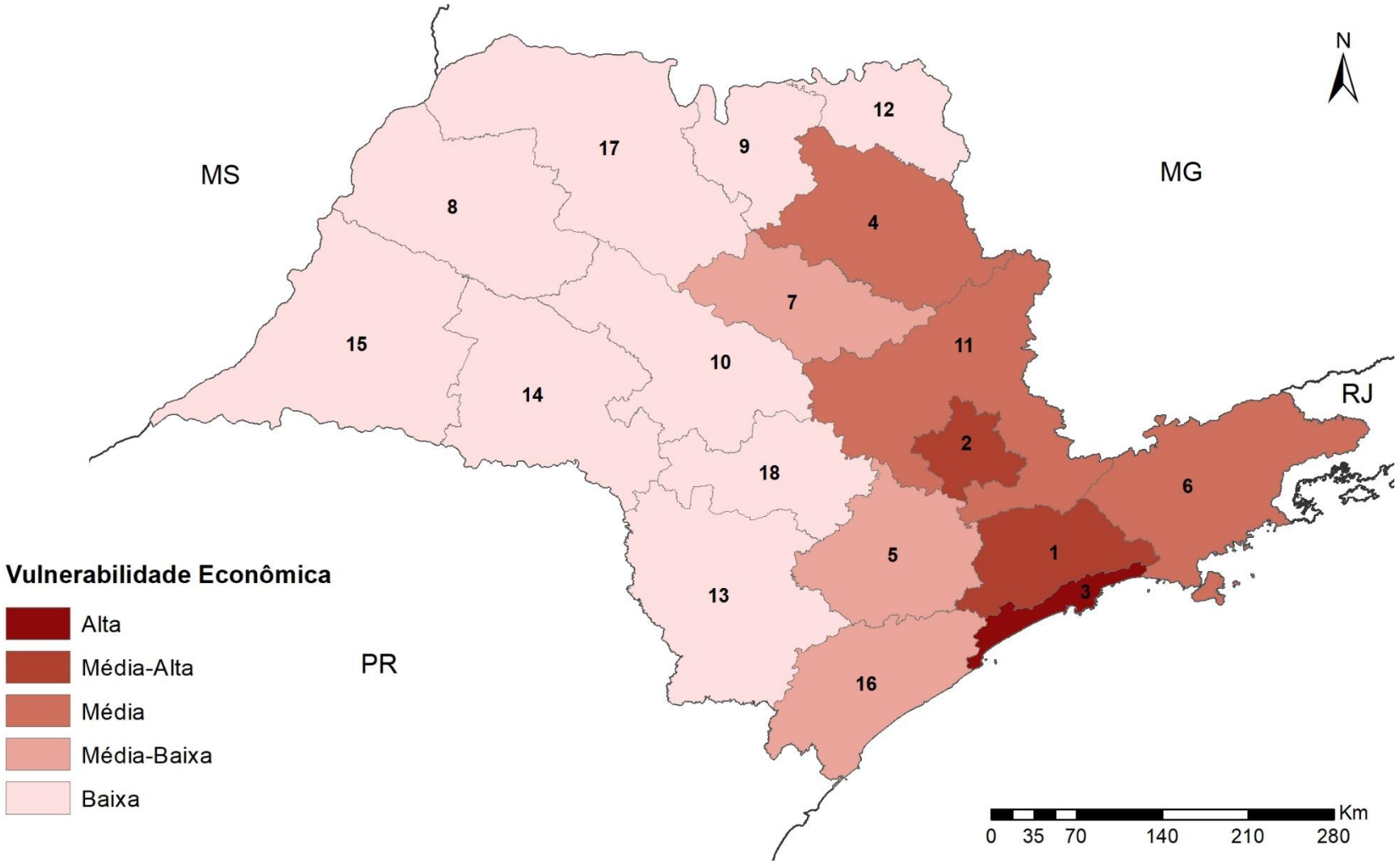
Determinants of regional economic vulnerability

Variável dependente: Índice de Vulnerabilidade Econômica (IVE)

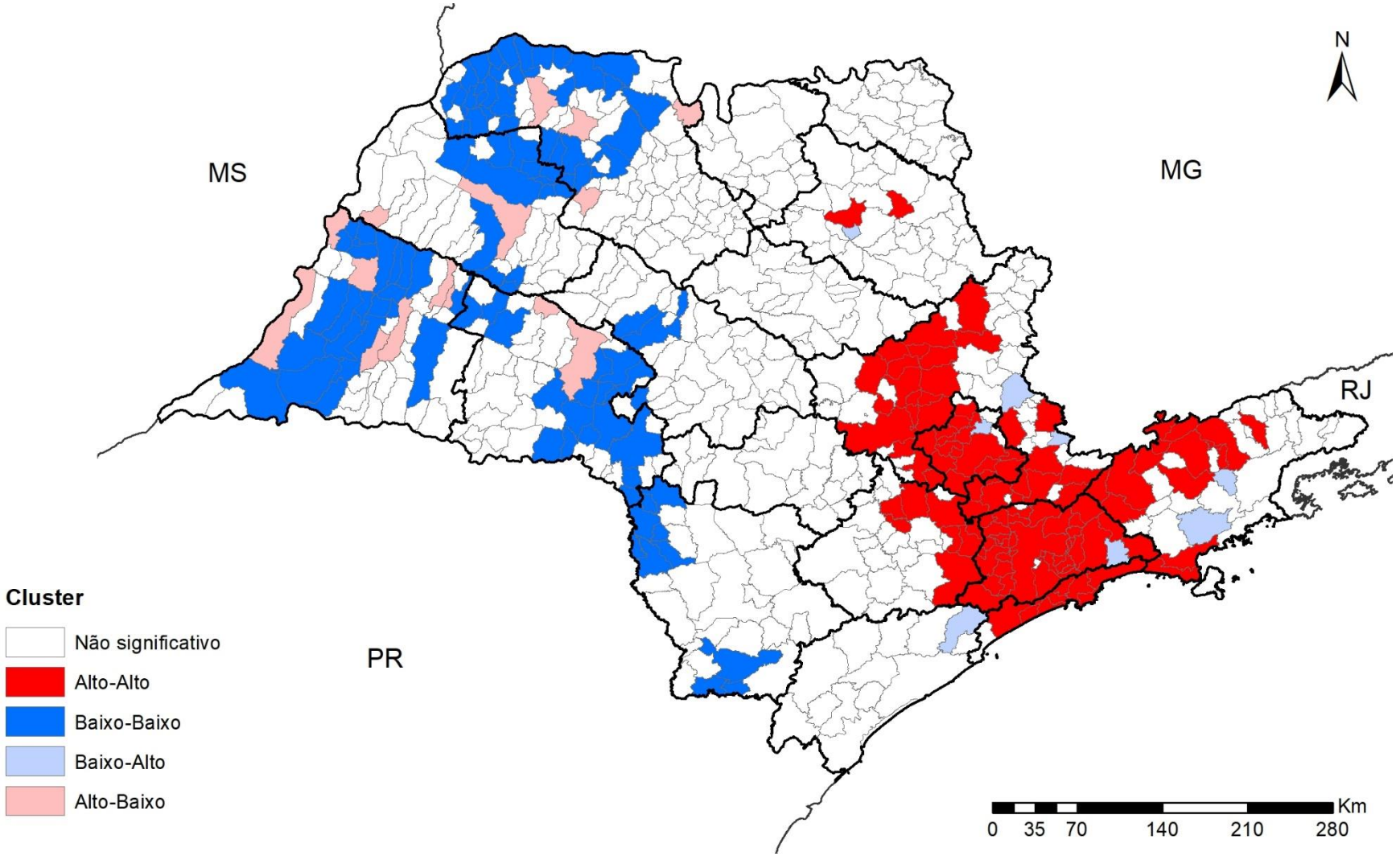
Variável	*Modelo de Defasagem Espacial*	*Impacto Médio*		
		Efeito Direto	*Efeito Indireto*	*Efeito Total*
W_Vulnerabilidade Econômica	0,146**			
	(0,062)			
Participação da Adm. Pública no PIB	-2,774***	-2,791***	-0,369**	-3,160***
	(0,304)	(0,301)	(0,169)	(0,346)
Informalidade no Mercado de Trabalho	0,957***	0,963***	0,127**	1,090***
	(0,168)	(0,168)	(0,065)	(0,204)
Índice de Isolamento Social	4,196***	4,223***	0,558**	4,782***
	(0,706)	(0,707)	(0,268)	(0,814)
Constante	-1,226***			
	(0,308)			
Obs.	27			
R2	0,845			

OBS.: A variável "W_ Vulnerabilidade Econômica" é a defasagem espacial do Índice de Vulnerabilidade Econômica usando a matriz de pesos espaciais do tipo distância inversa. Erro-padrão entre parênteses. Nível de significância estatística: *** 1%; ** 5%, * 10%.

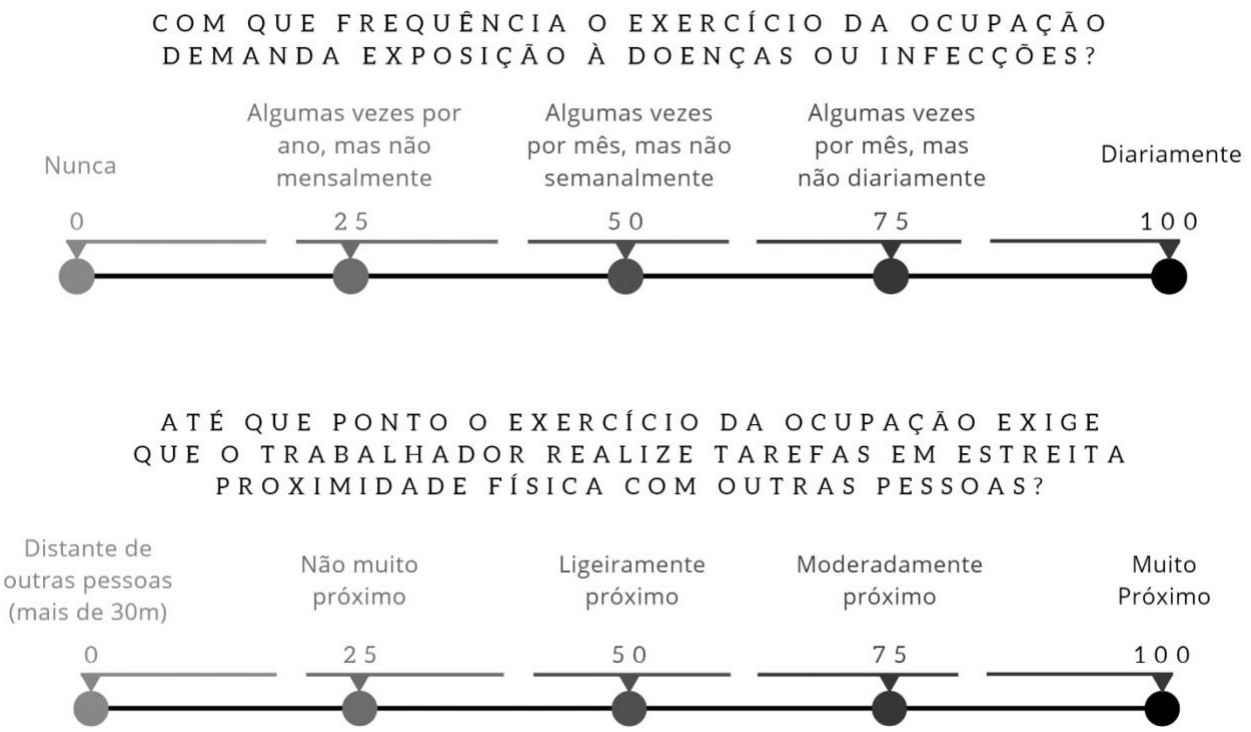
Regional economic vulnerability (São Paulo)



Map of municipal economic vulnerability (*Cluster map*)



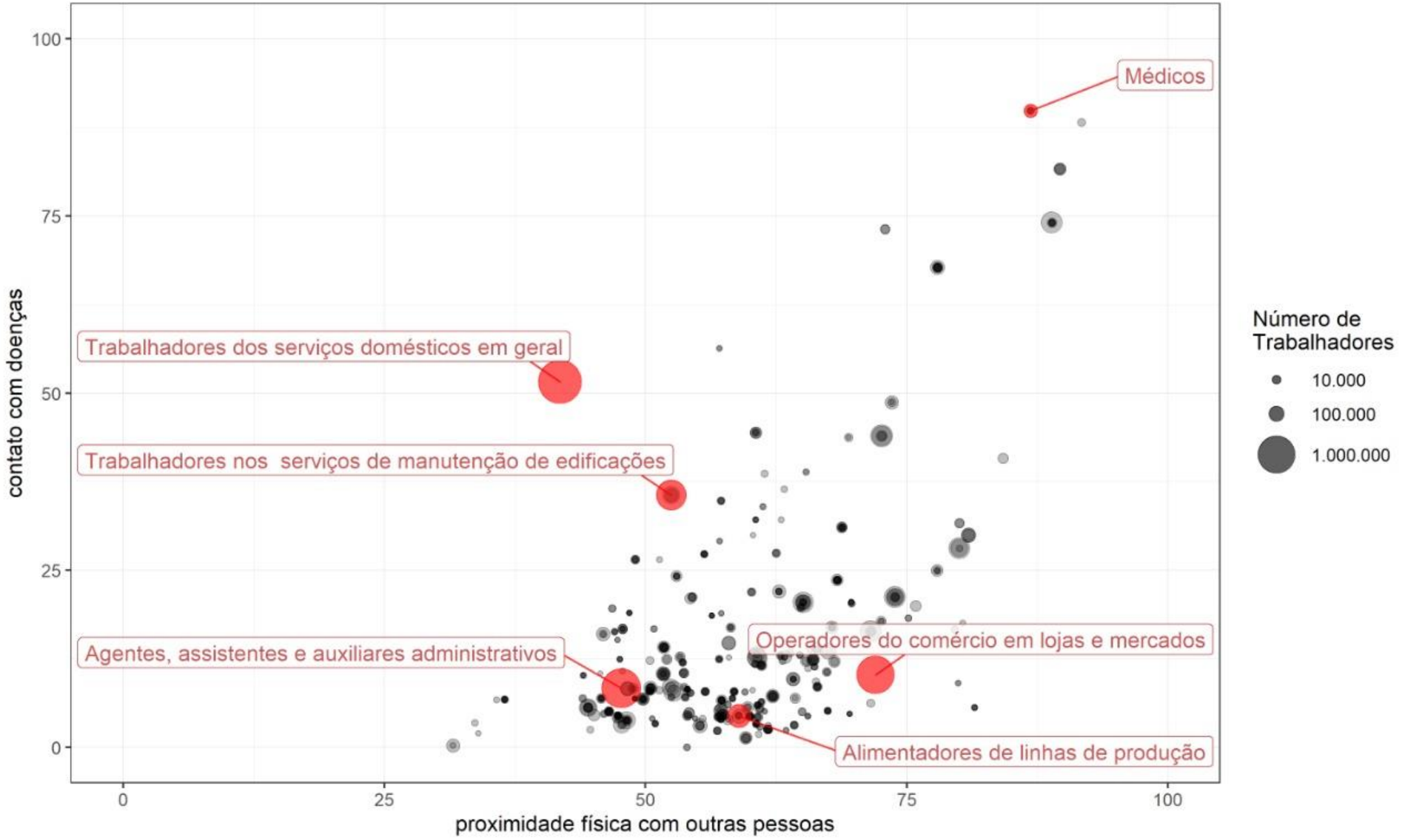
Occupational risk (622 occupations –CBO)



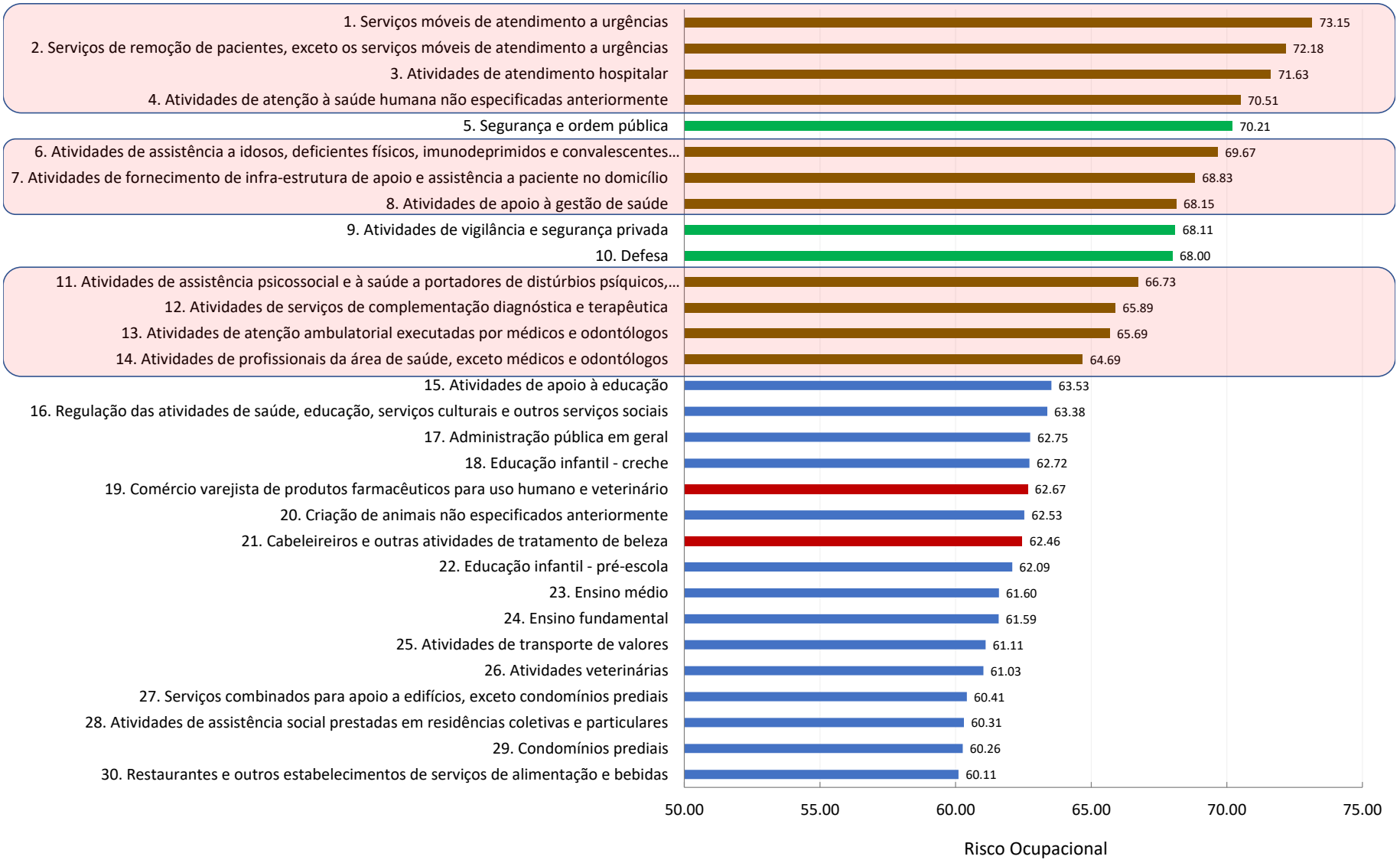
Terceira variável: o quanto cada ocupação exige contato com outras pessoas (de nenhum contato até contato constante)

Fonte: Lima et al. (2020)

Risk by occupation



Occupational risk by sector (CNAE – 665)



The importance of planning the economic recovery

1. *Decisions always aligned and subordinate to health recommendations*
2. *Decisions based on data and scientific evidence*

Pillars of effective exit strategies:

- **Gradualism**, taking into consideration the "phasing" scheme and regional heterogeneity
- **Transparency**, using a set of objective indicators easily understandable by society
- **Dynamism**, timely monitoring the evolution of indicators
- **Social contract**, following agreed protocols!!!
- Relevance of **testing**

“São Paulo Plan”: when, where and what defined by the Health Committee

SÃO PAULO
GOVERNO DO ESTADO

PLANO SÃO PAULO

O plano tem como fatores preponderantes a capacidade de atendimento de saúde à população e a evolução da epidemia, compatibilizando a visão econômica por meio da identificação de setores com maior nível de criticidade econômica, sujeitos a protocolos rígidos para garantir que a modulação evite a aceleração da contaminação

Pilares

Fases por nível de risco 	**Condições claras e mensuráveis de saúde** para avaliar o nível de risco e orientar o momento de abertura: – Evolução da epidemia, a partir de 3 indicadores – Capacidade hospitalar instalada, a partir de 2 indicadores Processo sistemático para **reavaliação e reclassificação dos níveis de risco**	**Quando** pode começar a modulação?
Regiões 	O **tratamento regional** na modulação de ações se deve a heterogeneidade da epidemia, das características populacionais e da infraestrutura hospitalar das diversas regiões do Estado	**Onde** pode haver modulação?
Setores 	A **análise setorial** foi realizada com base em fatores de criticidade de emprego e vulnerabilidade econômica, indicando a necessidade de modulação em setores particularmente afetados pela epidemia	**O que** pode ser modulado?
Protocolos 	Definição de **protocolos** com medidas específicas **para cada setor**, garantindo que a modulação de cada Fase evite a aceleração da contaminação	**Como** deve ser feita a modulação?
Testagem e monitoramento 	Protocolo de testagem, rastreamento e isolamento de novos casos, fundamental para garantir o sucesso no controle da epidemia	**Como controlar** a modulação?

Copyright ©2020, Oliver Wyman

"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

How do we estimate the economic effects of the São Paulo Plan?

Regional monitoring (DRS)

Health indicators (contemplated in the Plan)

- Health system capacity
- Evolution of the pandemic

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)

Monitoring regional economic activity

Need to complement tax monitoring with a broader indicator of regional economic activity in "real time"

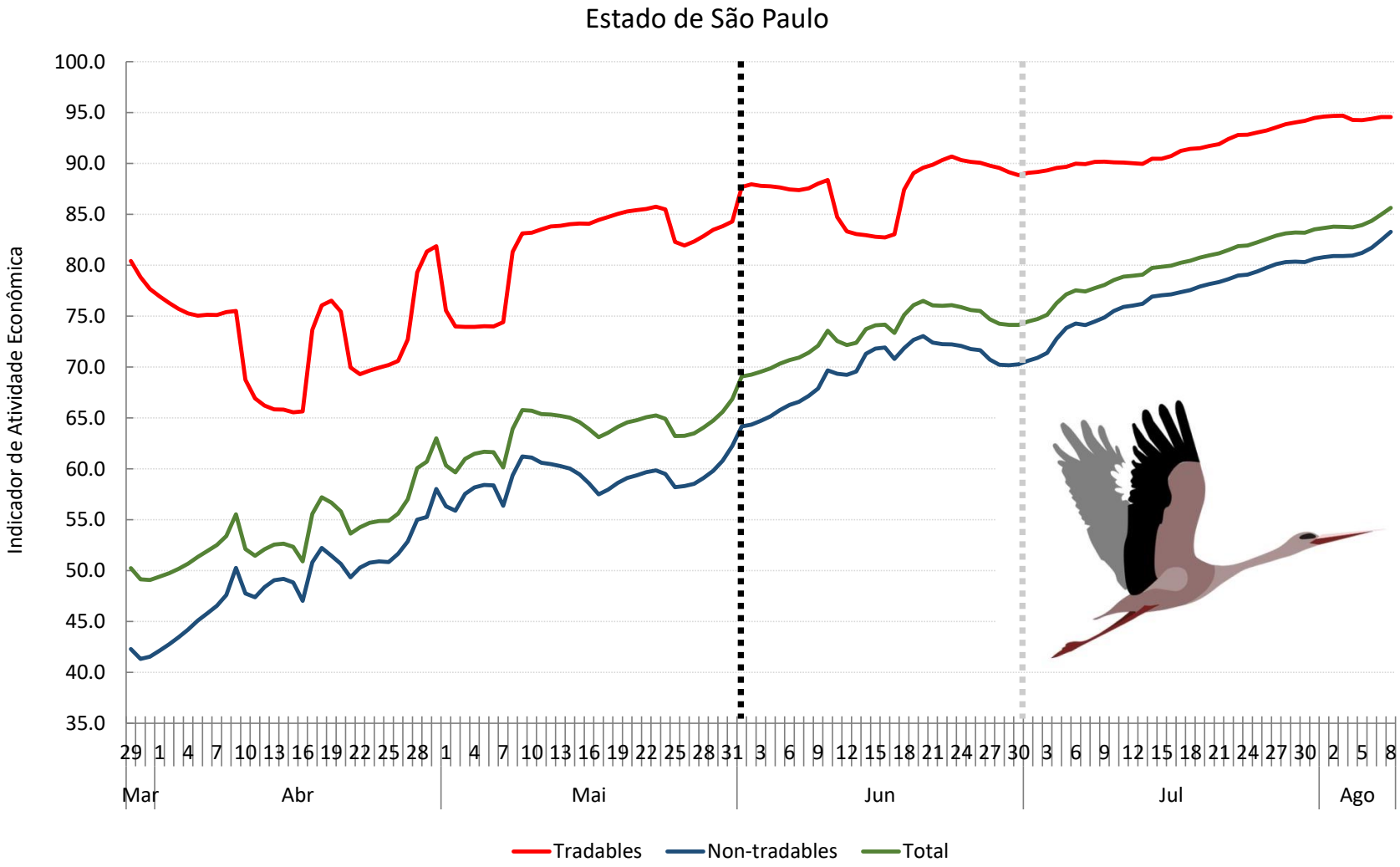
- Same frequency and regionalization of health indicators
- Combine input-output analysis and traffic data

We developed a daily *Index of Regional Sectoral Economic Activity* (t-3) – **EAI**

- 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)

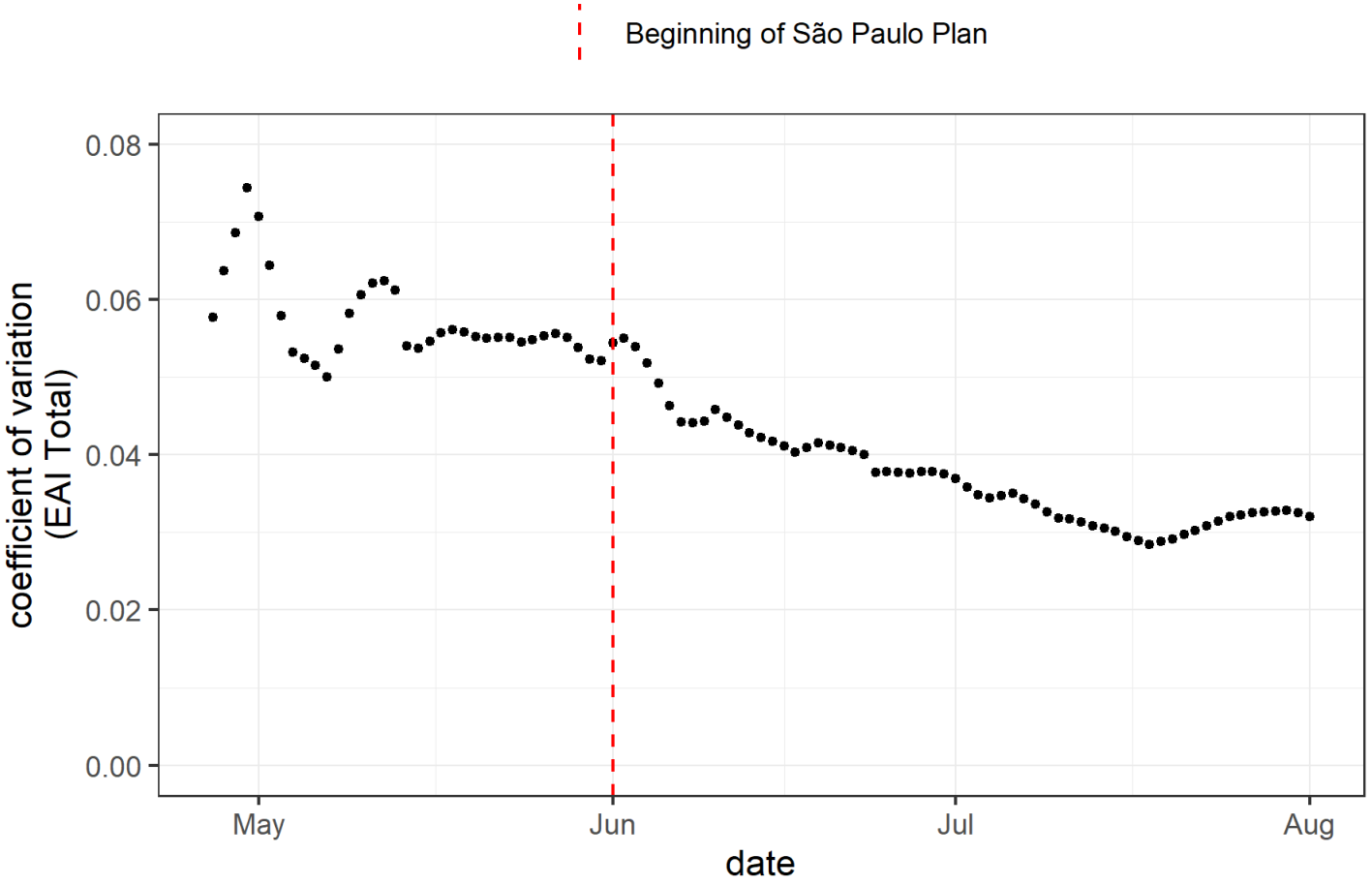
Traffic mobility → Economic Activity → Future Sanitary Effects

Defining clear rules improved the predictability of economic agents

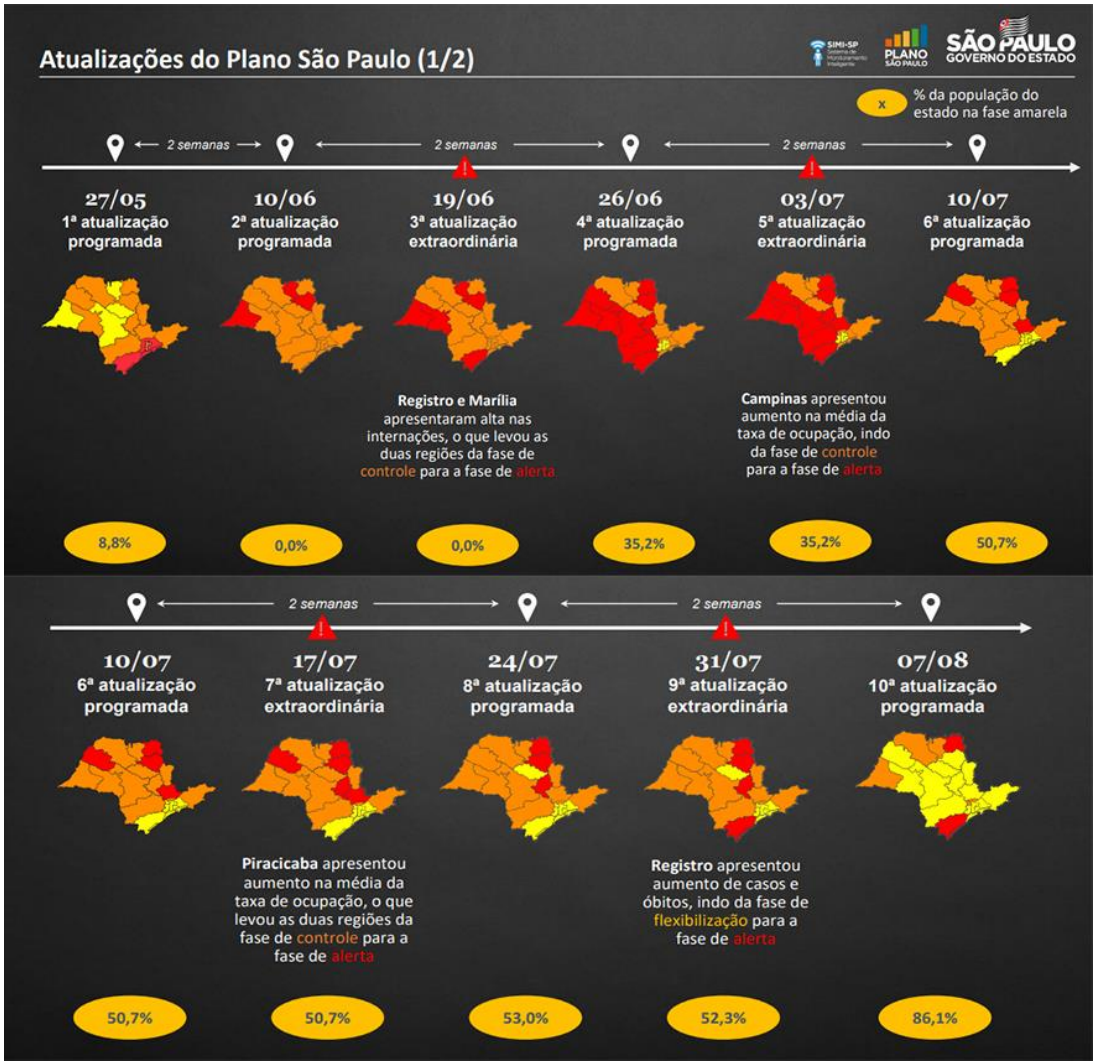


São Paulo Plan helped anchoring expectations

Coefficient of Variation of Total EAI – (April, 21 – August 1, 2020)

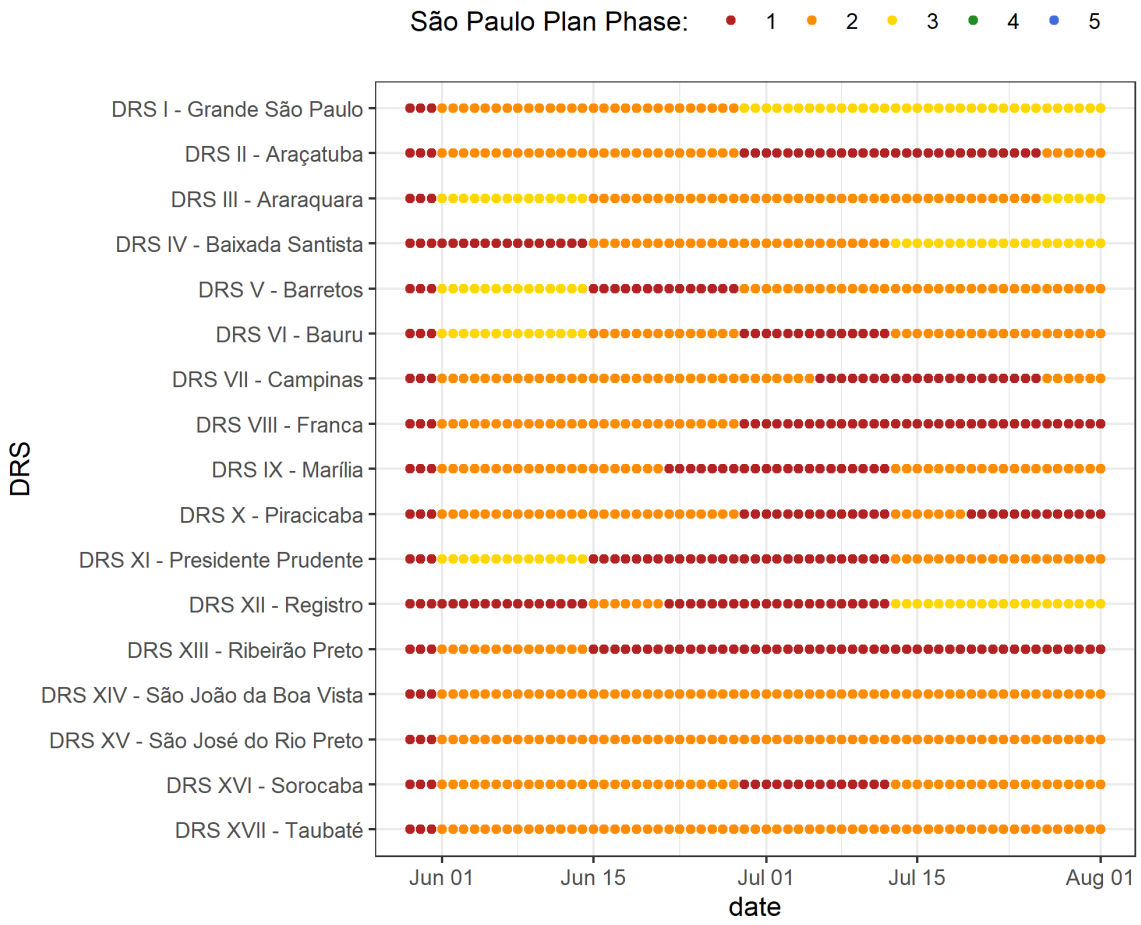


Changes of Phases in each DRS in the São Paulo Plan

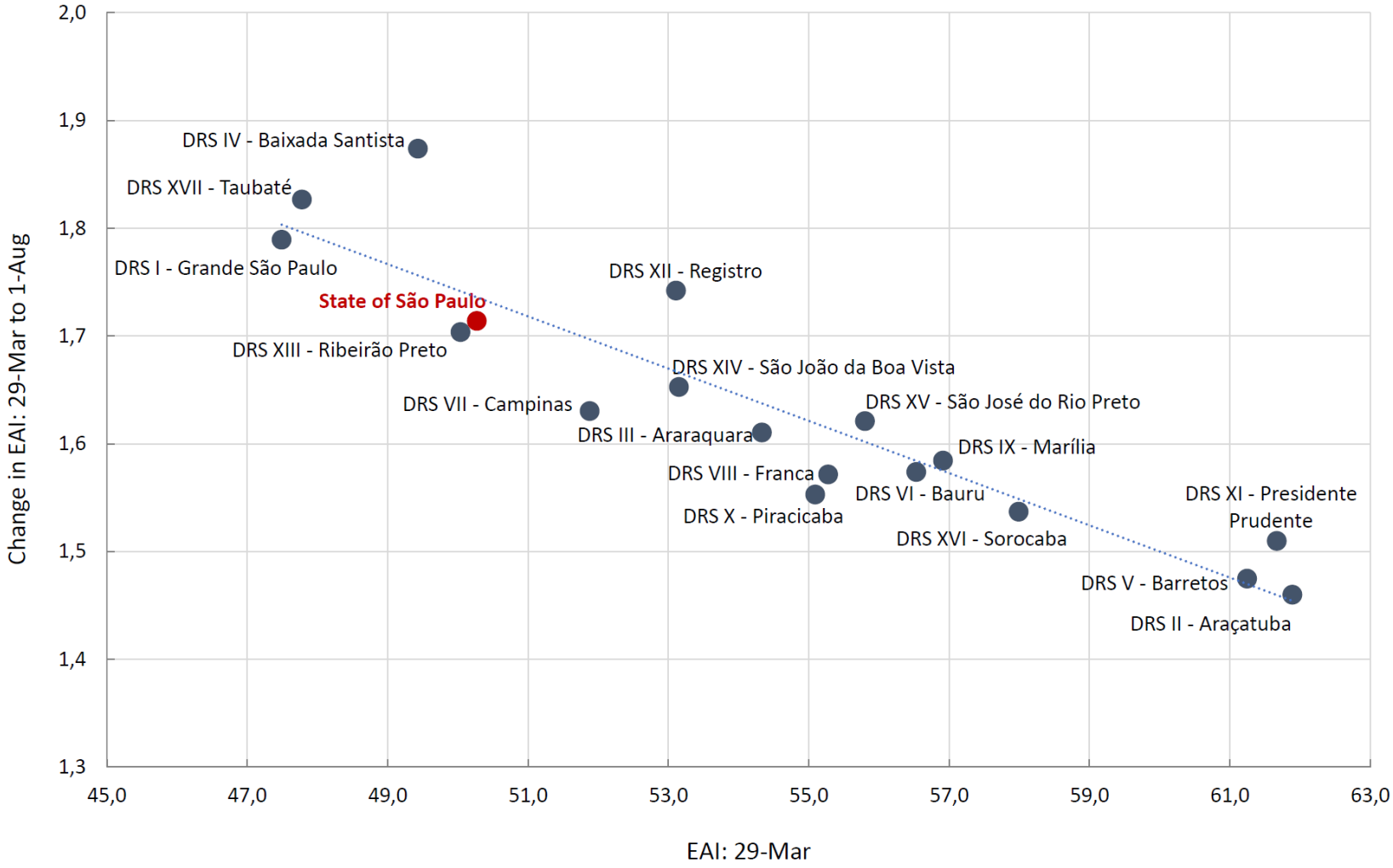


The regions that had greater adherence to restrictive measures also showed greater consistency in maintaining phases ...

Changes of Phases in Each DRS in the São Paulo Plan

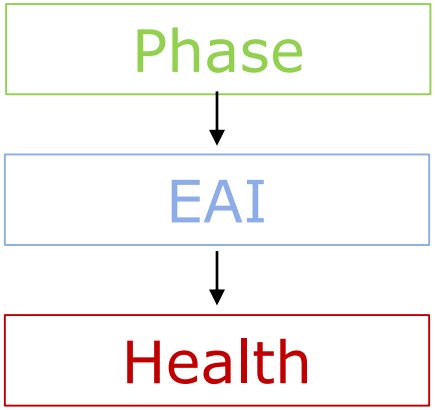


... and increased their economic activity more quickly, in a more sustainable way



Have the changes of phases affected the COVID-19 spread through an increase in the economic activity?

Estimation using an integrated model of fixed effects:



$$IAE_{dia,DRS} = \alpha_{DRS} + \tau_{dia} + \beta_2 F2_{t,DRS} + \beta_3 F3_{t,DRS} + \varepsilon_{dia,DRS}$$

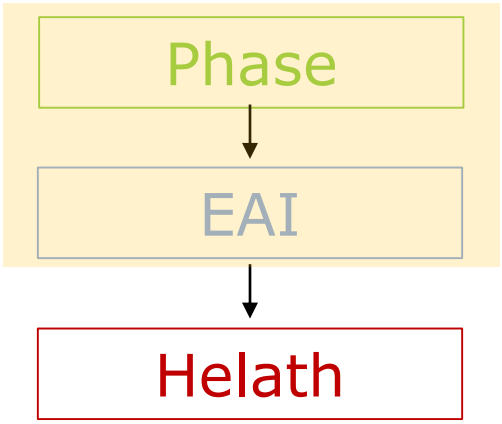
$$Saúde_{dia,DRS} = \left(\sum_q \gamma_q \, S_{q,dia,t-7,DRS}\right) + \phi IAE_{dia-t,DRS} + \epsilon_{dia,DRS}$$

Flaxman et al. (2020) + micro data

Assumptions:

- Phase change affects economic activity
- Increase in economic activity may affect the epidemiological curve

First estimation: effect of change in phase on EAI



$$IAE_{dia,DRS} = \alpha_{DRS} + \tau_{dia} + \beta_2 F2_{t,DRS} + \beta_3 F3_{t,DRS} + \varepsilon_{dia,DRS}$$

Model: Average effect of phase change controlling for:

- General trend in the EAI
- Regional activity level

Results:

- Gradual impacts
- Phase 2 increases total EAI by 1,11 pp compared to Phase 1
- Phase 2 increases total EAI by 2,32 pp compared to Phase 1

First estimation: results

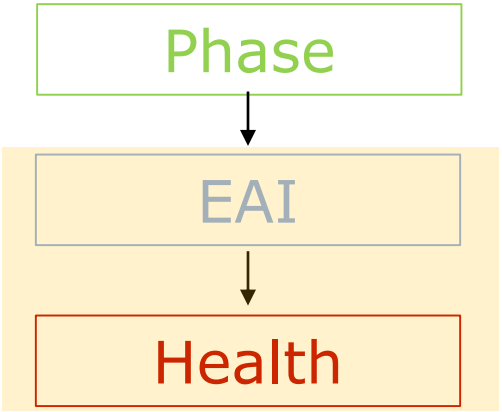
	EAI			Mobility Index	
	Tradables	Non-tradables	Total	Freight	Passengers
	(1)	(2)	(3)	(4)	(5)
Phase 2	0.412 ***	1.476 ***	1.110 ***	0.622 ***	2.212 ***
	(0.052)	(0.115)	(0.095)	(0.187)	(0.186)
Phase 3	0.718 ***	2.442 ***	2.322 ***	1.591 ***	3.666 ***
	(0.076)	(0.168)	(0.140)	(0.275)	(0.274)
Fixed effects:					
DRS	yes	yes	yes	yes	yes
date	yes	yes	yes	yes	yes
Obs.	1,751	1,751	1,751	1,751	1,751
R^2	0.992	0.978	0.981	0.941	0.953

*Note: *p<0.1; **p<0.01; ***p<0.001.*

Results:

- Bigger effects on services
- Bigger effects on mobility of people (1pp ~100K people in the SPMR)

Second estimation: effect of EAI on the epidemiological curve (per capita hospitalizations)



$$Saúde_{dia,DRS} = \left(\sum_q \gamma_q \, S_{q,dia,t-7,DRS}\right) + \phi IAE_{dia-t,DRS} + \epsilon_{dia,DRS}$$

Model: Average effect of EAI on total per capita hospitalizations 12 days later controlling for:

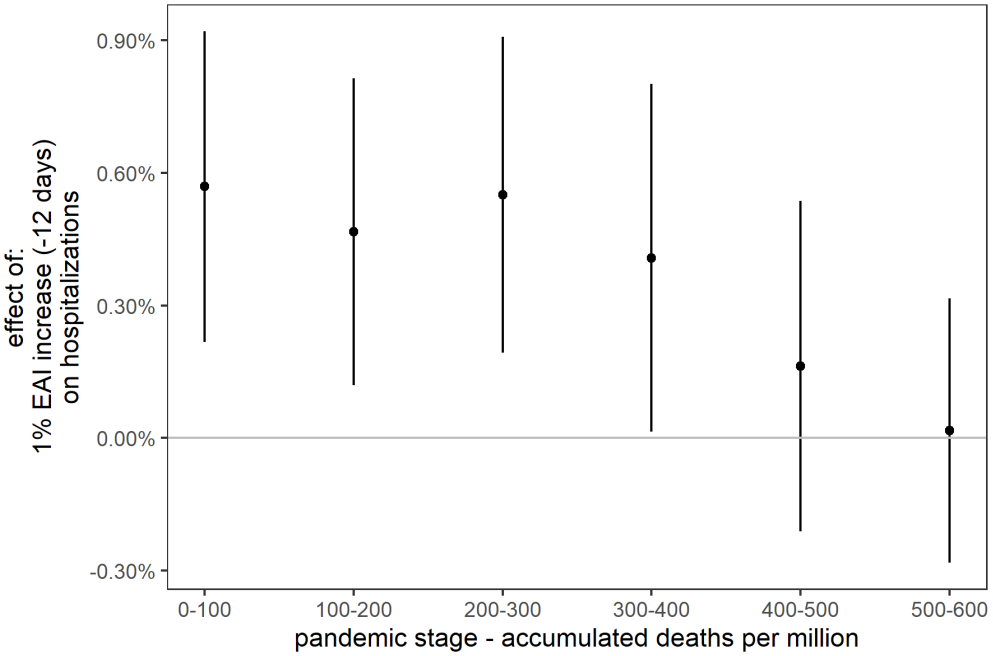
- Stage of the pandemic in each DRS (non-linear)

$$Saúde_{dia,DRS} = \left(\sum_q \gamma_q \, S_{q,dia,t-7,DRS}\right) + \left(\sum_q \phi_q \, S_{q,dia,t-7,DRS} IAE_{dia-t,DRS}\right) + \epsilon_{dia,DRS}$$

Results:

- An increase of 1 pp in the EAI is associated with an increase in daily hospitalizations up to 0,5% (+12 days)
- Bigger effects at the initial stages of the pandemic

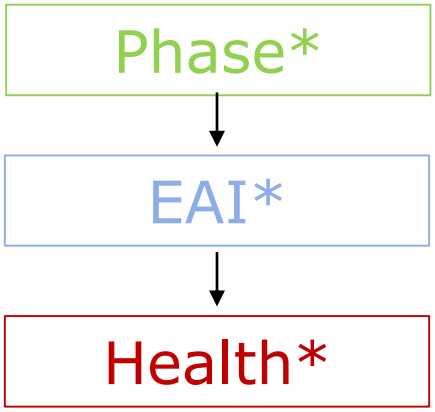
Second estimation: results



Results:

- An increase of 1 pp in the EAI is associated with an increase in daily hospitalizations up to 0,5% (+12 days)
- **Bigger effects at the initial stages of the pandemic**

What would have been the evolution of health indicators if the phase changes had not occurred?



Step 1: estimate the counterfactual EAI had all DRS remained in Phase 1 (red)

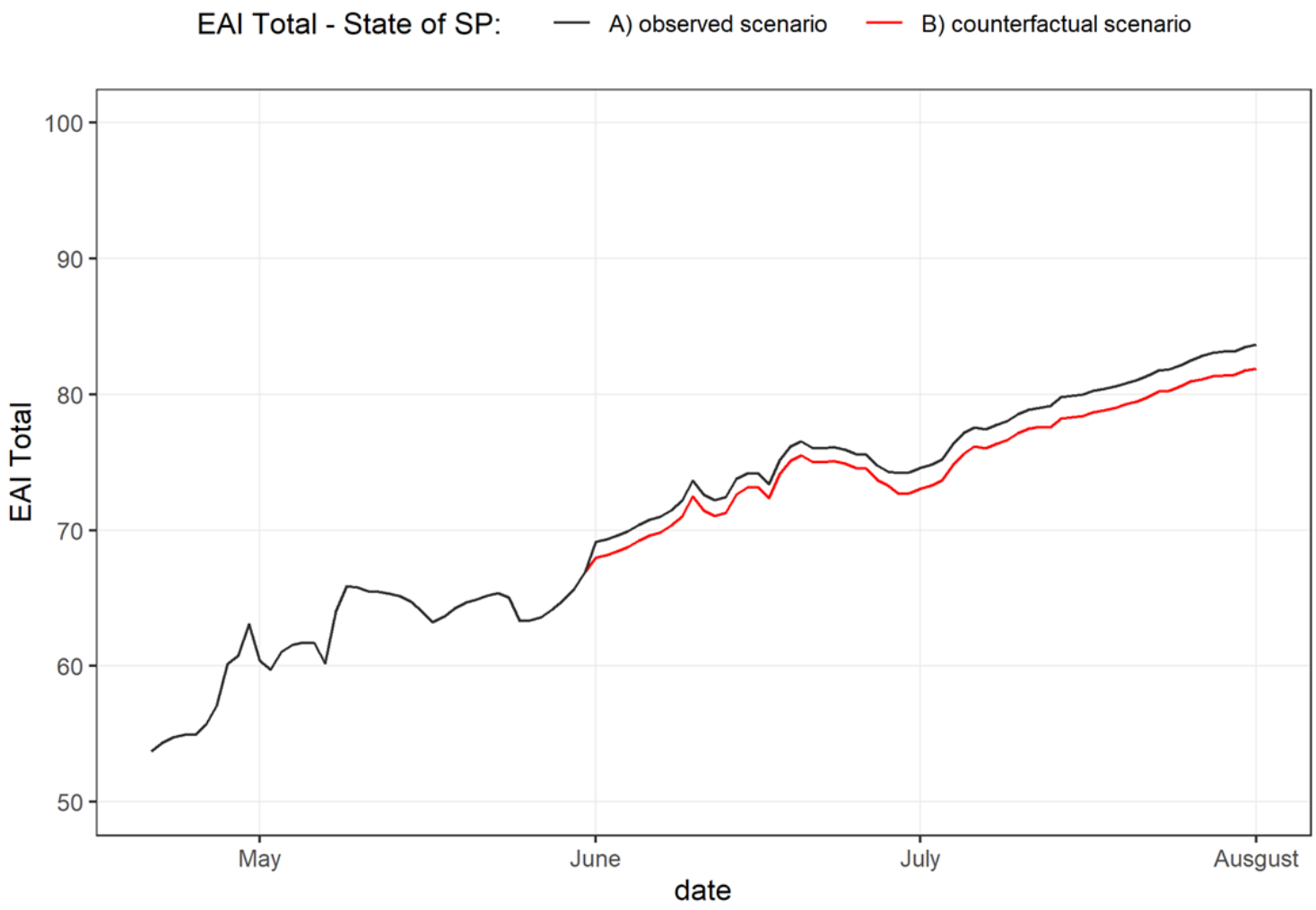
Step 2: compare the estimated number of hospitalizations given both the observed and the counterfactual EAI

Step 3: compare the difference in total hospitalizations between the two scenarios

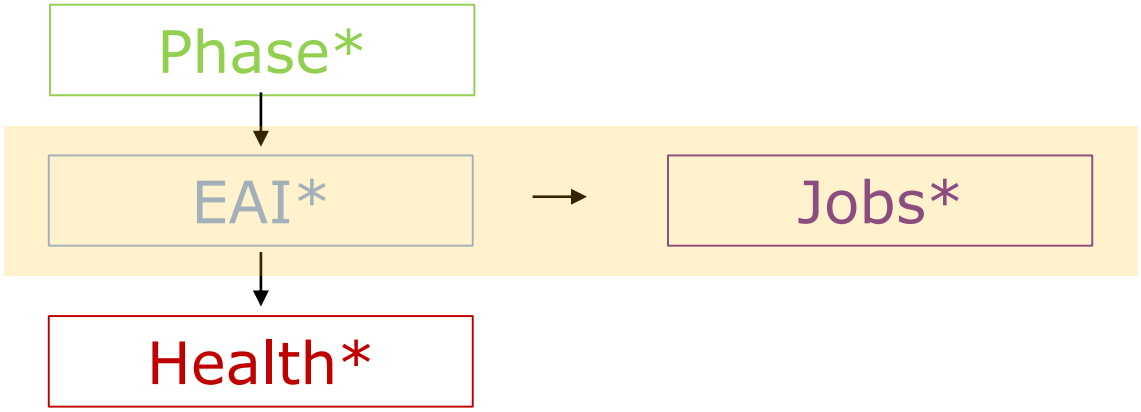
Results:

- Changes in phases led to an increase in the EAI
- The increase in the EAI, on its turn, would be associated with a 0,21-0,52% increase in total COVID-related hospitalizations in the state since the beginning of the São Paulo Plan

The impact of the DRS phase changes was gradual and differentiated between sectors and regions ...



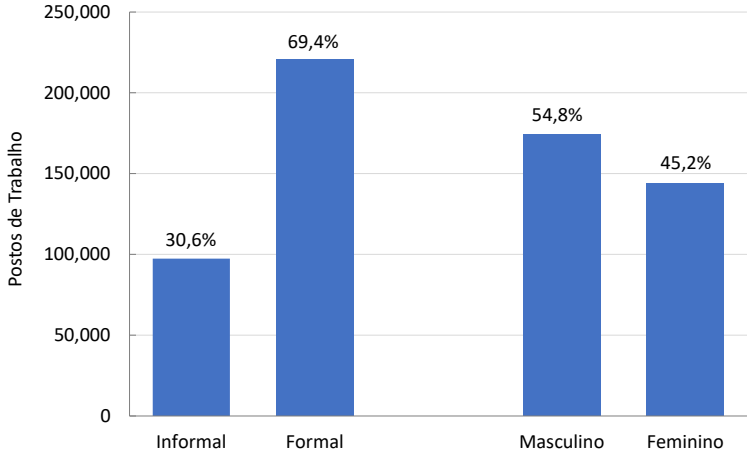
... helping to preserve jobs in the state

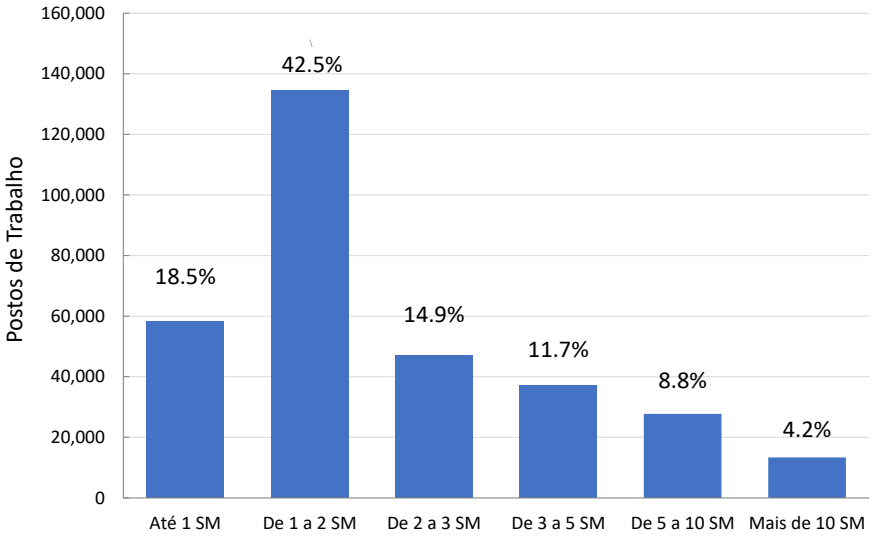


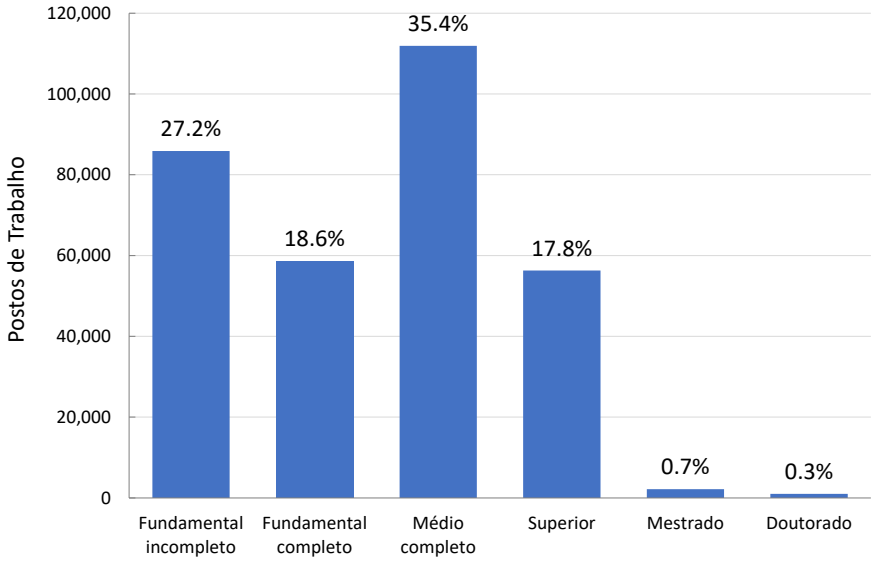
Results:

- By stimulating the economic recovery, the São Paulo Plan helped to preserve 318 thousand jobs
- 95% of jobs (~ 303 thousand) maintained with the gradual recovery of the São Paulo economy are concentrated in service activities

Mapping “saved” jobs by the Plan (1)







Mapping "saved" jobs by the Plan (2)

Nome da DRS	Pessoal Ocupado	
	Pré-Crise (%)	*Postos de Trabalho Preservados (%)*
DRS I - Grande São Paulo	47.5%	64.4%
DRS II - Araçatuba	1.7%	0.7%
DRS III - Araraquara	2.2%	2.2%
DRS IV - Baixada Santista	4.0%	4.5%
DRS V - Barretos	1.0%	0.7%
DRS VI - Bauru	3.9%	2.9%
DRS VII - Campinas	10.0%	5.7%
DRS VIII - Franca	1.6%	0.5%
DRS IX - Marília	2.5%	1.4%
DRS X - Piracicaba	3.4%	1.6%
DRS XI - Presidente Prudente	1.7%	0.9%
DRS XII - Registro	0.6%	0.4%
DRS XIII - Ribeirão Preto	3.3%	0.5%
DRS XIV - São João da Boa Vista	1.8%	1.6%
DRS XV - São José do Rio Preto	3.6%	3.1%
DRS XVI - Sorocaba	5.5%	3.6%
DRS XVII - Taubaté	5.5%	5.2%
Estado de São Paulo	**100.0%**	**100.0%**

Key messages

São Paulo Plan helped to preserve jobs

The regions that had greater adherence to restrictive measures also showed greater consistency in maintaining phases, and increased their economic activity more quickly, in a more sustainable way

- **Expectations** anchored with the São Paulo Plan
- **Communication** worked and saved lives (and jobs)

NEREUS

Núcleo de Economia Regional e Urbana da Universidade de São Paulo

The University of São Paulo Regional and Urban Economics Lab

POLICY CENTER FOR THE NEW SOUTH

THINK • STIMULATE • BRIDGE

Thank you!

ehaddad@usp.br

www.usp.br/nereus

Eduardo A. Haddad Renato Vieira Inácio Araújo Silvio Ichihara
Fernando Perobelli Karina Bugarin