

# Unequal Response to Mobility Restrictions: Evidence from COVID-19 Lockdowns in the City of Bogotá.

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# Motivation and Literature

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# Motivation and Literature

- COVID-19 pandemic: A mayor shock (in terms of health, but also in socio-economics terms) Revealing and aggravating socio-economic inequalities, and the unequal capacity to respond to policies aimed at contagion control
- Mobility reduction has been one of the main objectives of NPIs and one of the most effective ways to reduce the spread of cases (Glaeser et al., 2020).

However:

- Low-income families might have a more difficult time transitioning to teleworking (Wright et al., 2020).
- Households with higher incomes, more access to financial services, and working in formal sectors that can telecommute (Bick et al., 2020; Dingel and Neiman, 2020).

# Motivation and Literature

- A large majority of papers to date have focused on developed countries and on cross-city or cross-country comparisons (Dave et al., 2020).
- Barnett-Howell and Mobarak (2020) discuss the differences in trade-offs between the benefits and costs of social distancing experienced by developing and developed countries.
- One strand of the literature has analyzed the socioeconomic determinants of lockdown compliance at:
  - Regions of developed and developing countries (Bargain and Aminjonov, 2020; Askitas et al., 2020)
  - US counties (Wright et al., 2020),
  - Cities (Ruiz-Euler et al., 2020; Garcia-Lopez and Puga, 2020).

# Contribution

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# Summary of Paper

- This paper:
  - Focus on Bogotá, one of the largest and densest cities in Latin America.
  - Evaluate the unequal response to mobility restrictions across neighborhoods within a large city in the developing world.
  - Build a unique dataset combining information on mobility and socioeconomic characteristics at a disaggregated spatial level.
  - Estimate and compare the impact of the city-wide coordinated lockdown with that of localized measures.
  - Analyze the role of these subsidies on mobility restriction compliance.
  - Look not only at income levels, but also at other factors, including housing infrastructure, overcrowding, education and demographics.

# **Non-Pharmaceutical Interventions in Bogotá**

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## Context: Non-Pharmaceutical Interventions

- **General lockdown:**

- The Bogotá government was the first to announce a lockdown drill for March 20<sup>th</sup> to 23<sup>th</sup>. As cases surged, the lockdown was extended to May 11<sup>th</sup>.
- During this lockdown, only sectors considered fundamental were able to work, including transportation, food provision, healthcare, and deliveries. Some banks and notaries were partially open also.

- After the first city-level lockdown was lifted, cases surged. The city started implementing localized restrictions by district.

▶ Timeline

▶ Lockdown by district

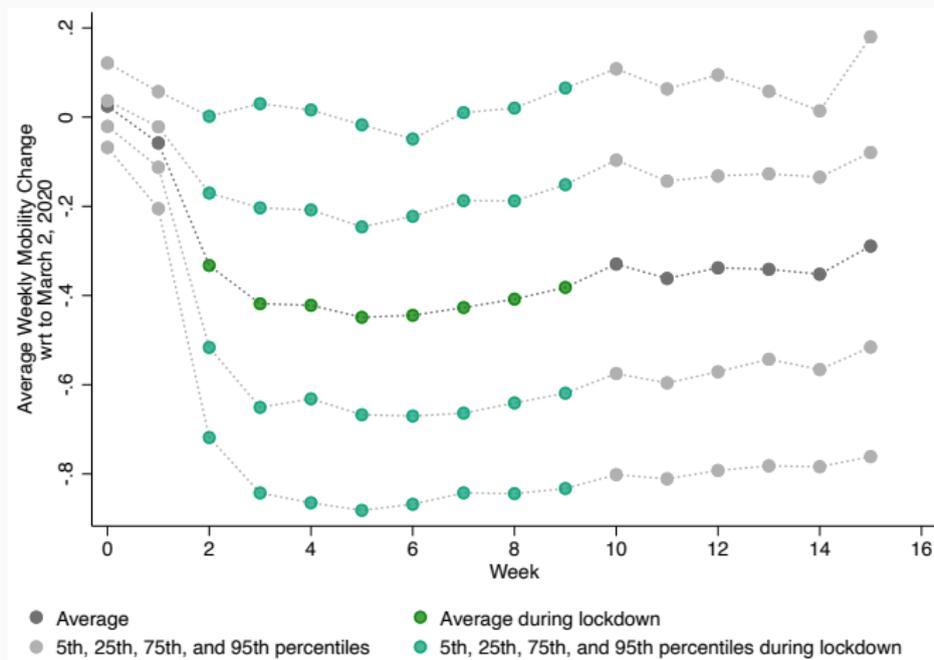
- More than 350.000 households receive at most three disbursements from March to September. The total amount in each payment was USD\$ 42 (vulnerable) and USD\$ 63 (poor).

# Data

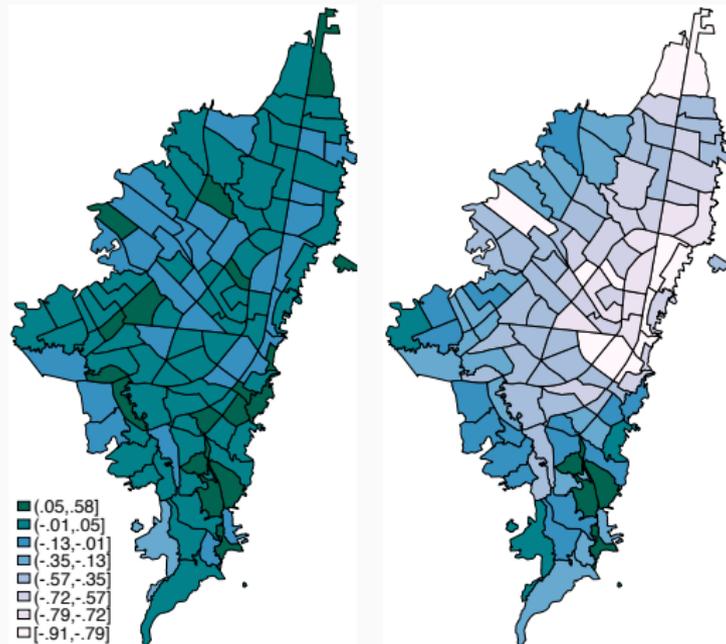
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## Data: Mobility

- Cases: We use registered COVID cases at a very disaggregated level.
- NPIs: We look at i) general lockdowns, ii) location-specific lockdowns, and iii) cash subsidies
- Mobility: We use mobile-phone-based tracked mobility as our primary outcome. Data comes from GRANDATA-UNDP. We look at changes compared to baseline mobility (pre-mobility restrictions)
- Socio-economic data: We look at a wide range of variables using data from Multiproposito Survey of the National Statistical Department (DANE).



**Figure 1:** Average and percentiles of UPZ weekly mobility change wrt to March 2, 2020.



(a) Week 0

(b) Week 3

**Figure 2:** Mobile phone mobility growth. The map shows the average weekly percentage growth rate with respect to the baseline date (March 2, 2020).

## Data: Socio-economic characteristics

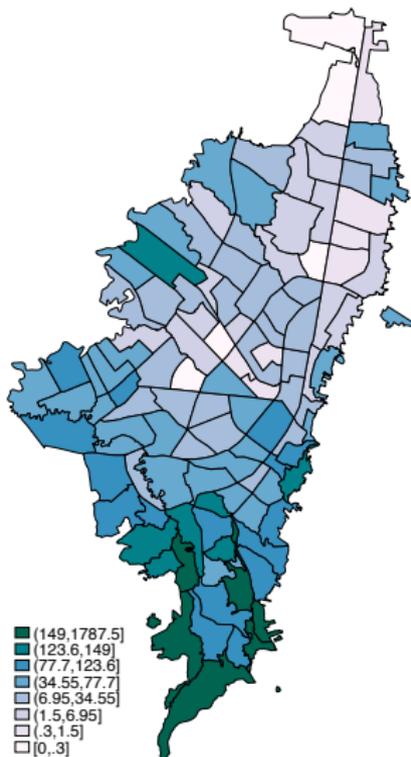
- We match our mobility data with data from the metropolitan 2017 household-level survey, called the Multipropósito Survey (DANE).
- Data on the labor market, housing conditions, poverty, and demographic characteristics.
- Information about households and individuals is representative at the UPZ level for 73 out of the 112 UPZs.

# Data: Socio-economic characteristics

Variable	Mean	Std. Dev.	Min	Max
Mobility change	-0.3	0.2	-0.7	0.2
Hshlds below poverty (%)	15	10	1	55
Income per cap ( <i>dollars</i> )	315	215	80,3	1076,3
Education	9.0	0.7	7.3	10.5
<i>Labor market variables</i>				
Informality rate (%)	37.2	11.5	15.0	63.6
<i>Sector variables</i>				
Shr Health (%)	5.8	1.5	2.8	9.1
Shr Construction (%)	5.7	3.1	1.5	14.9
Shr Commerce (%)	19.2	4.3	8.6	30.3
Shr Manufactures (%)	11.9	4.1	4.5	20.4
Shr Transportation (%)	9.6	2.7	3.5	16.4
Shr Education (%)	5.5	2.8	1.8	14.8
<i>Demographics characteristics</i>				
Shr 0-13 yrs (%)	17.7	4.4	8.6	29.3
Shr older 65 yrs (%)	7.5	3.1	2.5	13.9
<i>Infrastructure variables</i>				
Mobile Internet (%)	64.0	11.1	36.7	85.1
Cooking stove (%)	96.8	1.9	90.3	99.6
Fridge (%)	94.3	3.9	85.7	99.9

**Table 1:** Descriptive statistics for the UPZ used in the analysis

## Data:Subsidies



- Virtually all UPZs in Bogotá had households that received subsidies.
- Higher concentration in the south and southwest, and a couple of lower-income neighborhoods in the northwest.

# Analysis

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## Estimation equation: First stage

We estimate different specifications of the following difference-in-difference type:

$$\ln M_{it} = \eta \text{LockDown}_t + \sum_i \beta_i \text{LockDown}_t \gamma_i + \alpha \text{District Specific LockDown}_{it} + \gamma_i + \tau_t + \epsilon_{it}$$

- $M_{it}$  is mobility in the week  $t$  for UPZ  $i$
- $\text{LockDown}_t$  is an indicator for the city-wide initial lockdown.
- $\gamma_i$  and  $\tau_t$  are UPZ and week fixed effects.
- $\eta$  captures the effect of the general lockdown on mobility.
- $\beta_i$  are parameters that measure the unequal response by UPZ to the city-level lockdown.
- District Specific lockdown $_{it}$ , take a value of 1 when lockdown measures are implemented in the district of UPZ $i$ .
- $\alpha$  is the average effect of district-specific restrictions.

## Estimation equation: Second Stage

We use the estimated coefficients  $\hat{\beta}_i$  to analyse the role of UPZ's socio-economic characteristics in explaining the unequal response to lockdown across UPZs, as specified in Equation (2):

$$\hat{\beta}_i = \mathbf{P}_i\theta_1 + \mathbf{L}_i\theta_2 + \mathbf{D}_i\theta_3 + \mathbf{S}_i\theta_4 + \mu_i$$

- $P_i, L_i, D_i$  and  $S_i$  are vectors of variables measuring UPZ's aggregate poverty, labor market, demographics, infrastructure, and other characteristics.
- The  $\theta$  parameters explain the role of the initial socio-economic characteristics in explaining the heterogeneity in the mobility changes across UPZs as a reaction to the general lockdown.

## Main Results

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# The impact of lockdown on mobility

	Percentage change in mobility						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Week before lockdown	0.30*** (0.02)			-0.08*** (0.01)			
Lockdown		-0.20*** (0.01)			-0.41*** (0.03)		-0.56*** (0.02)
Week after lockdown			0.01 (0.01)			-0.35*** (0.03)	
R-squared	0.191	0.278	0.000	0.605	0.605	0.605	0.722
Observations	1456	1456	1456	1456	1456	1456	1456
UPZ FEs	✓	✓	✓	✓	✓	✓	✓
Week FEs				✓	✓	✓	✓
UPZ Specific Lockdown Effect							✓

Standard errors in parentheses

Robust standard errors reported in parenthesis.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

**Table 2:** The impact of general lockdown on mobility

# The impact of lockdown on mobility

	Percentage change in mobility			
	(1)	(2)	(3)	(4)
Lockdown	-0.10*** (0.01)	-0.41*** (0.03)	-0.47*** (0.03)	-0.48*** (0.03)
Localized lockdown	-0.08*** (0.01)	-0.01** (0.01)	-0.02*** (0.00)	-0.00 (0.01)
R-squared	0.105	0.552	0.606	0.608
Observations	2912	2912	2912	2912
UPZ FEs	✓	✓	✓	✓
Week FEs		✓	✓	✓
UPZ Specific <i>trend</i>			✓	
Lowckdown heterogeneous effect				✓

Robust standard errors reported in parenthesis.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

**Table 3:** Localized lockdowns impact

# The impact of lockdown on mobility

	Percentage change in mobility			
	(1)	(2)	(3)	(4)
Lockdown	-0.41*** (0.03)	-0.41*** (0.03)	-0.41*** (0.03)	-0.42*** (0.03)
Lockdown × Subsidies per capita			-0.09 (0.22)	-0.68 (1.39)
Lockdown=1 × Subsidies per capita <sup>2</sup>				-0.57 (5.40)
Subsidies per capita		1.11*** (0.34)	1.16*** (0.29)	4.84** (2.00)
Subsidies per capita <sup>2</sup>				-13.26** (6.01)
R-squared	0.605	0.609	0.609	0.615
Observations	1456	1456	1456	1456
UPZ FEs	✓	✓	✓	✓
Week FEs	✓	✓	✓	✓

Robust standard errors reported in parenthesis.

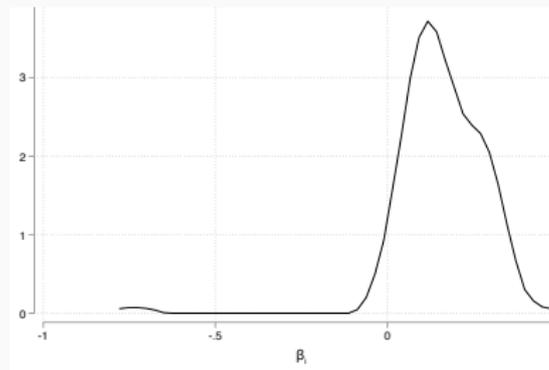
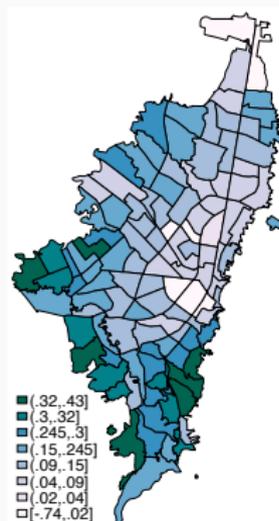
\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

**Table 4:** Exploring the role of subsidies

# **The Role of Socioeconomic Characteristics**

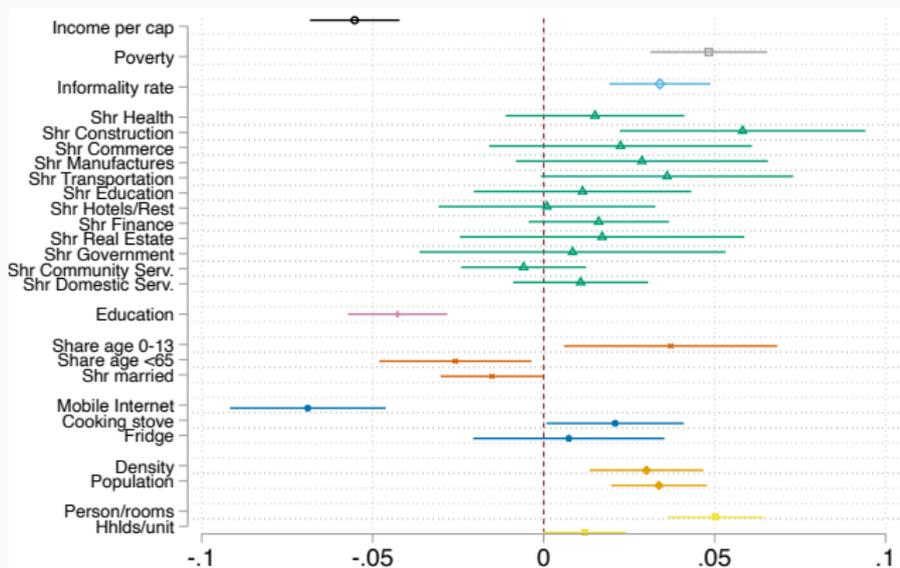
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# The role of socioeconomic characteristics



**Figure 3:** UPZ relative reaction to the general lockdown. The values for each UPZ come from the coefficients that allow for a heterogeneous response to the general lockdown.

# The role of socioeconomic characteristics



**Figure 4:** Results from the second stage regressions. Each group of coefficients, identified by color and marker, comes from a separate regression.

▶ 2nd Stage Table 1

▶ 2nd Stage Table 2

## Conclusions

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- We find that
  - The city-level lockdown reduced mobility, on average, by around 41pp.
  - Localized district-specific restrictions seem to have had small marginal effects on mobility.
  - Very heterogeneous spatial effects within the city.
  - The lockdown compliance was smaller in UPZs with lower schooling levels and with higher levels of poverty.
  - Subsidies were not effective in reducing mobility, it would have been necessary to give a much higher number of subsidies by UPZ to achieve that goal.

**Thanks**

# Placebo

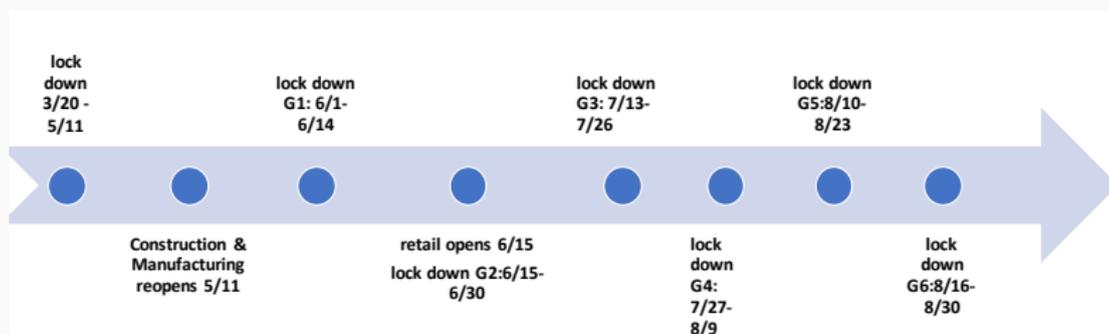
	Percentage change in mobility					
	(1)	(2)	(3)	(4)	(5)	(6)
Lockdown (continuous)	-0.41*** (0.03)					
Lockdown		-0.41*** (0.03)	-0.41*** (0.03)	-0.66*** (0.02)	-0.56*** (0.02)	
Placebo						-0.01 (0.01)
R-squared	0.605	0.605	0.605	0.752	0.722	0.752
Observations	1456	1456	1456	1456	1456	1456
UPZ FEs	✓	✓	✓	✓	✓	✓
Week FEs	✓	✓	✓	✓	✓	✓
<i>trend</i>			✓			
UPZ specific <i>trend</i>				✓		✓
UPZ specific lock down effect					✓	

Robust standard errors reported in parenthesis.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

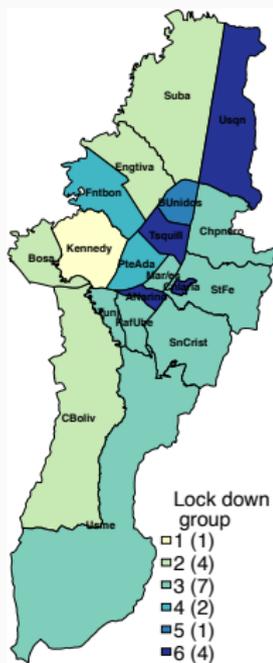
**Table 1:** Impact of lockdowns on mobility

# Lockdowns Timeline



**Figure 1:** After the first general lockdown, 6 localized stay at home orders were implemented by districts, shown in the timeline as groups G1 to G6. The districts included in each were the following: **G1:**Kennedy; **G2:**Ciudad Bolívar, Suba Engativa y Bosa; **G3:**Ciudad Bolívar, San Cristóbal, Rafael Uribe, Chapinero, Santa Fe, Usme, Los Mártires and Tunjuelito; **G4:**Bosa, Kennedy, Puente Aranda, and Fontibón; **G5:**Suba, Engativá, and Barrios Unidos; **G6:** Usaquén, Chapinero, Santa Fe, La Candelaria, Teusaquillo, Puente Aranda, and Antonio Nariño. Some districts went through more than one lockdown.

# Lockdowns by district



**Figure 2:** After the first general lockdown from March 20 to April 12, 6 localized stay at home orders were implemented by districts. Figure 1 show specific dates and districts in each group G1 to G6. This map shows districts included in each group. The number in the bracket indicates how many districts are in each group. Some districts went through more than one lockdown. They are associated with the group with which they experienced their earlier lockdown.

# 2nd Stage1 Part I

	UPZ mobility premium				
	(1)	(2)	(3)	(4)	(5)
Income per cap	-0.06***				
	(0.01)				
Poverty		0.05***			
		(0.01)			
Informality rate			0.03***		
			(0.01)		
Shr Health				0.02	
				(0.02)	
Shr Construction				0.06***	
				(0.02)	
Shr Commerce				0.02	
				(0.02)	
Shr Manufactures				0.03	
				(0.02)	
Shr Transportation				0.04	
				(0.02)	
Shr Education				0.01	
				(0.02)	
Shr Hotels/Rest				0.00	
				(0.02)	
Shr Finance				0.02	
				(0.01)	
Shr Real Estate				0.02	
				(0.02)	
Shr Government				0.01	
				(0.03)	
Shr Community Serv.				-0.01	
				(0.01)	
Shr Domestic Serv.				0.01	
				(0.01)	
Education					-0.04**
					(0.01)
R-squared	0.386	0.294	0.146	0.589	0.231
Observations	73	73	73	73	73

Robust standard errors reported in parenthesis.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

**Table 2:** Impact of socioeconomic characteristics on UPZ mobility premium captured by interaction coefficients

# 2nd Stage Part II

	UPZ mobility premium			
	(1)	(2)	(3)	(4)
Share age 0-13	0.04*			
	(0.02)			
Share age >65	-0.03*			
	(0.01)			
Shr married	-0.02*			
	(0.01)			
Mobile Internet	-0.07***			
	(0.01)			
Cooking stove	0.02*			
	(0.01)			
Fridge	0.01			
	(0.02)			
Density		0.03***		
		(0.01)		
Population		0.03***		
		(0.01)		
Person/rooms			0.05***	
			(0.01)	
Hhlds/unit			0.01	
			(0.01)	
R-squared	0.639	0.420	0.333	0.369
Observations	73	73	73	73

Robust standard errors reported in parenthesis.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

**Table 3:** Impact of socioeconomic characteristics on UPZ mobility premium captured by interaction coefficients

## References

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