Urban Mobility, Inequality and Welfare

Evidence from Rio de Janeiro 2016 Olympics

Maína Celidonio

Casa das Garças

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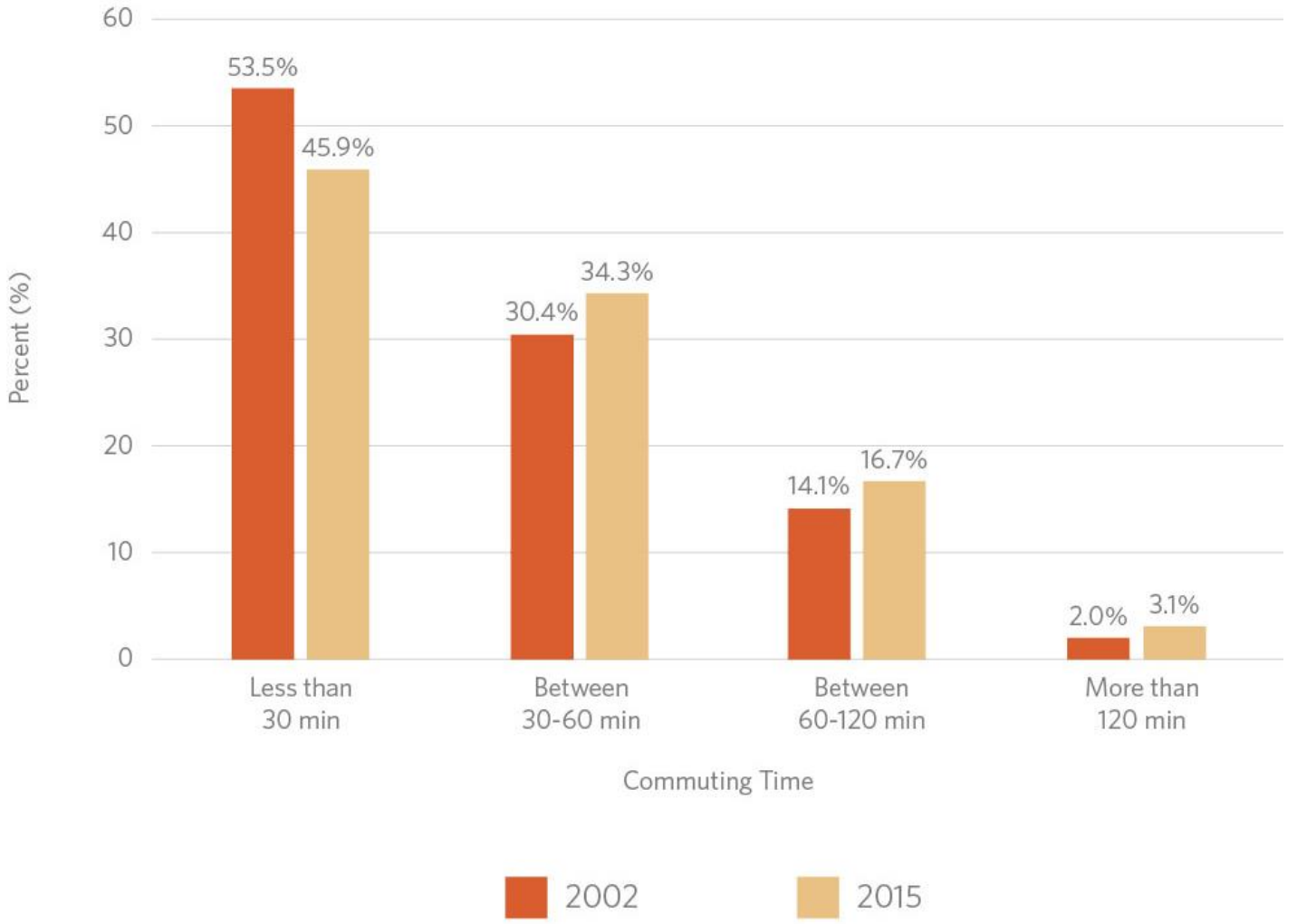
Motivation

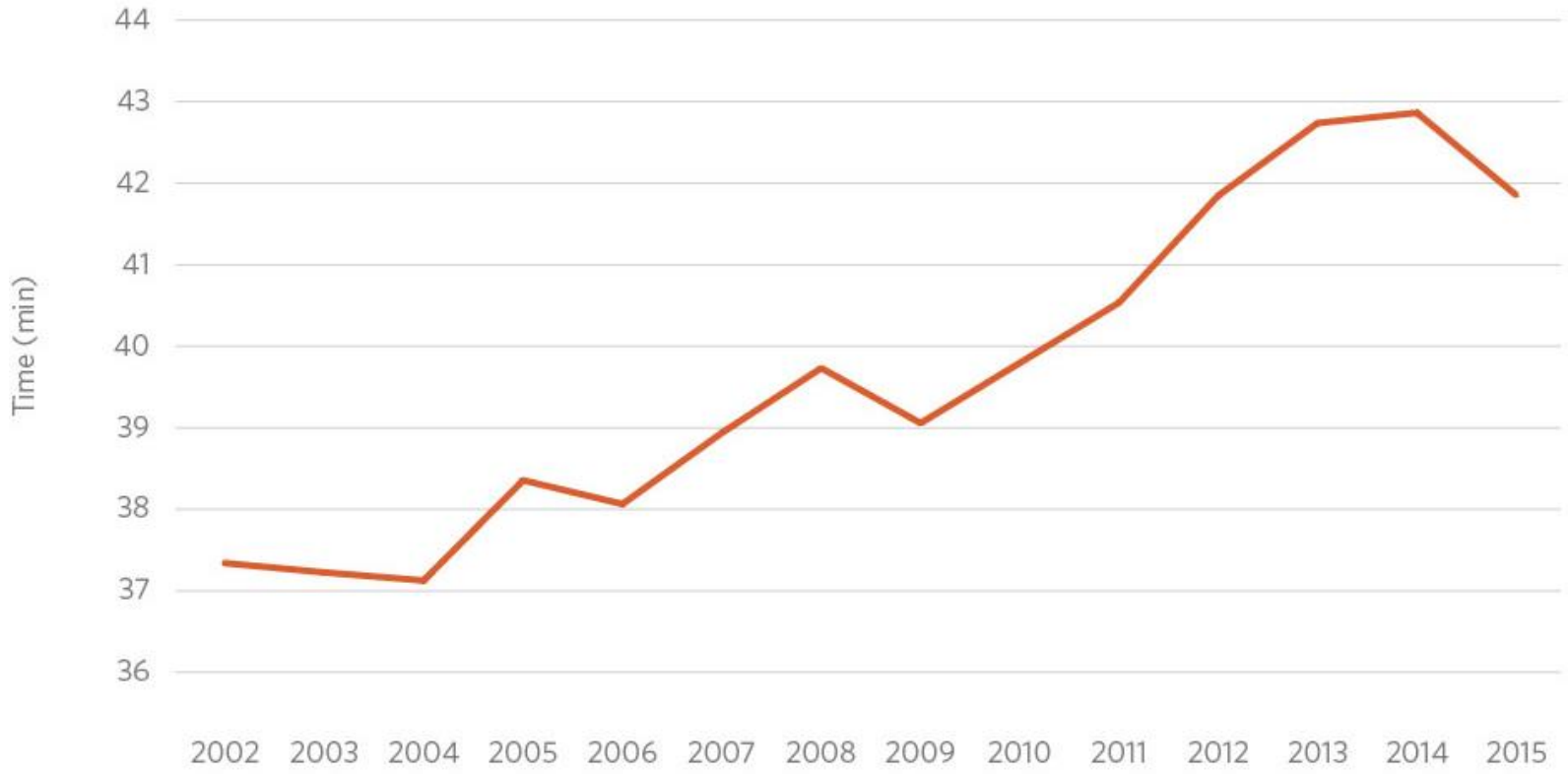
- Today half of the world's population lives in cities, representing 70-80% of global GDP;
- Public transportation plays a key role in shaping the consequences of urbanization;
  - Transportation connects individuals with jobs and services;
  - It facilitates the separation of workplace and residence;
- The lack of adequate transport infrastructure prevent cities from fully seizing the benefits of agglomeration economies.

Commuting time: Metropolitan Brazil



Source: *Climate Policy Initiative with data from Instituto Brasileiro de Geografia e Estatística, 2002, 2015*

Commuting time: Metropolitan Brazil



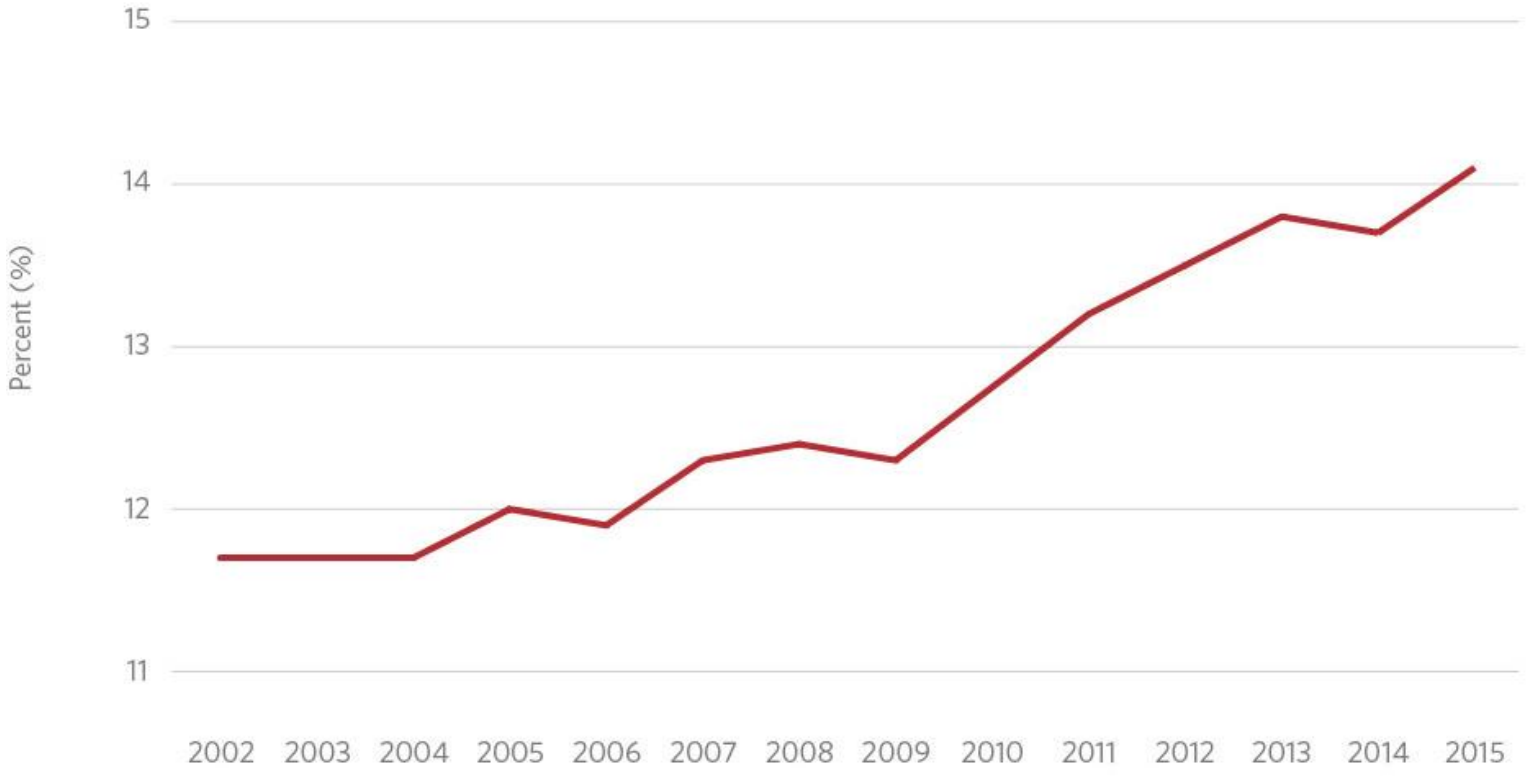
Source: *Climate Policy Initiative with data from Instituto Brasileiro de Geografia e Estatística, 2002-2015*

Commuting costs indicators

- Commuting tax rate (CTR)
  - Total labor day = commuting time + working hours
  - **CTR = commuting time/total labor day**

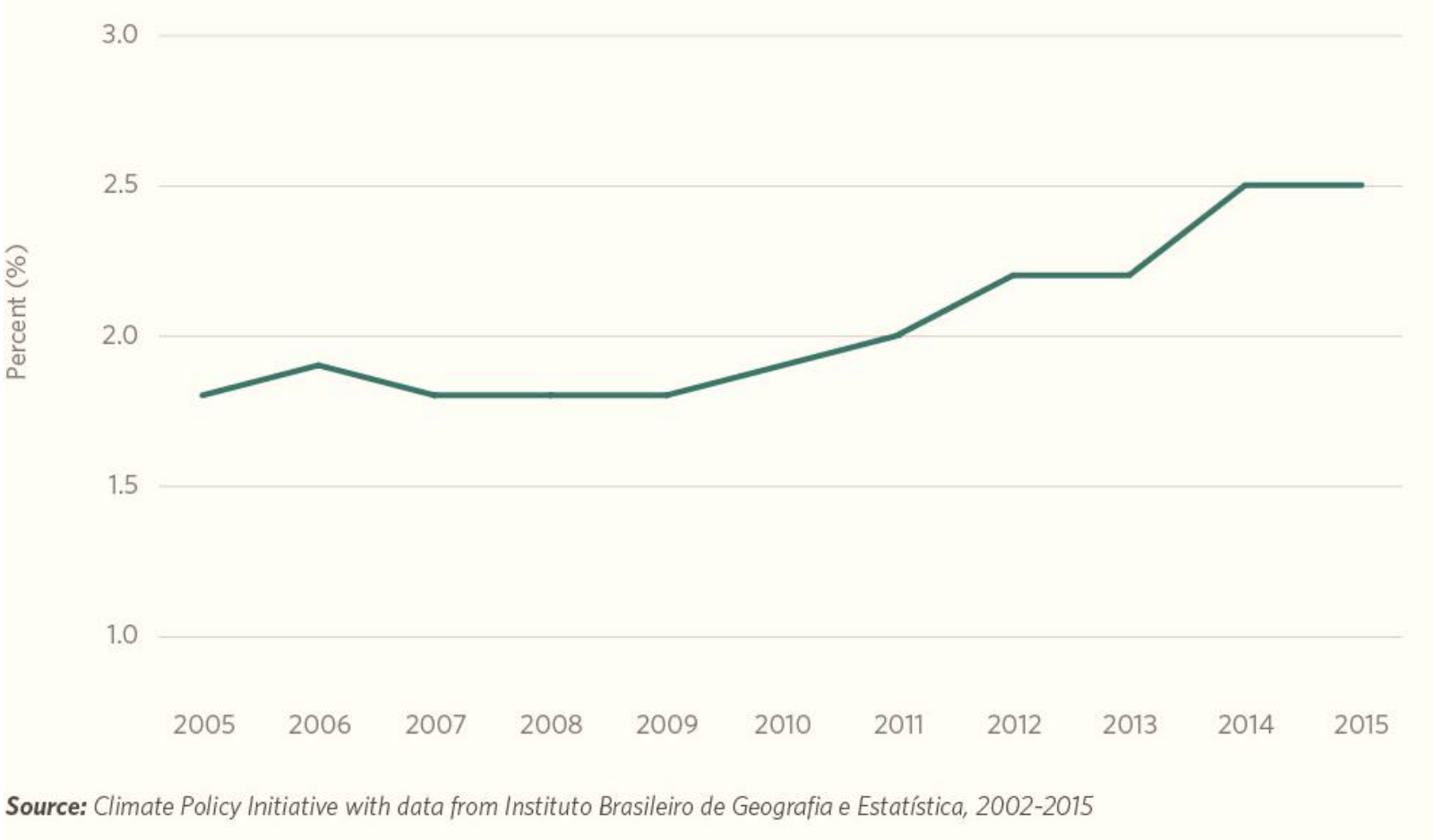
- Commuting total cost (CTC)
  - ct = commuting time
  - *nwd = number of work days per week*
  - hw= hourly wage
  - **CTC = ct x *nwd* x hw/2**

Commuting tax rate: Metropolitan Brazil



Source: *Climate Policy Initiative with data from Instituto Brasileiro de Geografia e Estatística, 2002-2015*

Commuting total cost/GDP: Metropolitan Brazil



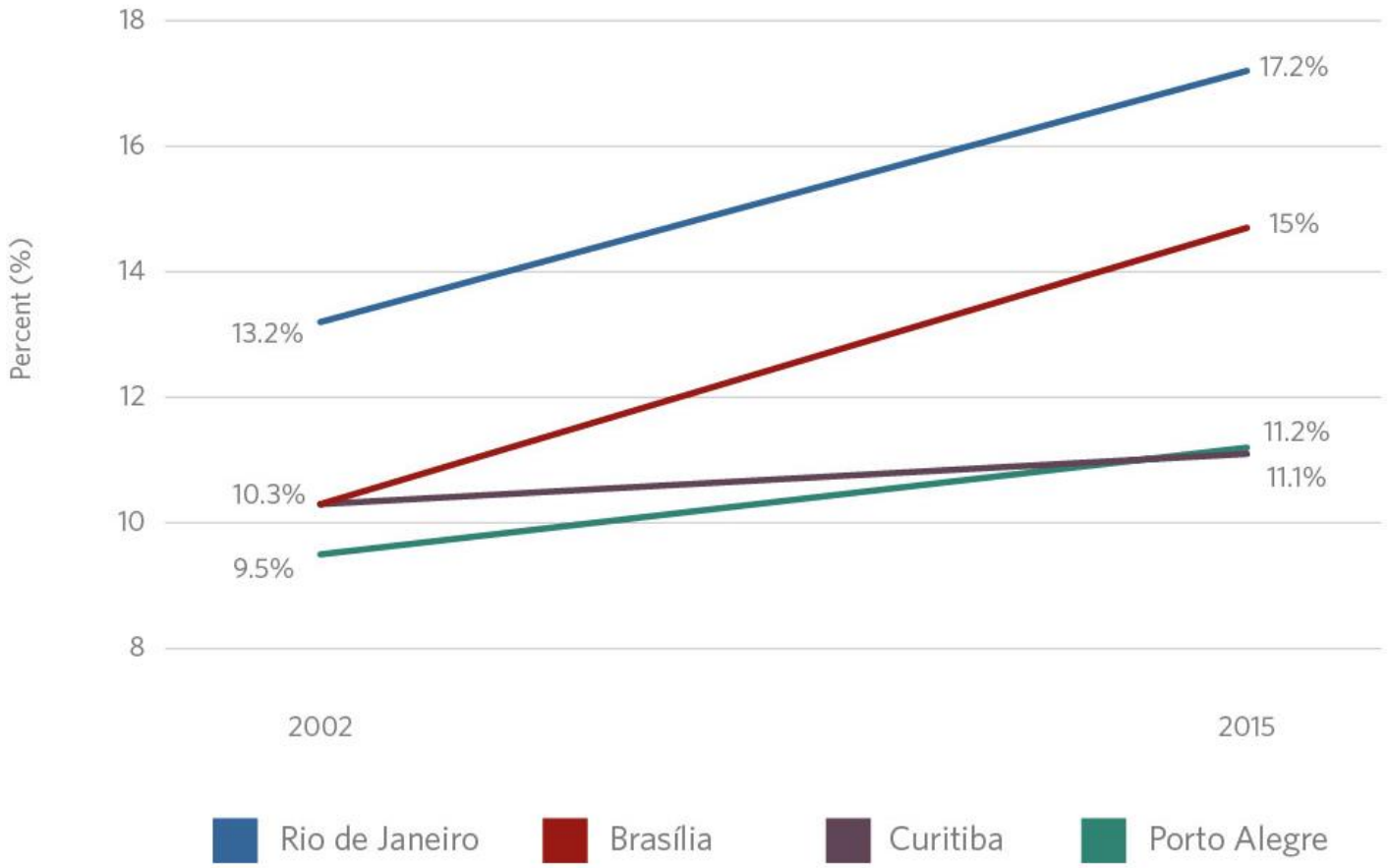
Source: *Climate Policy Initiative with data from Instituto Brasileiro de Geografia e Estatística, 2002-2015*

Cost vs. Investment

- In 2014, BNDES estimated the cost for addressing the urban mobility infrastructure gap:
  - R$234 billion or 4.8% of the 2014 GDP;
  - BNDES recommended a targeted investment of 0.4% GDP investment per year for 12 years.

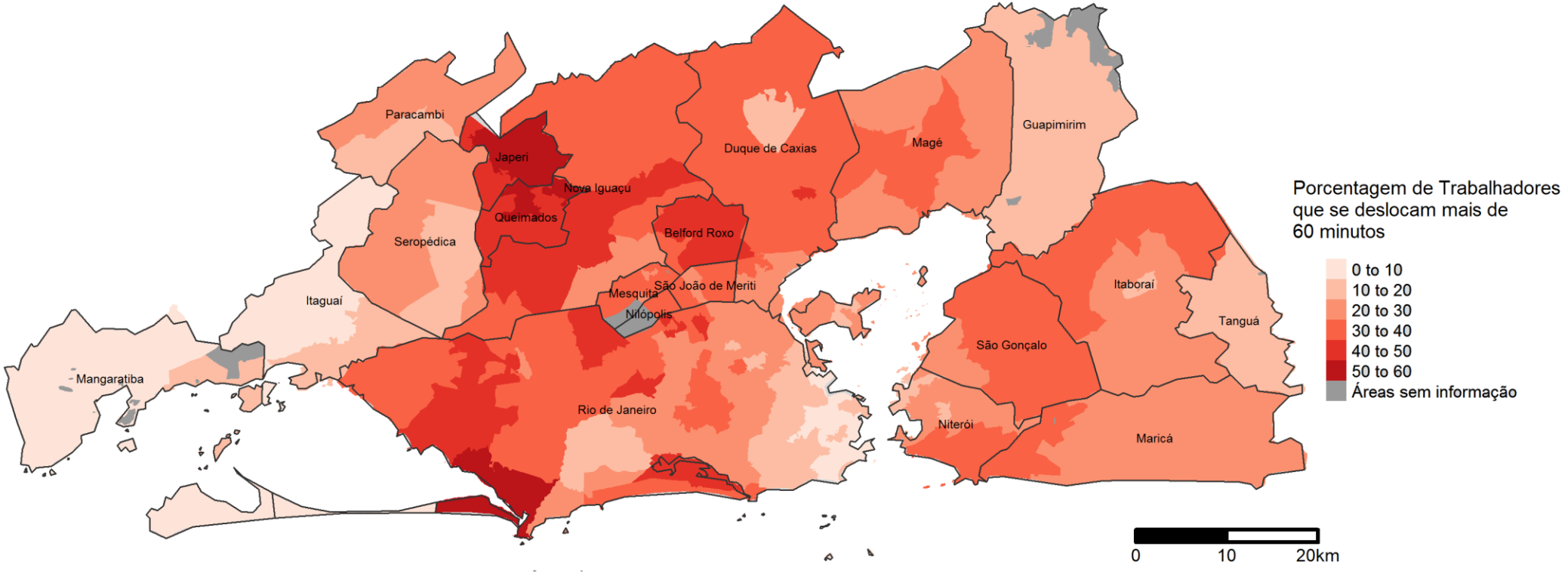
- BNDES recommendation ≅ 20% of the cost that Brazilian citizens lose annually in time commuting
  - For example, in Rio de Janeiro, investment per year represents 0.81% of its GDP and commuting costs per year amount to 3.24%

Commuting tax rate: Metropolitan areas

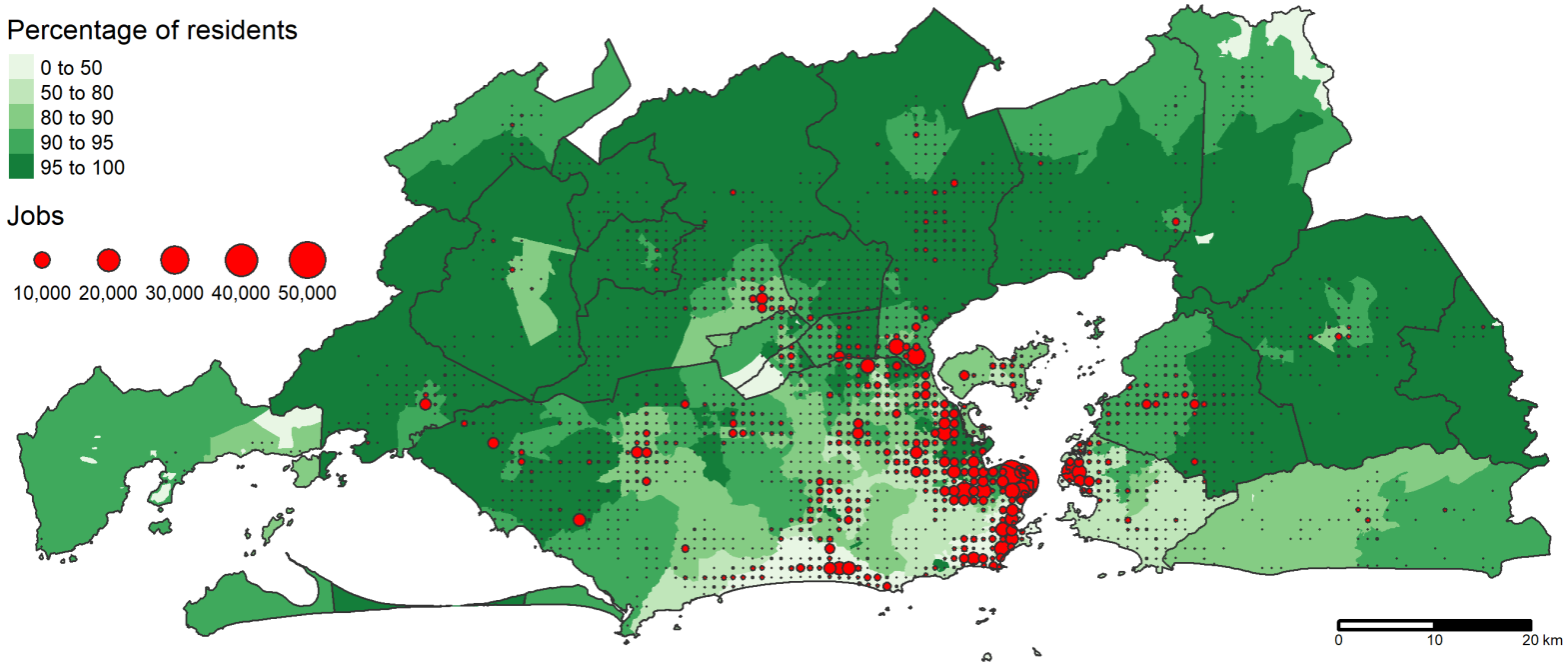


Source: *Climate Policy Initiative with data from Instituto Brasileiro de Geografia e Estatística, 2002, 2015*

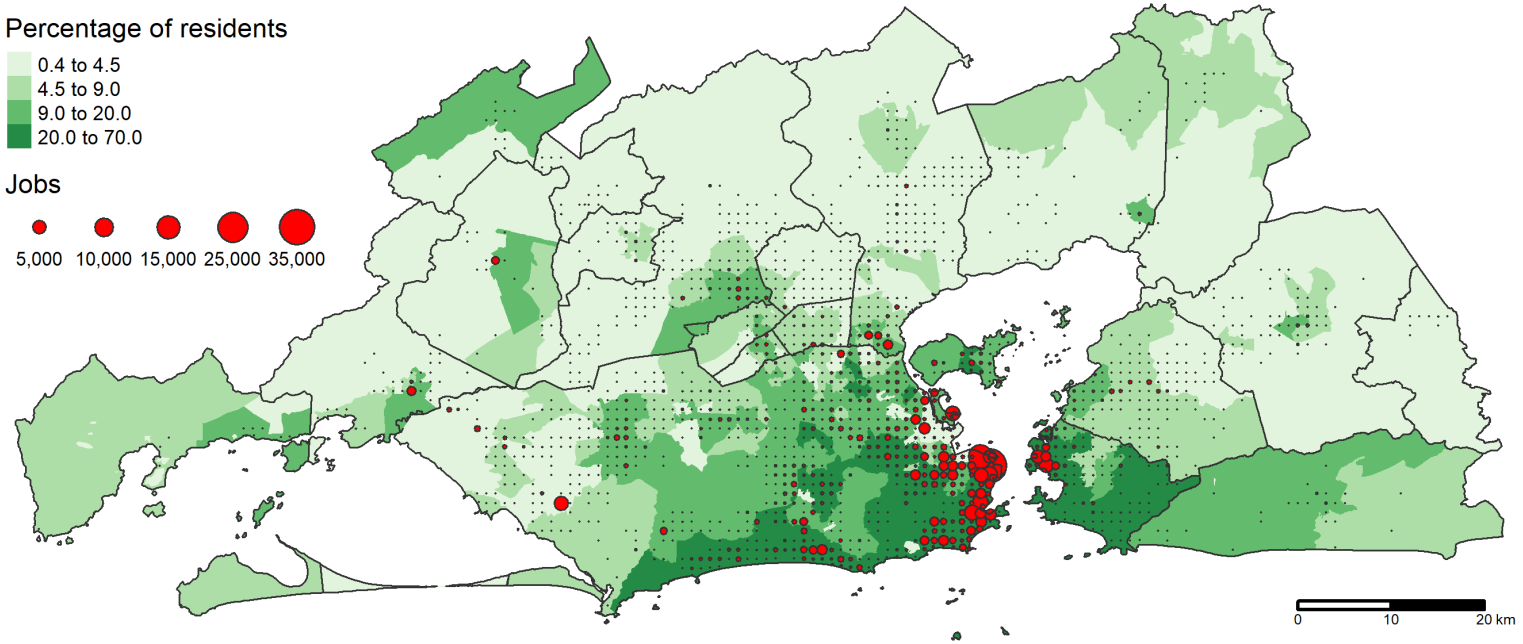
Rio de Janeiro Metropolitan Area



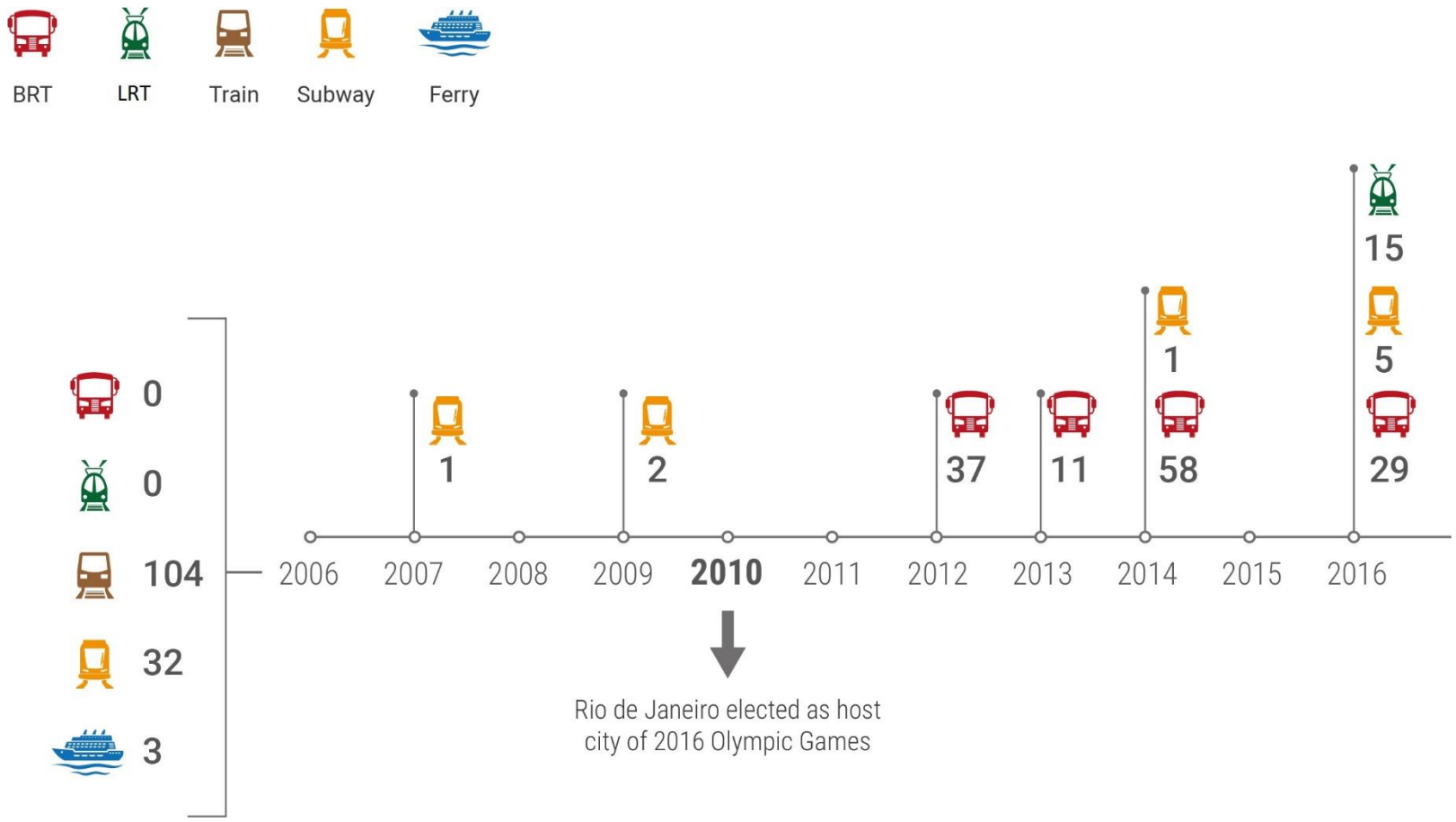
High School



College

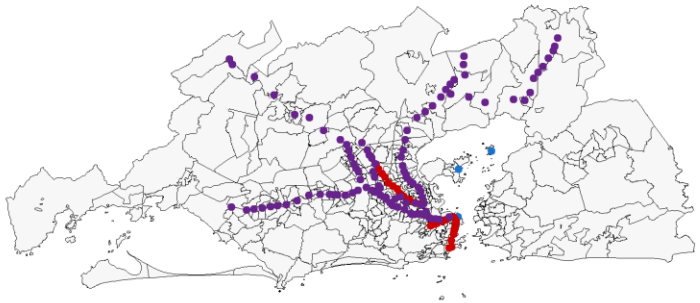


Transport Infrastructure Expansion



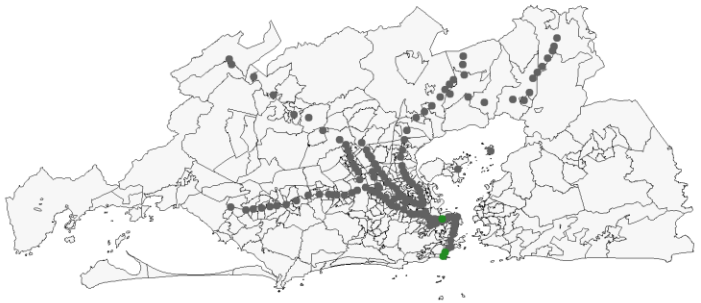
Transport Infrastructure Expansion

2006



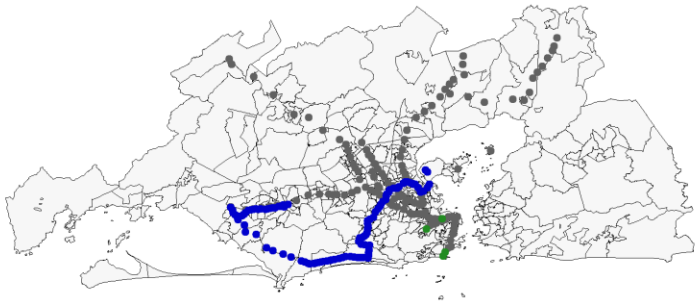
- ferry
- subway
- train

2010



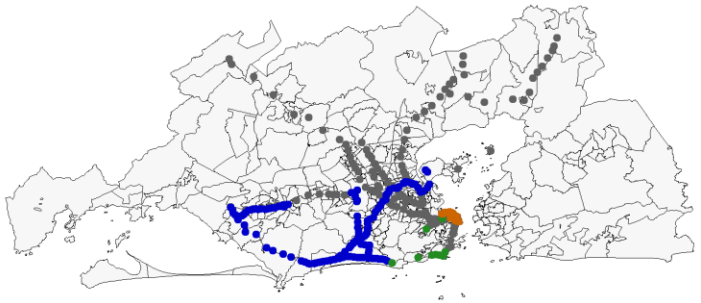
- subway extension

2014



- BRT
- subway extension

2016



- BRT
- subway extension
- LRT

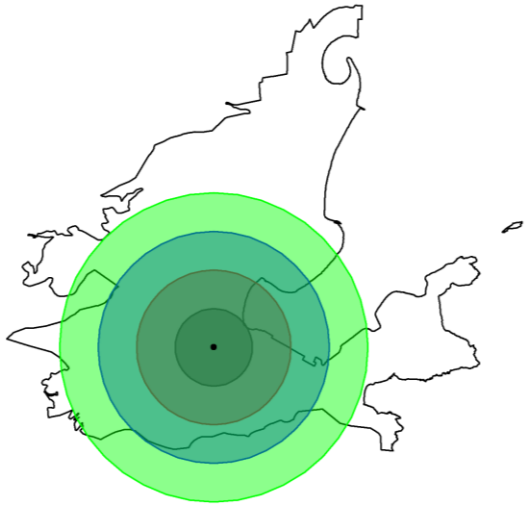
Research questions

1. What are the impacts of new transport stations on the organization of economic activity on its surroundings?

2. What are the overall effects of transport infrastructure expansion on wages, employment, inequality, productivity and welfare? What are the mechanisms?

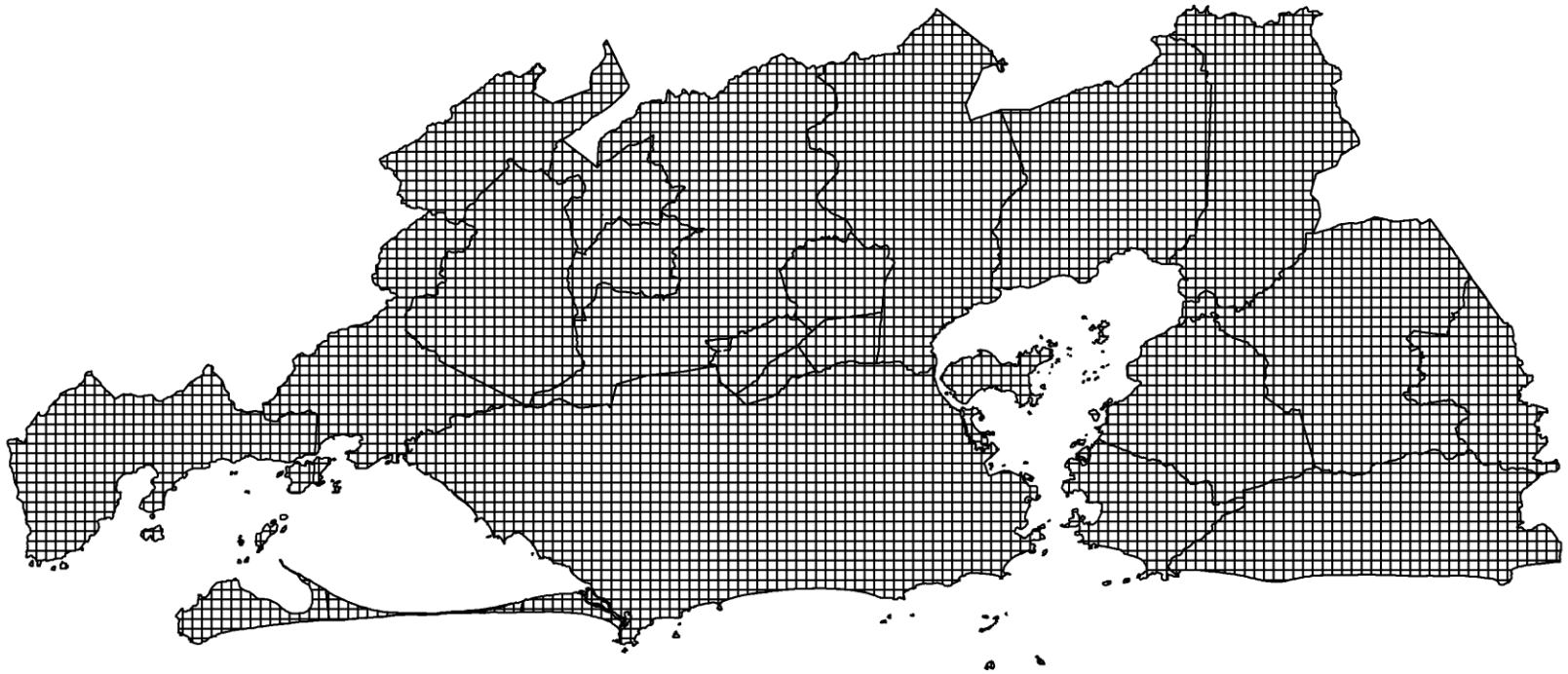
What are the impacts of new transport stations on the organization of economic activity on its surroundings?

- I use a **panel data set** (2006-2016) with a **difference in difference** methodology to estimate the effect of the inauguration of new BRT, subway and LRT stations;



Data

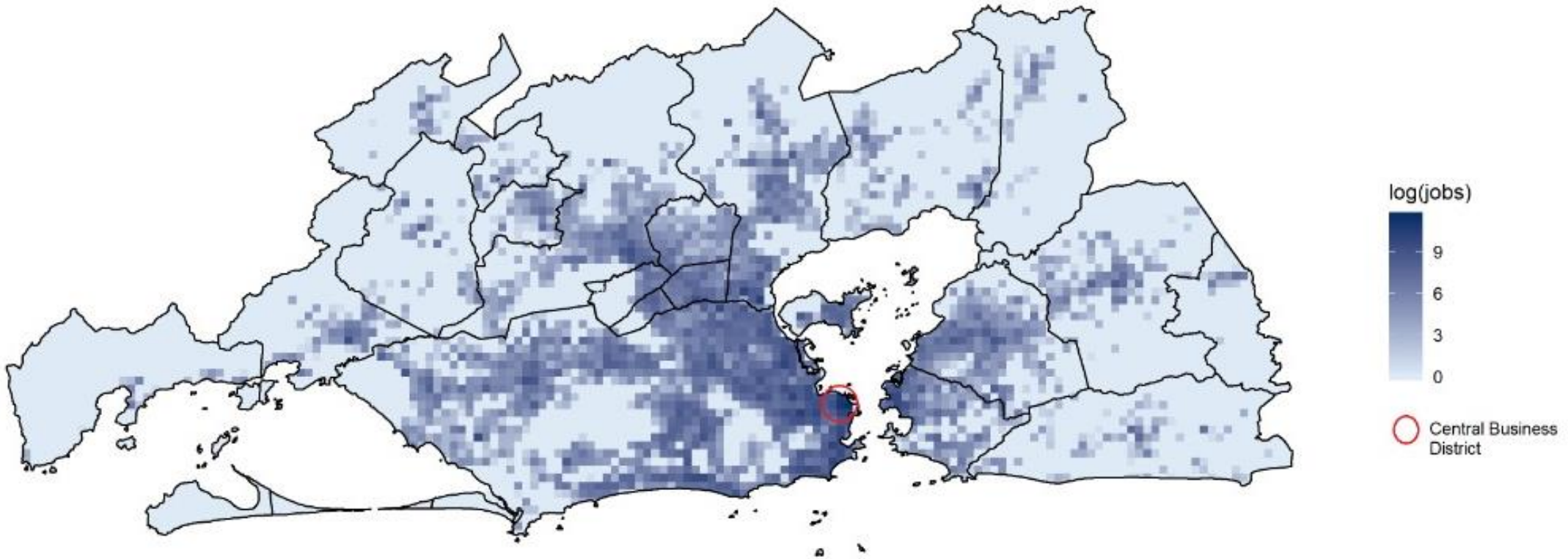
- Panel dataset of 100 square meters square grid from 2006 to 2016
  - I geocoded firms' addresses from RAIS and matched to grid shapefile (580,000 in RJMA, 123,000 in Rio)



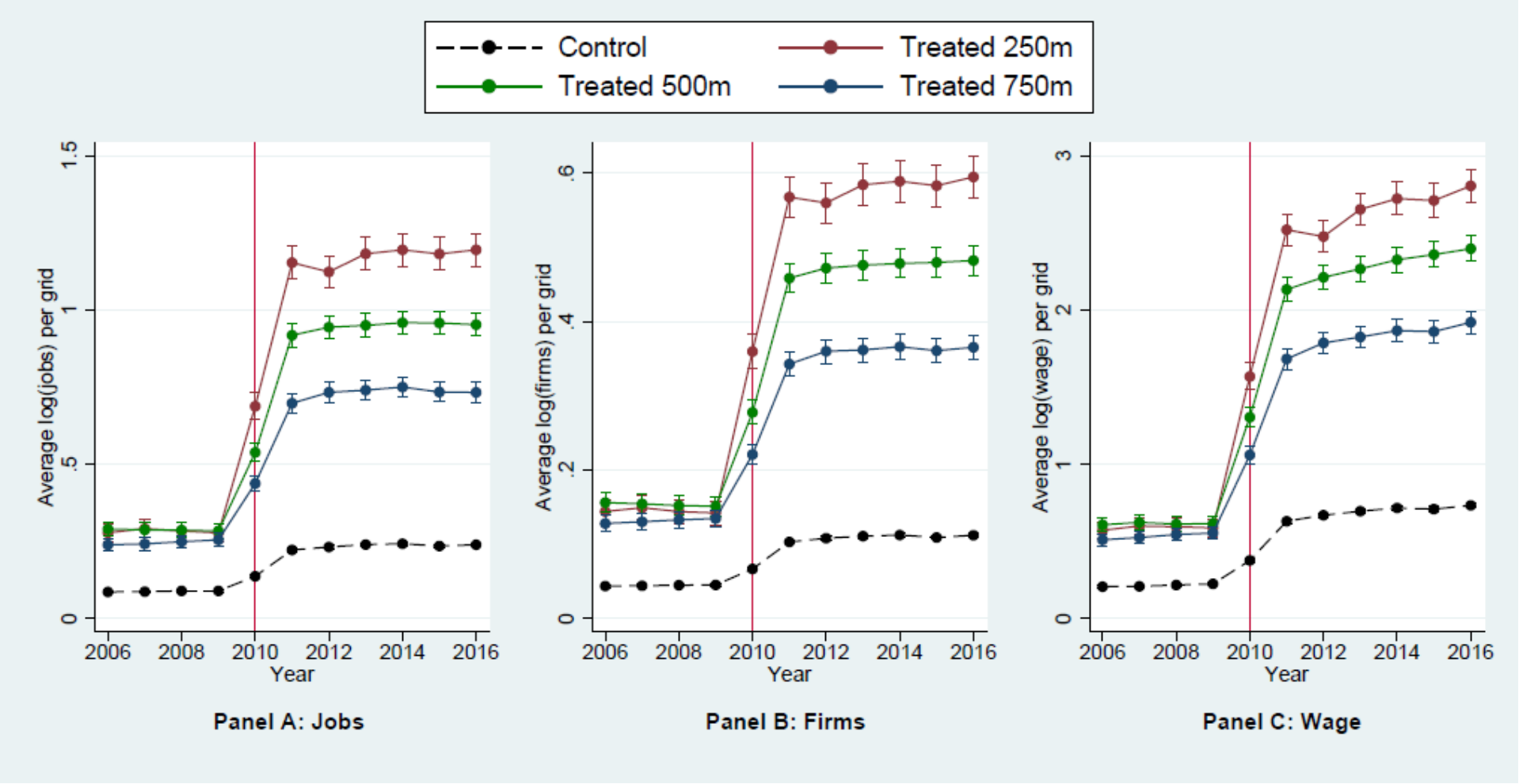
Data

- Number of firms
  - Per firms' size (0, 1, 2-10, 11-20, 21+)
  - Per sector of activity (construction, service, commerce, industry, agriculture and public administration)
- Number of jobs and average wage
  - Per workers' educational level (no high school, high school, college)

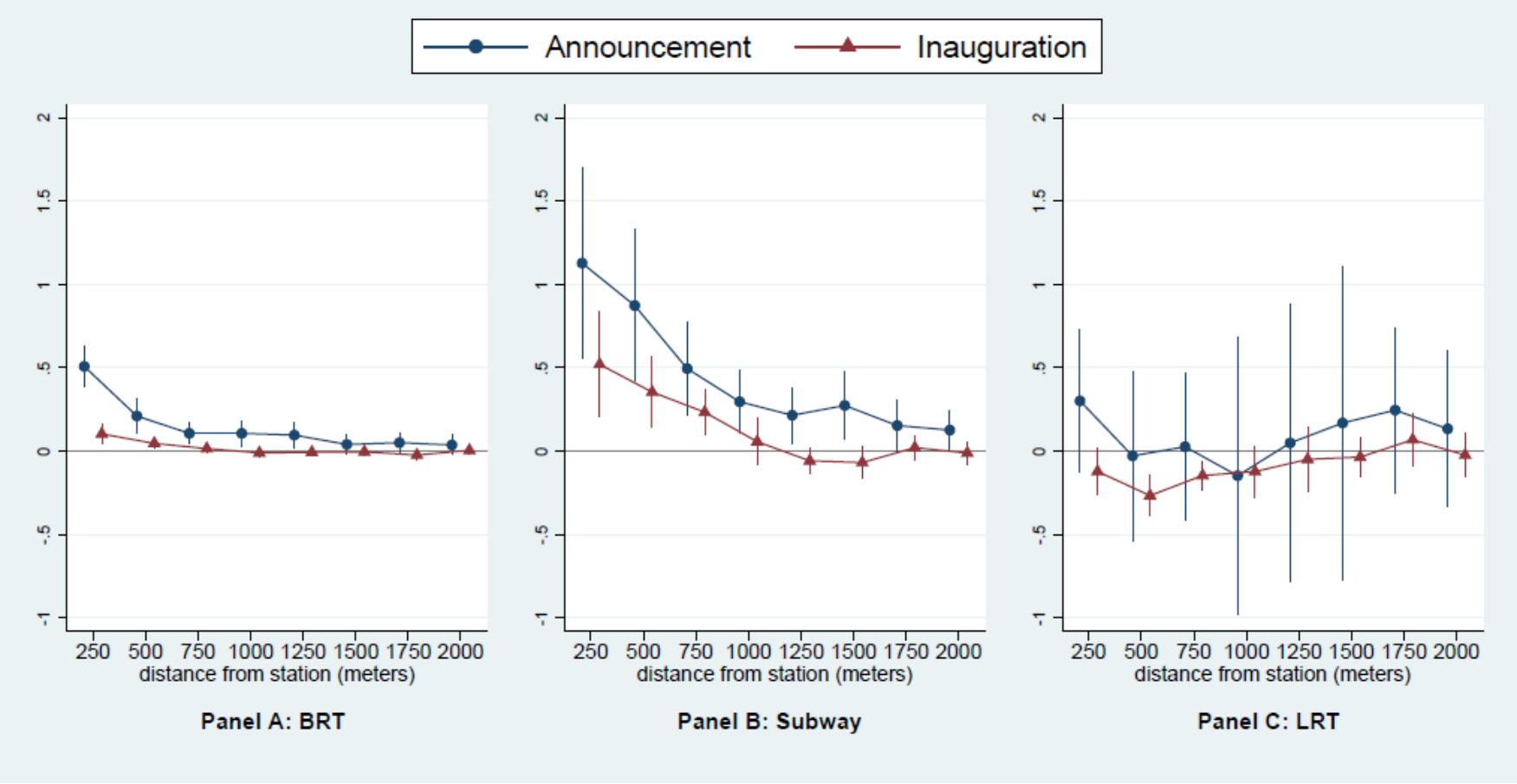
Number of firms per grid



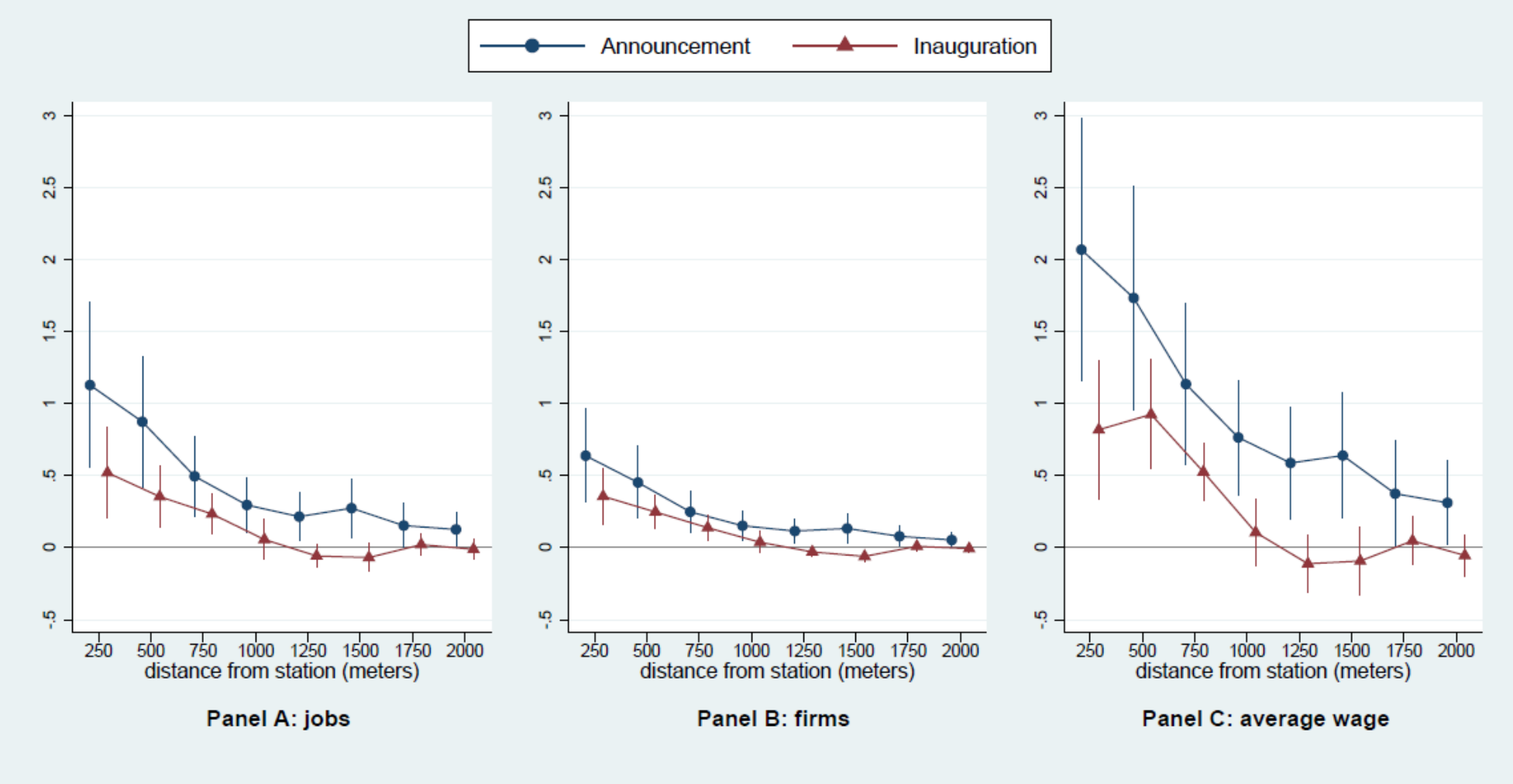
Descriptive statistics: treatment and control groups



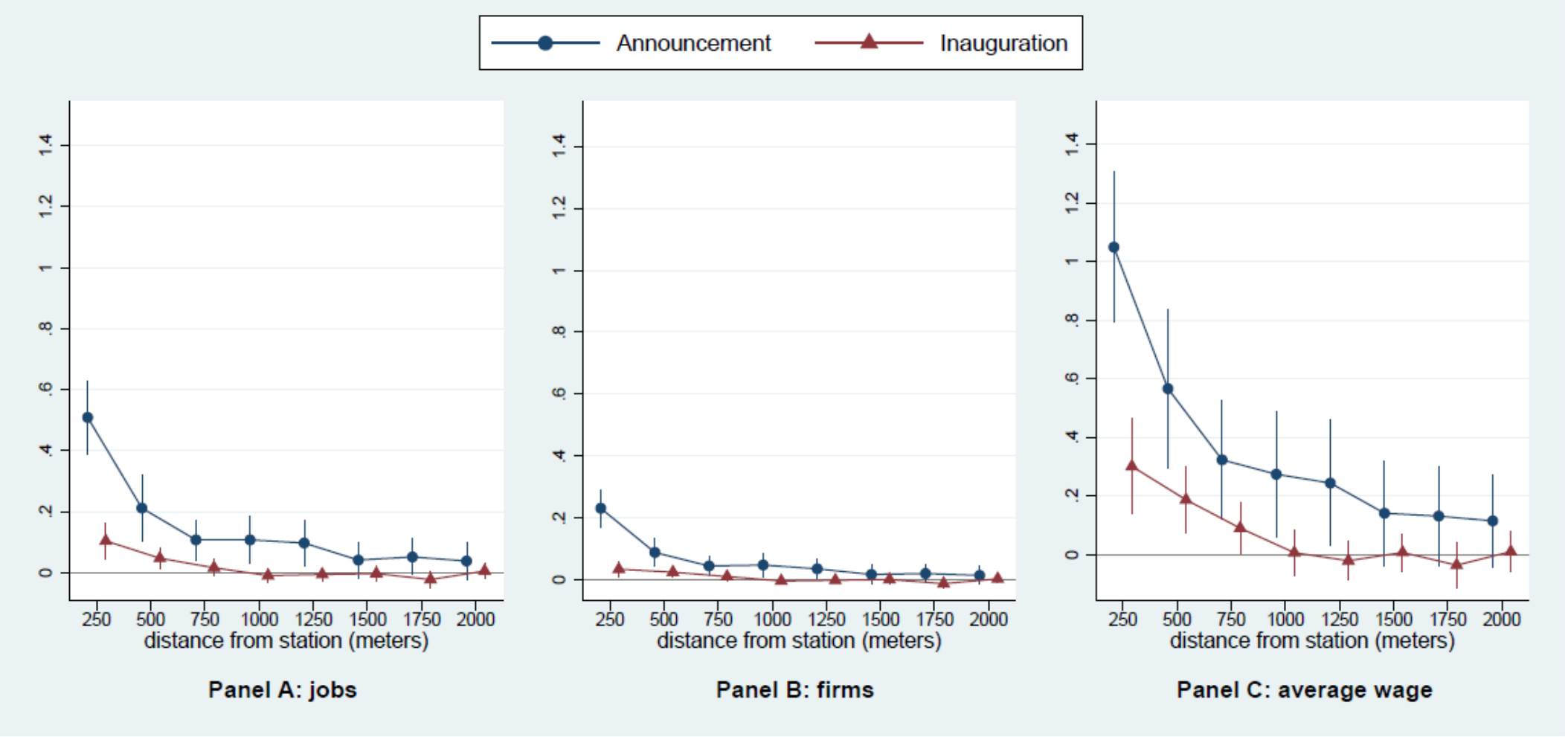
Results


Announcement
Inauguration
2
1.5
1
.5
0
-.5
-1
250 500 750 1000 1250 1500 1750 2000
distance from station (meters)
Panel A: BRT
Panel B: Subway
Panel C: LRT

Results: subway



Results: BRT


Announcement
Inauguration
0
.2
.4
.6
.8
1
1.2
1.4
250
500
750
1000
1250
1500
1750
2000
distance from station (meters)
Panel A: jobs
Panel B: firms
Panel C: average wage

Results: heterogeneity

- **Educational level**
  - average wages: homogeneous effects
  - number of jobs: workers up to high school are twice the magnitude of effects for college workers
- **Sector of activity**
  - commerce and service;
- **Firm size**
  - Firms up to ten employees.
- **City sprawl**

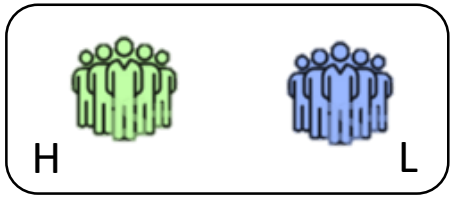
What are the overall effects of transport infrastructure expansion?

- To uncover general equilibrium effects, I need a model that incorporates that **firms and workers reallocate** in response to new commuting costs.

- I propose a model in which **high-** and **low-skilled workers** sort over where to live and work between heterogenous city blocks.

The model

1º Choice:
Move or not to the city



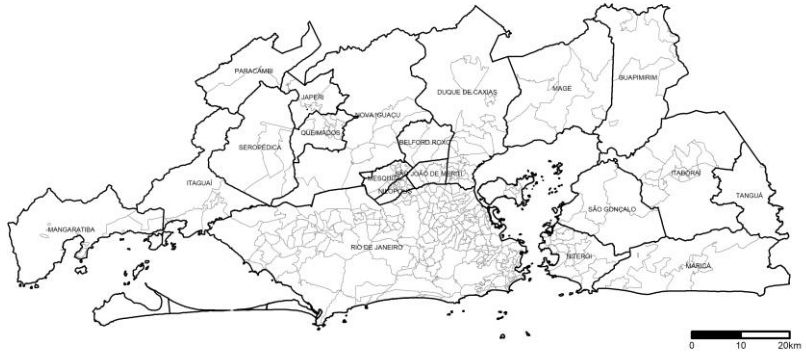
Workers

Wider economy

$\overline{U_H}$, $\overline{U_L}$

The City

$E[u_H], E[u_L]$



z_{ijH}, z_{ijL}

2º Choice:
Where to live (i) and work (j)

Residence

B_i, Q_i

Commuting costs

d_{ijH}, d_{ijL}

Workplace

w_{jH}, w_{jL}

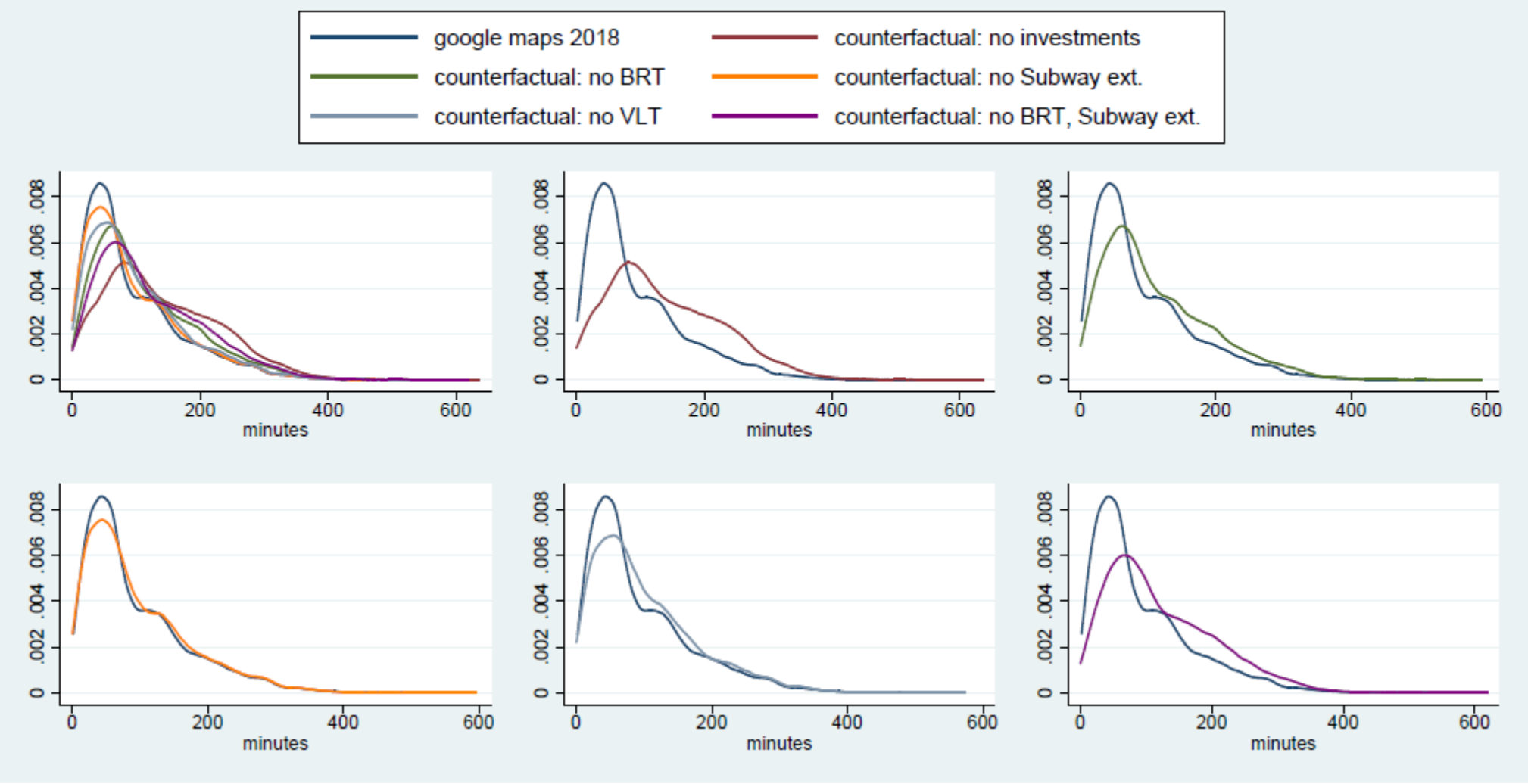
Firms

$A_i, q_i,$
w_{jH}, w_{jL}

Data

- Census 2010
  - Number of high- and low-skilled households
  - Proportion of high- and low-skilled workers that commute up to an hour
  - Dispersion of high- and low-skilled average wage per residence location
- RAIS 2010
  - Number of high- and low-skilled workers
  - Dispersion of high-skilled average wage per workplace
- Origin-Destination Survey 2011
- Google Maps API 2018

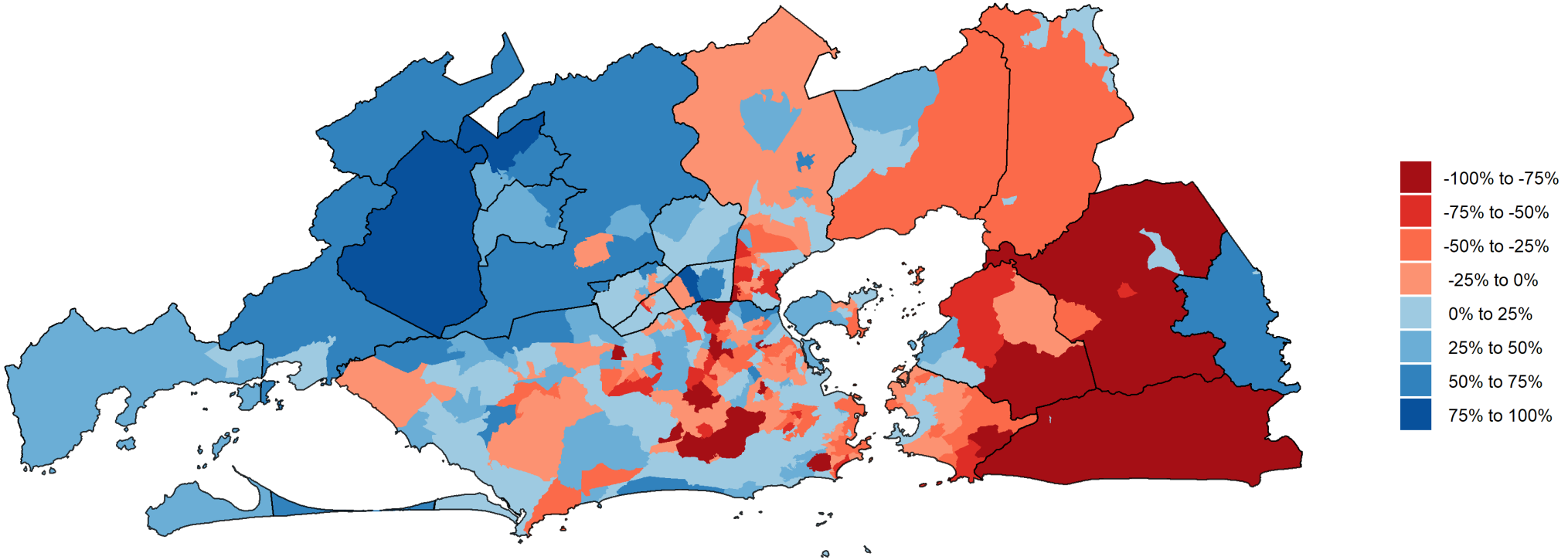
Results


google maps 2018
counterfactual: no BRT
counterfactual: no VLT
counterfactual: no investments
counterfactual: no Subway ext.
counterfactual: no BRT, Subway ext.
0
.002
.004
.006
.008
0
200
400
600
minutes

Results

	All	Low-skilled	High-skilled
GDP	11,1		
Rents	8,6		
Welfare		41,9	48,6
Inequality	11,6		
Jobs			
Herfindhal Index	27,9	25,0	20,4
Dissimilarity Index	2,5		
Residents			
Herfindhal Index	-2,7	0,3	-20,8
Dissimilarity Index	-1,3		
Wage premium			
Mean	-28,9		
Dispersion	20,1		
Residential wages			
Mean		7,1	11,8
Dispersion		-12,2	-19,3

Results: residents



Final Remarks

- Evidences suggest that connecting new areas to the central business district results in **lower residential concentration** and **higher employment concentration**.
- The improvement of transportation services allows citizens to work in high productivity locations and live in high amenity locations, which leads to **higher overall welfare**.
- **High-skilled workers experience larger benefits** since they have higher benefits from agglomeration and, consequently, they are able to pay for higher rent prices from lower commuting costs.
- Moreover, due to the **sprawl of residents**, newly connected areas saw an increase in economic activity.
- The bulk of the impact is characterized by **small firms**, from the **commerce** and service sectors; and most of the workforce employed are **low-skilled**.

Obrigada!

mainaccampos@gmail.com