# Moving Citizens and Deterring Criminals: Innovation in Public Transport Facilities

**Gustavo Canavire-Bacarreza**
Inter-American Development Bank

**Juan Carlos Duque**
Universidad EAFIT

**Joaquin A. Urrego**
Syracuse University

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# Preview

- Spatial Difference-in-Difference (SDiD) and Identification of Mechanisms. Flores and Flores-Lagunes (2009), Delgado and Florax (2015), Chagas et al. (2016).
- Empirical exercise for the Metrocable in Medellin (Colombia)
- Neighborhoods immediately next to the Metrocable stations had a reduction in homicides of 40% higher than the rest of the city between 2004-2006. This figure is 51% for the medium-run (2004-2012).
- Positive externalities of the Metrocable in terms of reduction of homicides are observed in neighborhoods farther than 2 kilometers.
- Improvements in labor conditions and increases in police presence account for 40% of the total effect of the Metrocable on homicides in the short-run. In the medium-run, these mechanisms explain a quarter of the total effect.

# Outline

# Outline

# Motivation

The treated neighborhoods before the Metrocable construction:

Source: Medellin Mayor's Office (2009).

# Motivation

The treated neighborhoods after the Metrocable construction:

Source: Flickr and TeleMedellin. Downloaded on Dec, 2019.

# Motivation

The investment was more than just the Metrocable:

Source: Quesada (2013).

# Motivation

- Urban policies are tools to deal with city challenges: labor force efficiency, transportation, and crime.
- Determinants of crime in big cities might affect: payoffs of crime, probability of apprehension, and citizens' characteristics (Glaeser and Sacerdote, 1999). We focus on **infrastructure**.
- This study examines the effects of urban infrastructure on crime and its mechanisms. Could be relevant for cities that implement these systems and those with high crime criminality:
  - Some examples: La Paz, Rio de Janeiro. Mexico City.

# Medellín & Metrocable

- Medellín (Colombia) faces insufficient public transportation and a high incidence of criminal activity.
- Labeled one of the most violent cities in the world 20 years ago, it has had a remarkable reduction in crime rates: 98.2 homicides per 100,000 inhabitants in 2000 to 26.95 in 2014.
- **Metrocable**: cable cart public transportation system introduced in 2004 to reach geographically challenging areas.
- The number of homicides around the two initial metro lines decreased after the implementation of the Metrocable.
- Significant decrease in commuting time and cost of transportation.

# Outline

# The role of public transportation stations

- Loukaitou-Sideris et al. (2001, 2002) finds no direct positive effect of all Los Angeles' metro stations on crime. It depends on the station's characteristics.
- La Vigne (1996, p.191) argues about Washington D.C.'s metro:
  *Metro's success suggests that it is indeed possible to manipulate environments to reduce criminal opportunities. Further, it implies that offenders do consider the costs and benefits of their actions, weighing the risks of apprehension versus the effort and expected payoff, and considering the presence of capable guardians when weighing those risks.*

# The role of public transportation stations

- Levine and Wachs (1986); Brantingham and Brantingham (1993); Loukaitou-Sideris (1999): stations act as **crime attractors** or **generators**.

- Ehrlich (1973); La Vigne (1996); Foster et al. (2010): on the contrary, stations **reduce crime** acting as **safe zones** for citizens and increasing policing.

# A previous Metrocable study

- Cerda et al. (2012) examine the effect of Metrocable on crime using pre and post-implementation surveys.
- The homicide rate decreased 66% more in treated neighborhoods.
- **Pros:** captures the feeling of victimization, uses diverse crime outcomes.
- **Cons:** lack of information at low geographical level, specific control group, perception variables, no spatial specification.

# Outline

# Hypotheses

- Metrocable led to a greater homicide reduction for treated neighborhoods.
- Stations act as security zones.
- **Economic mechanism:** Metrocable has an inclusive effect, improving residents' social opportunities (Lochner (1999); Scorzafave and Soares (2009); Menezes et al. (2013)). This mechanism is supported by the 'Spatial mismatch hypothesis' (Kain, 1992)
- **Police mechanism:** stations have police presence and security cameras, which deter criminal activity (Becker (1968); Ehrlich (1973)).
- There's a spillover effect on neighbors, which could impact broader areas.

# Assumptions

- Treatment (Metrocable) was assigned according to geographical characteristics.
- Neighbors of treated units experienced similar crime reduction patterns as the treated geographical units.
- Spatial side effects can be identified for the last assumption.

# Spatial Diff-in-Diff

- We use a spatial difference-in-difference approach (similar to Delgado and Florax (2015) and Chagas et al. (2016)).
- Crime outcomes:
  - $y_i(1)$ if region $i$ is affected by Metrocable.
  - $y_i(0)$ if region $i$ is not affected.
- A starting model would be:

$$y_{it} = X_{it}\beta + u_{it} \tag{1}$$

# Spatial Diff-in-Diff

- Due to the relevance of the spatial relationship, the correct specification would be:

$$Y_{it} = \rho W_i Y_i + X_{it}\beta + U_{it} \tag{2}$$

Where $W$ is a spatial weight matrix.

# Spatial Diff-in-Diff

- The traditional Diff-in-Diff equation has the form:

$$Y_{it} = X_{it}\beta + \alpha_0 D_i + \alpha_1 t_t + \alpha D_i * t_t + U_{it} \tag{3}$$

Where:

- $t_t$ is a time dummy (0 for pre-treatment and 1 post-treatment).
- $\alpha$ measures the impact of the treatment.
- $D$ is a binary vector which identifies treated units.

# Spatial Diff-in-Diff

- Including spatial effects, the model is re-specified as:

$$\begin{aligned} Y_{it} =& \rho W_i Y_t + X_{it}\beta + \alpha_0 D_i + \alpha_1 t_t + \alpha D_i * t_t + \\ & \alpha_2 W_i D + \delta W_i D * t_t + U_{it} \end{aligned} \tag{4}$$

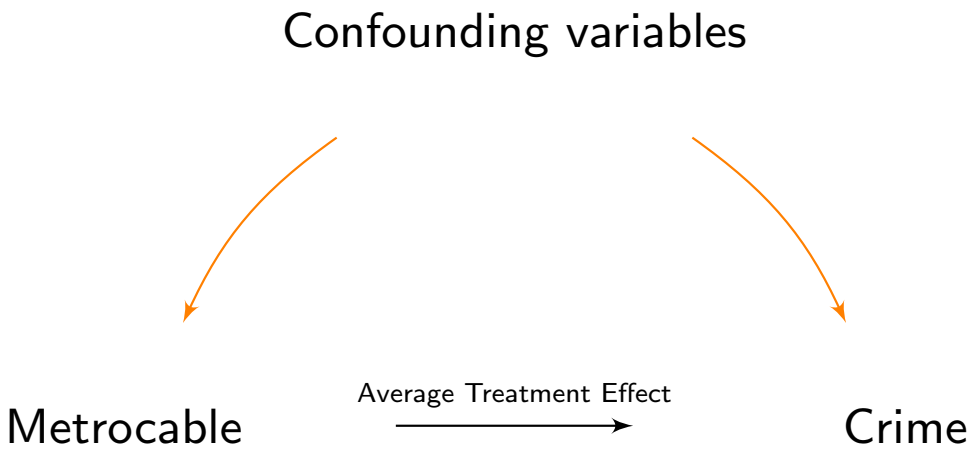
- $\alpha_2$ captures differences between units spatially correlated with treatment and the control group.

- $\delta$ identifies the spatial effect of treatment.

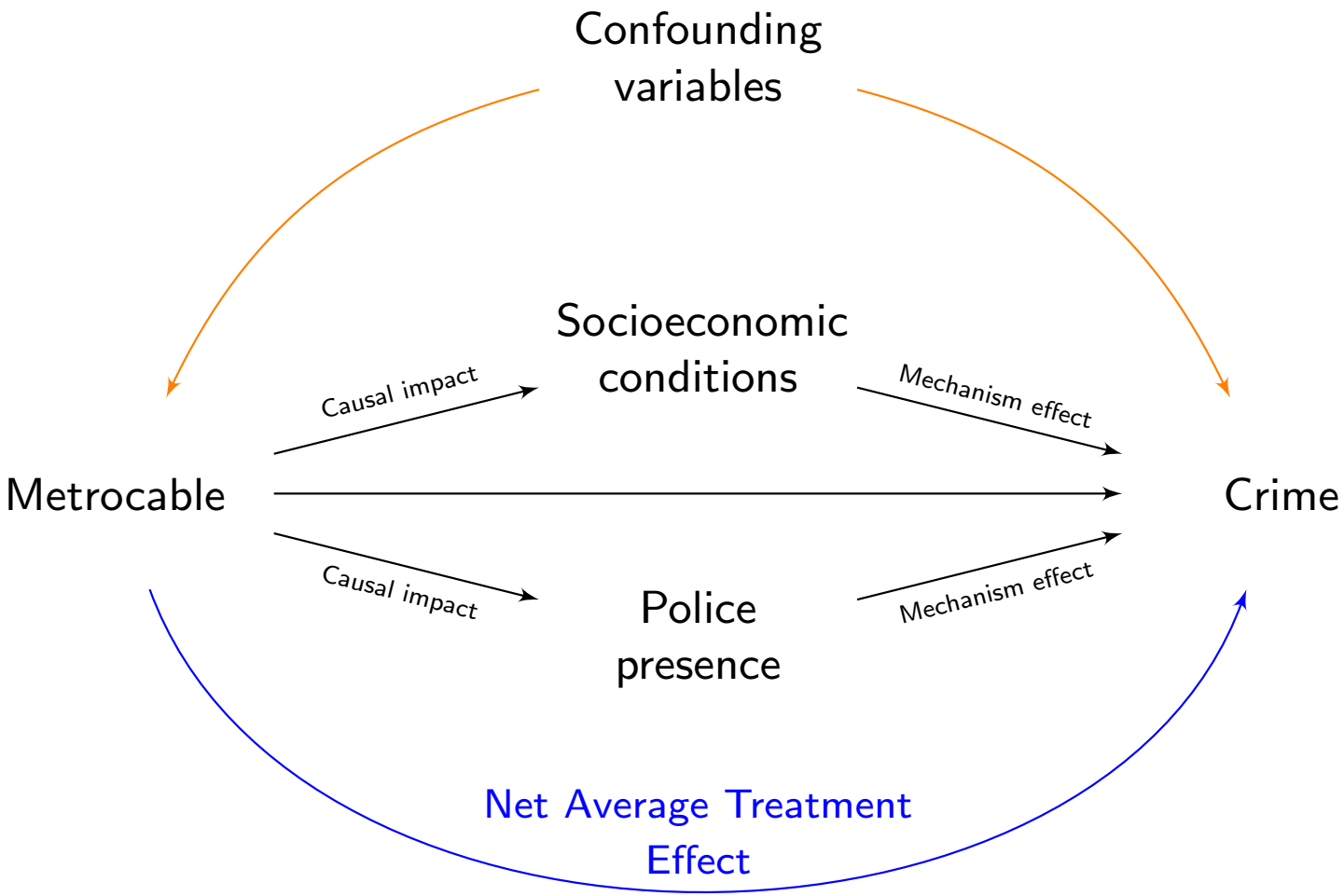
- We evaluate the **average treatment effect**:

$$ATE = E\left[Y\left(1\right) - Y\left(0\right)|X, D, t, WD\right] \tag{5}$$

# Mechanisms


Confounding variables
Metrocable
Average Treatment Effect
Crime

# Mechanisms


Confounding variables
Socioeconomic conditions
Causal impact
Mechanism effect
Metrocable
Crime
Causal impact
Police presence
Mechanism effect
Net Average Treatment Effect

# Main Assumptions

We rely on the following 3 main assumptions to estimate and identify the Mechanism Average Treatment Effect and the Net Average Treatment Effect (Flores and Flores-Lagunes (2009) provide similar assumptions).

$$Y\left(1, S_j\left(1\right)\right), Y\left(0, S_j\left(0\right)\right), Y\left(1, S_j\left(0\right)\right) \perp D \mid X, t, W \tag{6}$$

$$Y\left(1, S_j\left(1\right)\right), Y\left(0, S_j\left(0\right)\right), Y\left(1, S_j\left(0\right)\right) \perp \left\{S_j\left(1\right), S_j\left(0\right)\right\} \mid X, t, W \tag{7}$$

$$E\left[Y\left(1, S_j\right) \mid S_j = s_j,\ X, t, W\right] = f_1\left(s_j,\ X, t, W\right) \tag{8}$$

# Mechanisms

How we do it?

- Estimate the effect of the treatment on the outcome
- Estimate the effect of the mechanism on the outcome
- Obtain the marginal effects of the mechanisms on the outcome (for treated units)
- Plug the obtained effect of the treatment on the mechanism using the marginal effects.

# Outline

# Data sources

- We use georeferenced homicide data as our output.
- We compiled georeferenced data for arrests, burglary
- Complementary covariates are taken from the Quality of Life survey (2004, 2005, 2006, 2012).
- Geographical units of analysis come from the *max-p regions* model from Duque et al. (2012).
- The *max-p regions* model designs regions keeping a number of observations and a high degree of homogeneity, reaching significance at low geographical levels.

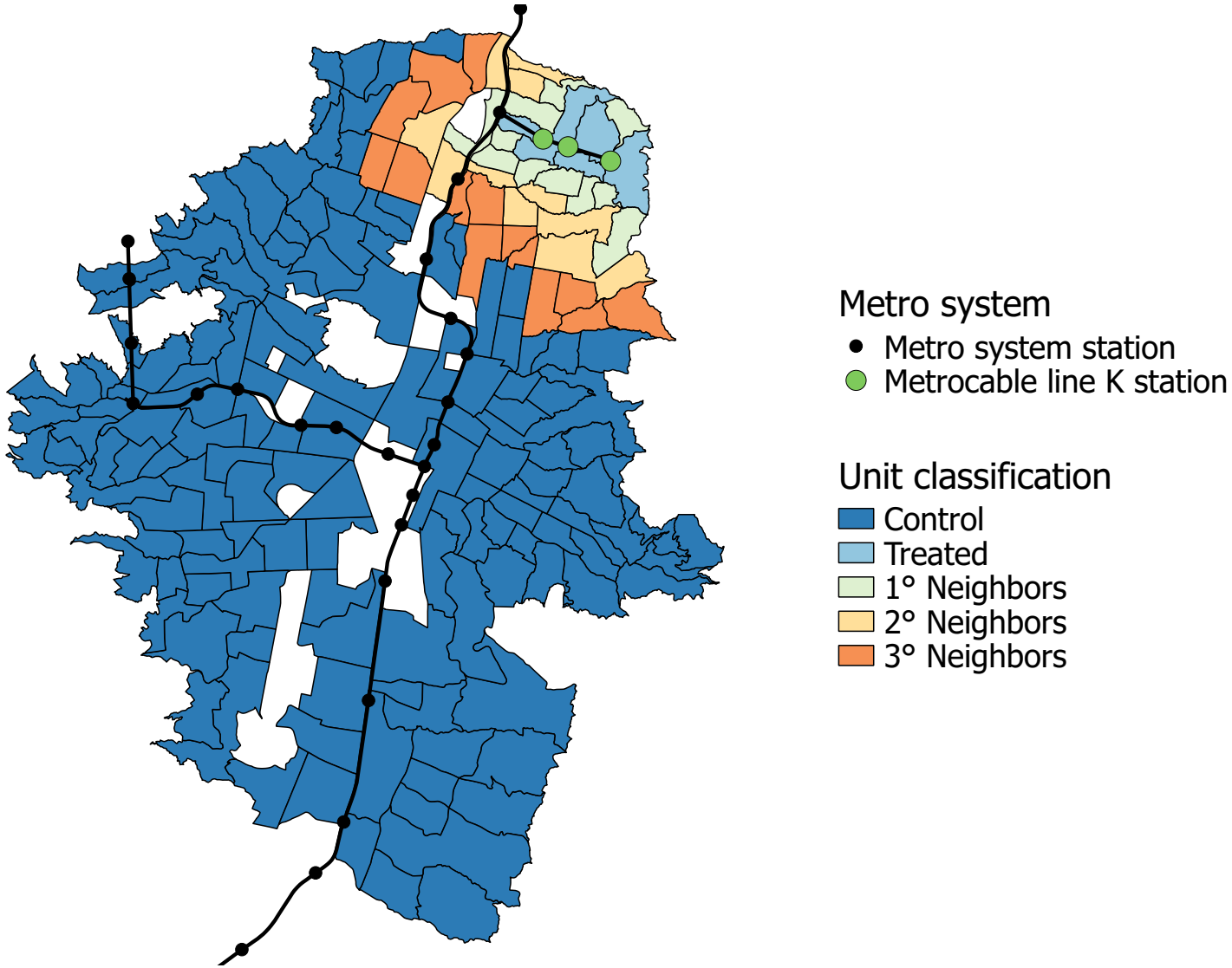
# City's Background

- Geographical barriers: Medellin River
- Between 2004 and 2007 the city spent 6.6 times the construction cost of the Metrocable in 290 complementary programs.
- Public space per resident increased from 0.65 to 1.48 square meters, and the number of trees in the area rose from 154 to 527.
- "Medellin la mas educada"
- "Medellin Solidaria"
- Sex-Ed program to teenagers in 2006.

# Summary statistics

| Variable | Observations | Statistic | Year 2004 | Year 2006 | Year 2012 |
|---|---|---|---|---|---|
| **City data** | | | | | |
| Homicides per 100,000 | | | 50.51 | 35.91 | 52.28 |
| Captures per 100,000 | | | 315.03 | 212.33 | 225.57 |
| % workers without retirement | | | 70.39% | 60.22% | 42.95% |
| Average labor income | | | $667,107 | $542,474 | $929,615 |
| % Married | | | 24.68% | 24.50% | 23.97% |
| % Youth 15-19 not in school | | | 31.84% | 28.17% | 28.17% |
| % Secondary education | | | 45.51% | 41.01% | 39.67% |
| **Treated+1st Neighbors** | | | | | |
| Homicides per 100,000 | 17 | Mean | 54.18 | 20.58 | 25.97 |
| Homicides per 100,000 | 17 | Std. Dev. | 28.53 | 22.93 | 23.77 |
| Captures per 100,000 | 17 | Mean | 194.28 | 72.65 | 118.63 |
| Captures per 100,000 | 17 | Std. Dev. | 74.20 | 53.88 | 69.32 |
| % workers without retirement | 17 | Mean | 77.36% | 74.97% | 58.76% |
| % workers without retirement | 17 | Std. Dev. | 7.77% | 10.40% | 7.77% |
| Average labor income | 17 | Mean | $393,935 | $386,661 | $482,469 |
| Average labor income | 17 | Std. Dev. | $46,474 | $52,504 | $48,231 |
| **No treated** | | | | | |
| Homicides per 100,000 | 159 | Mean | 58.56 | 35.41 | 51.57 |
| Homicides per 100,000 | 159 | Std. Dev. | 111.57 | 42.58 | 61.88 |
| Captures per 100,000 | 159 | Mean | 505.94 | 253.90 | 305.05 |
| Captures per 100,000 | 159 | Std. Dev. | 1726.42 | 888.07 | 700.51 |
| % workers without retirement | 159 | Mean | 69.35% | 58.25% | 40.83% |
| % workers without retirement | 159 | Std. Dev. | 13.79% | 13.54% | 15.14% |
| Average labor income | 159 | Mean | $789,289 | $582,321 | $1,000,106 |
| Average labor income | 159 | Std. Dev. | $582,971 | $363,935 | $736,281 |

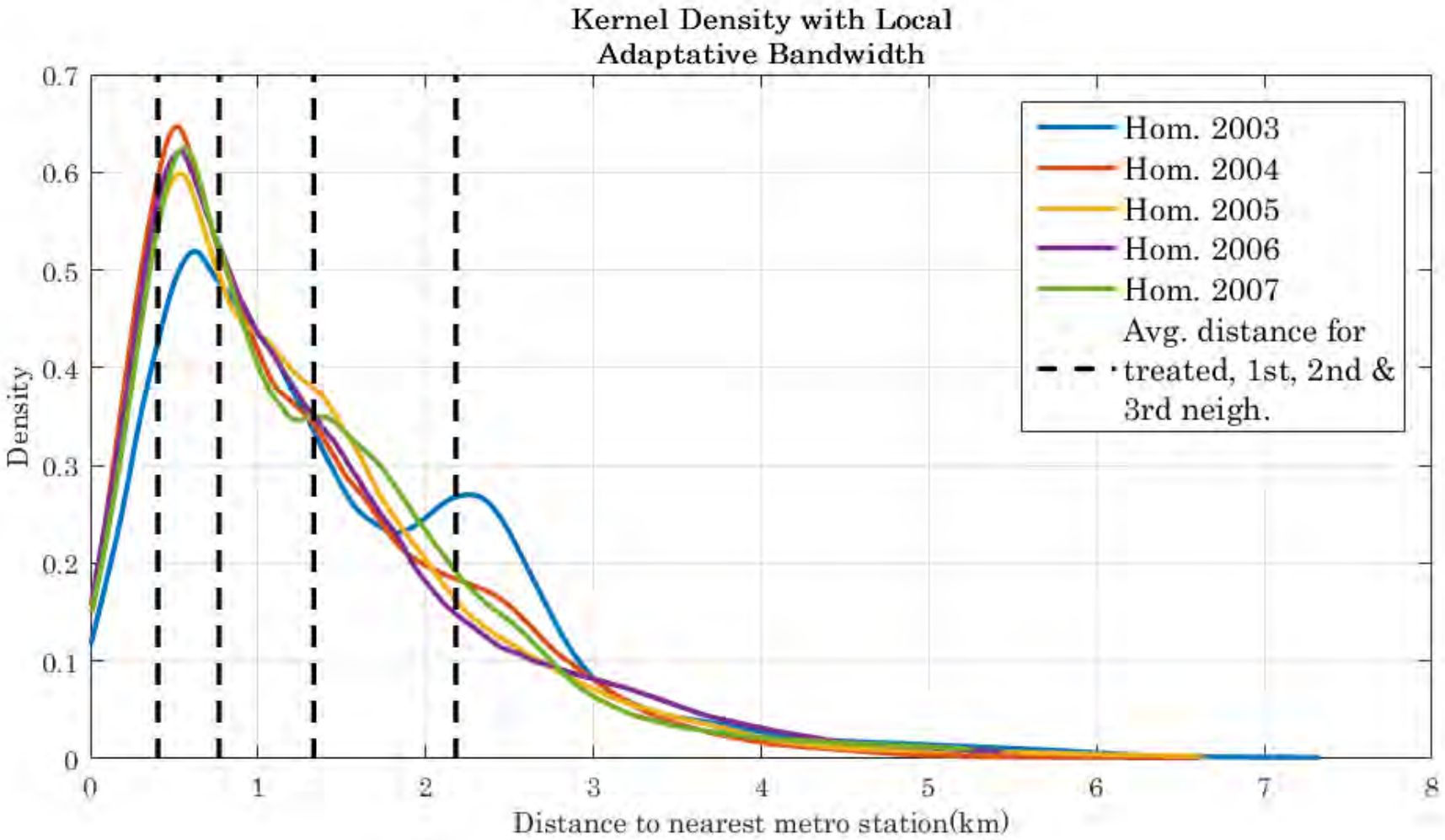
# Max-p regions and treatment levels



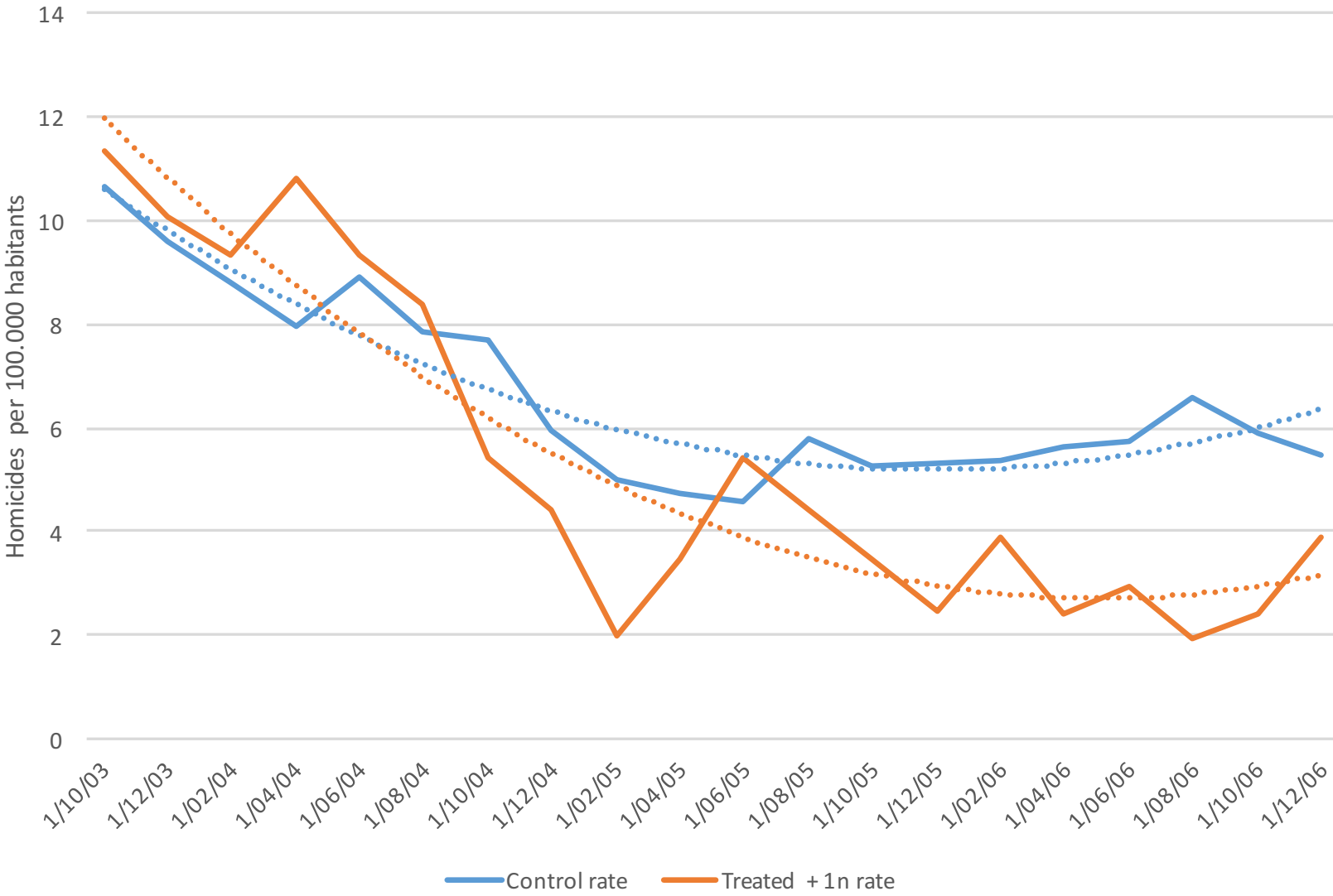
# Sample size and distance to treatment

| | Mean distance to nearest Metrocable Line K station (Km) | | Number of geographical units in group | |
|---|---|---|---|---|
| **Group** | Neighborhoods | Maxp 30 | Neighborhoods | Maxp 30 |
| 1st Neighbors | 0.69 | 0.77 | 11 | 11 |
| 2nd Neighbors | 1.15 | 1.33 | 13 | 10 |
| 3rd Neighbors | 1.84 | 2.18 | 9 | 14 |
| Others | 6.65 | 6.82 | 186 | 135 |
| **Total** | 5.65 | 5.54 | 226 | 176 |

# Homicide distribution



# Pre and post-treatment behavior of homicides



# Outline

# Main results

| Dependent: ln(Homicides+1) | Treated | | Treated + 1st Neighbors | | Treated + 2nd Neighbors | | Treated + 3rd Neighbors | |
|---|---|---|---|---|---|---|---|---|
| **Short impact (2004-2006)** | | | | | | | | |
| Total Impact | -0.388 | * | -0.511 | *** | -0.163 | | -0.089 | |
| | (0.23) | | (0.19) | | (0.18) | | (0.17) | |
| | -32.17% | | -40.00% | | -15.00% | | -8.54% | |
| Net of Economic mechanism | -0.350 | | -0.443 | ** | -0.117 | | -0.051 | |
| | (0.22) | | (0.19) | | (0.18) | | (0.16) | |
| | - | | 13.37% | | - | | - | |
| Net of Police mechanism | -0.359 | | -0.422 | ** | -0.138 | | -0.062 | |
| | (0.22) | | (0.19) | | (0.17) | | (0.15) | |
| | - | | 17.45% | | - | | - | |
| Net of Both mechanisms | -0.278 | | -0.298 | | -0.049 | | 0.016 | |
| | (0.22) | | (0.19) | | (0.17) | | (0.15) | |
| | - | | 41.76% | | - | | - | |
| **Medium impact (2004-2012)** | | | | | | | | |
| Total Impact | -0.633 | * | -0.721 | *** | -0.585 | *** | -0.612 | *** |
| | (0.37) | | (0.22) | | (0.20) | | (0.17) | |
| | -46.89% | | -51.40% | | -44.29% | | -45.78% | |
| Net of Economic mechanism | -0.577 | | -0.687 | *** | -0.568 | *** | -0.600 | *** |
| | (0.37) | | (0.22) | | (0.20) | | (0.17) | |
| | - | | 4.83% | | 2.92% | | 2.02% | |
| Net of Police mechanism | -0.480 | | -0.629 | *** | -0.486 | *** | -0.483 | *** |
| | (0.37) | | (0.21) | | (0.18) | | (0.16) | |
| | - | | 12.80% | | 16.87% | | 21.06% | |
| Net of Both mechanisms | -0.376 | | -0.560 | *** | -0.440 | ** | -0.443 | *** |
| | (0.37) | | (0.21) | | (0.18) | | (0.16) | |
| | - | | 22.35% | | 24.71% | | 27.61% | |

# Main results

| Dependent: ln(Homicides+1) | Treated | | Treated + 1st Neighbors | | Treated + 2nd Neighbors | | Treated + 3rd Neighbors | |
|---|---|---|---|---|---|---|---|---|
| **Short impact (2004-2006)** | | | | | | | | |
| Total Impact | -0.388 | * | -0.511 | *** | -0.163 | | -0.089 | |
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| Net of Police mechanism | -0.359 | | -0.422 | ** | -0.138 | | -0.062 | |
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| | - | | 17.45% | | - | | - | |
| Net of Both mechanisms | -0.278 | | -0.298 | | -0.049 | | 0.016 | |
| | (0.22) | | (0.19) | | (0.17) | | (0.15) | |
| | - | | **41.76%** | | - | | - | |
| **Medium impact (2004-2012)** | | | | | | | | |
| Total Impact | -0.633 | * | -0.721 | *** | -0.585 | *** | -0.612 | *** |
| | (0.37) | | (0.22) | | (0.20) | | (0.17) | |
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| | (0.37) | | (0.22) | | (0.20) | | (0.17) | |
| | - | | 4.83% | | 2.92% | | 2.02% | |
| Net of Police mechanism | -0.480 | | -0.629 | *** | -0.486 | *** | -0.483 | *** |
| | (0.37) | | (0.21) | | (0.18) | | (0.16) | |
| | - | | 12.80% | | 16.87% | | 21.06% | |
| Net of Both mechanisms | -0.376 | | -0.560 | *** | -0.440 | ** | -0.443 | *** |
| | (0.37) | | (0.21) | | (0.18) | | (0.16) | |
| | - | | **22.35%** | | **24.71%** | | **27.61%** | |

# Robustness checks

- Crime Displacement
- Neighborhoods as analytical units
- Placebo test: a no so fake Metrocable
- Buffers
- Genetic Matching
- Other crimes
- Endogeneity of captures
- Monthly structure including pre-treatment periods

# Sequential estimations: criminal displacement?

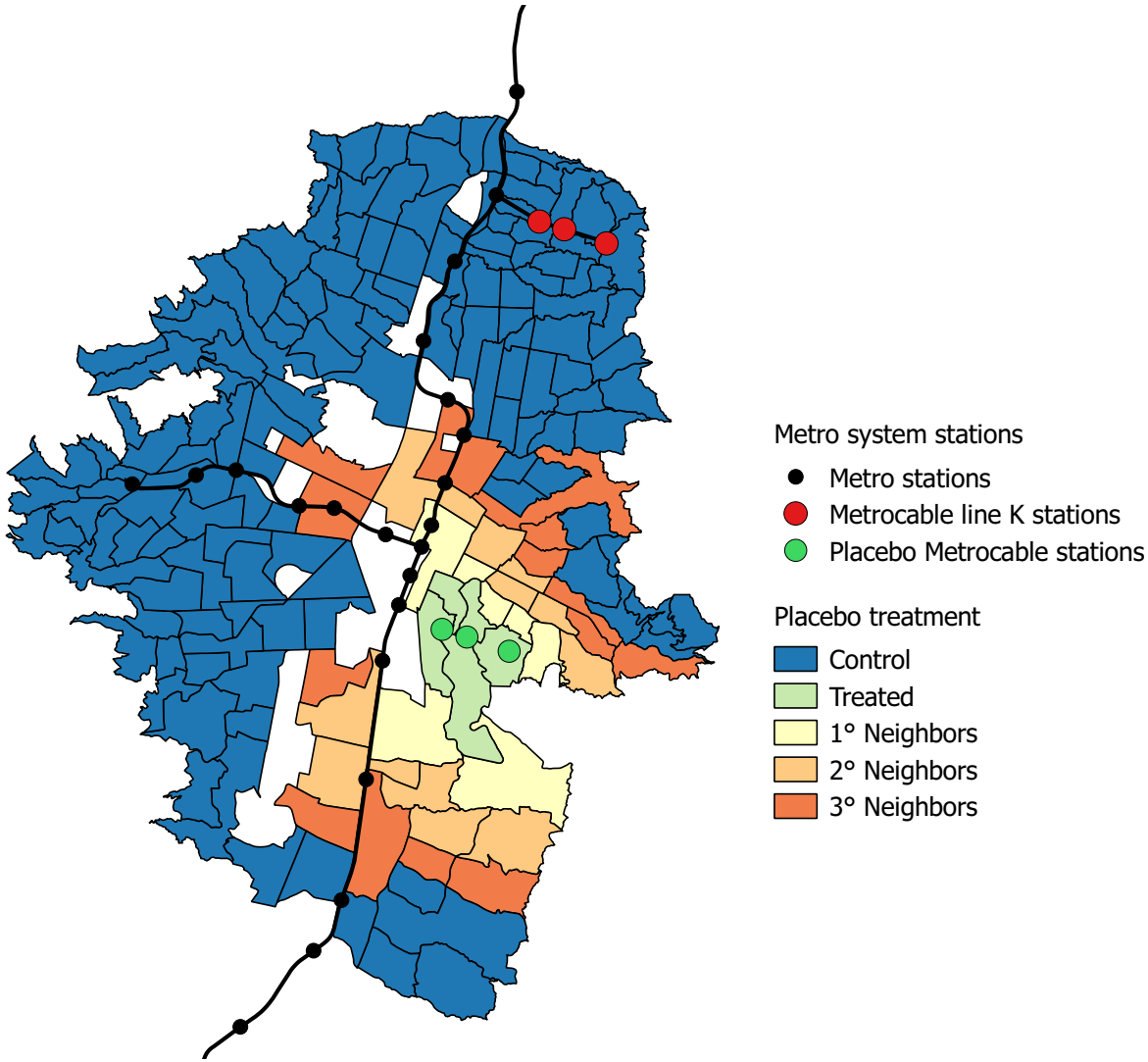
## Spatial Diffs-in-Diffs using Max-p regions

| **Dependent: ln(Homicides+1)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Short impact (2004-2006)** | | | | | | | |
| | Treated | | 1st Neighbors | | 2nd Neighbors | | 3rd Neighbors | |
| Treated | -0.388 | * | | | | | | |
| | (0.23) | | | | | | | |
| Treated + 1st Neighbors | -0.415 | * | -0.564 | ** | | | | |
| | (0.23) | | (0.26) | | | | | |
| Treated + 2nd Neighbors | -0.388 | * | -0.527 | ** | 0.389 | | | |
| | (0.22) | | (0.26) | | (0.31) | | | |
| Treated + 3rd Neighbors | -0.392 | * | -0.528 | ** | 0.392 | | 0.055 | |
| | (0.23) | | (0.26) | | (0.32) | | (0.26) | |
| | **Medium impact (2004-2012)** | | | | | | | |
| | Treated | | 1st Neighbors | | 2nd Neighbors | | 3rd Neighbors | |
| Treated | -0.633 | * | | | | | | |
| | (0.37) | | | | | | | |
| Treated + 1st Neighbors | -0.684 | * | -0.742 | *** | | | | |
| | (0.36) | | (0.26) | | | | | |
| Treated + 2nd Neighbors | -0.717 | ** | -0.769 | *** | -0.319 | | | |
| | (0.36) | | (0.26) | | (0.33) | | | |
| Treated + 3rd Neighbors | -0.785 | ** | -0.829 | *** | -0.378 | | -0.534 | ** |
| | (0.37) | | (0.26) | | (0.34) | | (0.27) | |

# Robustness test: neighborhoods as geo-units

| Dependent: ln(Homicides+1) | Treated | | Treated + 1st Neighbors | | Treated + 2nd Neighbors | | Treated + 3rd Neighbors | |
|---|---|---|---|---|---|---|---|---|
| **Difference-in-Differences** | | | | | | | | |
| | | | **Short Impact (2004-2006)** | | | | | |
| Total Impact | -0.430 | * | -0.501 | ** | -0.133 | | -0.041 | |
| | (0.23) | | (0.20) | | (0.17) | | (0.16) | |
| | -34.98% | | -39.38% | | -12.47% | | -4.00% | |
| | | | **Medium Impact (2004-2012)** | | | | | |
| Total Impact | -0.619 | * | -0.676 | *** | -0.605 | *** | -0.561 | *** |
| | (0.32) | | (0.22) | | (0.18) | | (0.17) | |
| | -46.17% | | -49.12% | | -45.39% | | -42.96% | |
| **Spatial Difference-in-Differences** | | | | | | | | |
| | | | **Short Impact (2004-2006)** | | | | | |
| Total Impact | -0.435 | ** | -0.523 | *** | -0.150 | | -0.058 | |
| | (0.22) | | (0.20) | | (0.16) | | (0.16) | |
| | -35.27% | | -40.74% | | -13.89% | | -5.64% | |
| | | | **Medium Impact (2004-2012)** | | | | | |
| Total Impact | -0.588 | * | -0.676 | *** | -0.601 | *** | -0.553 | *** |
| | (0.31) | | (0.22) | | (0.18) | | (0.17) | |
| | -44.45% | | -49.12% | | -45.18% | | -42.49% | |
| **Number of treated units** | 7 | | 18 | | 31 | | 40 | |
| **Number of control units** | 219 | | 208 | | 195 | | 186 | |

# Placebo test



# Placebo estimation

| Dependent: ln(Homicides+1) | Treated | | Treated + 1st Neighbors | | Treated + 2nd Neighbors | Treated + 3rd Neighbors |
|---|---|---|---|---|---|---|
| **Difference-in-Differences** | | | | | | |
| | | | **Short Impact (2004-2006)** | | | |
| Total Impact | -0.477 | | -0.172 | | -0.123 | -0.218 |
| | (0.42) | | (0.34) | | (0.26) | (0.20) |
| | -37.95% | | -15.82% | | -11.54% | -19.56% |
| | | | **Medium Impact (2004-2012)** | | | |
| Total Impact | -0.661 | ** | -0.441 | | -0.312 | -0.203 |
| | (0.30) | | (0.29) | | (0.24) | (0.18) |
| | -48.35% | | -35.65% | | -26.81% | -18.33% |
| **Spatial Difference-in-Differences** | | | | | | |
| | | | **Short Impact (2004-2006)** | | | |
| Total Impact | -0.524 | | -0.180 | | -0.129 | -0.217 |
| | (0.36) | | (0.30) | | (0.24) | (0.19) |
| | -40.79% | | -16.50% | | -12.14% | -19.54% |
| | | | **Medium Impact (2004-2012)** | | | |
| Total Impact | -0.639 | ** | -0.462 | * | -0.340 | -0.222 |
| | (0.30) | | (0.27) | | (0.23) | (0.18) |
| | -47.23% | | -37.01% | | -28.79% | -19.93% |
| **Number of treated units** | 5 | | 12 | | 24 | 39 |
| **Number of control units** | 171 | | 164 | | 152 | 137 |

# Placebo Metrocable

Beginning 2017, our "fake" Metrocable was opened.

Source: Al Poniente (2016).

# Other Robustness checks

- Crime Displacement
- Neighborhoods as analytical units
- Placebo test: a no so fake Metrocable
- Buffers here
- Genetic Matching here
- Other crimes here
- Endogeneity of captures here
- Monthly structure including pre-treatment periods

# Outline

# Conclusions I

- The point estimates suggest that the implementation of the cable cart did not have an effect in the treated units alone, but had a large and statistically significant effect when considering the treated and neighbor units (up to third-degree, depending on the time frame).
- Our results seem not to rely on the choice of Max-p analytical units, as similar temporal and geographical effects arise when using neighborhoods as observations.
- Migration must not distort our estimates, as treated areas have under-average rates of migrant population (6% - 10%).
- We find no evidence of criminal displacement.
- Our estimates suggest the greatest impact on homicide rates is found in a frame between 500m and 1km from the nearest Metrocable station. This is where neighbor units are mainly located.
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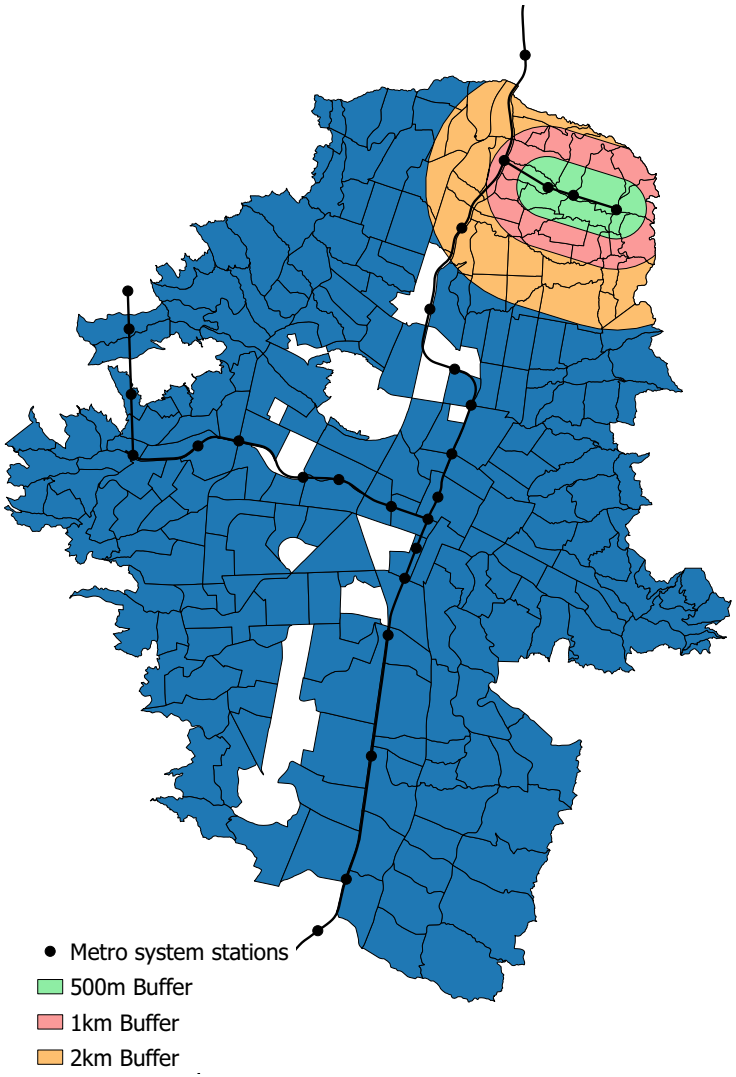
# Conclusions II

- The Metrocable has reduced medium-run homicide rates in first neighbors by 51% while when considering the second neighbors this effect is reduced to 44%.
- In the short run, about 13% of the total effect can be attributed to the economic mechanism, which tends to be reduced in the medium run.
- We find that about 17% of the effect in the short run can be explained by the police mechanism (deterrent), however, this mechanism reduces to about 13% in the medium run.
- Finally, we find that a combination of these two mechanisms explains about 40% of the effect in the short run and near 25% in the medium run.

# Robustness test: buffer estimations




- Neighborhoods as analytical units.
- Units are considered treated if at least 10% of their area lies in the buffer.

# Robustness test: buffer estimations

| Dependent: ln(Homicides+1) | 500m | | 1km | | 2km | |
|---|---|---|---|---|---|---|
| | **Short Impact (2004-2006)** | | | | | |
| Total Impact | -0.335 | | -0.313 | | -0.047 | |
| | (0.21) | | (0.20) | | (0.18) | |
| | -28.45% | | -26.88% | | -4.63% | |
| Net of Economic mechanism | -0.304 | | -0.255 | | -0.035 | |
| | (0.21) | | (0.20) | | (0.17) | |
| | - | | - | | - | |
| Net of Police mechanism | -0.399 | * | -0.265 | | -0.055 | |
| | (0.22) | | (0.19) | | (0.16) | |
| | - | | - | | - | |
| Net of Both mechanisms | -0.300 | | -0.153 | | 0.015 | |
| | (0.23) | | (0.19) | | (0.16) | |
| | - | | - | | - | |
| | **Medium Impact (2004-2012)** | | | | | |
| Total Impact | -0.334 | | -0.628 | *** | -0.578 | *** |
| | (0.26) | | (0.22) | | (0.19) | |
| | -28.42% | | -46.63% | | -43.91% | |
| Net of Economic mechanism | -0.324 | | -0.582 | *** | -0.572 | *** |
| | (0.27) | | (0.22) | | (0.19) | |
| | - | | 7.38% | | 1.16% | |
| Net of Police mechanism | -0.347 | | -0.521 | ** | -0.477 | *** |
| | (0.25) | | (0.21) | | (0.17) | |
| | - | | 16.97% | | 17.52% | |
| Net of Both mechanisms | -0.296 | | -0.449 | ** | -0.431 | ** |
| | (0.26) | | (0.21) | | (0.17) | |
| | - | | 28.43% | | 25.48% | |

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# Robustness test: genetic matching

- Proposed by Diamond and Sekhon (2013), restricts the control set to improve pre-treatment homogeneity.
- Weights for covariates are determined using a genetic search algorithm.
- We perform 1-to-1 matching based on pre-treatment social controls, homicides, and geographical characteristics: elevation and slope.

# Robustness test: genetic matching

| **Analytical regions as spatial units** | | | | | | |
|---|---|---|---|---|---|---|
| | **1st Neighbors** | | **2nd Neighbors** | | **3rd Neighbors** | |
| Short impact (2004-2006) | -0.531 | | -0.532 | ** | -0.410 | * |
| | (0.32) | | (0.24) | | (0.21) | |
| | -41.21% | | -41.28% | | -33.61% | |
| Medium impact (2004-2012) | -1.008 | *** | -0.817 | *** | -0.840 | *** |
| | (0.30) | | (0.24) | | (0.20) | |
| | -63.50% | | -55.82% | | -56.83% | |
| **Neighborhoods as spatial units** | | | | | | |
| | **1st Neighbors** | | **2nd Neighbors** | | **3rd Neighbors** | |
| Short impact (2004-2006) | -0.248 | | -0.284 | | -0.175 | |
| | (0.26) | | (0.23) | | (0.23) | |
| | -22.00% | | -24.72% | | -16.07% | |
| Medium impact (2004-2012) | -0.554 | * | -0.830 | *** | -0.688 | *** |
| | (0.31) | | (0.26) | | (0.22) | |
| | -42.55% | | -56.39% | | -49.75% | |

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# Robustness test: Other Crimes

| Dependent: | Treated | Treated + 1st Neighbors | | Treated + 2nd Neighbors | | Treated + 3rd Neighbors | |
|---|---|---|---|---|---|---|---|
| **ln(Auto Theft+1)** | | | | | | | |
| | | **Short Impact (2004-2006)** | | | | | |
| Total Impact | -0.502 | 0.318 | | 0.502 | ** | 0.477 | ** |
| | (0.35) | (0.30) | | (0.25) | | (0.21) | |
| | -39.50% | 37.44% | | 65.17% | | 61.05% | |
| | | **Medium Impact (2004-2012)** | | | | | |
| Total Impact | -0.199 | -0.278 | | -0.433 | * | -0.518 | ** |
| | (0.28) | (0.25) | | (0.25) | | (0.22) | |
| | -18.08% | -24.28% | | -35.13% | | -40.44% | |
| **ln(Theft to Establishments+1)** | | | | | | | |
| | | **Short Impact (2004-2006)** | | | | | |
| Total Impact | -0.058 | 0.060 | | 0.217 | | 0.176 | |
| | (0.57) | (0.35) | | (0.29) | | (0.25) | |
| | -5.61% | 6.20% | | 24.27% | | 19.23% | |
| | | **Medium Impact (2004-2012)** | | | | | |
| Total Impact | -0.065 | 0.074 | | 0.103 | | 0.269 | |
| | (0.54) | (0.33) | | (0.28) | | (0.23) | |
| | -6.32% | 7.68% | | 10.80% | | 30.81% | |
| **Number of treated units** | 7 | 18 | | 31 | | 40 | |
| **Number of control units** | 219 | 208 | | 195 | | 186 | |

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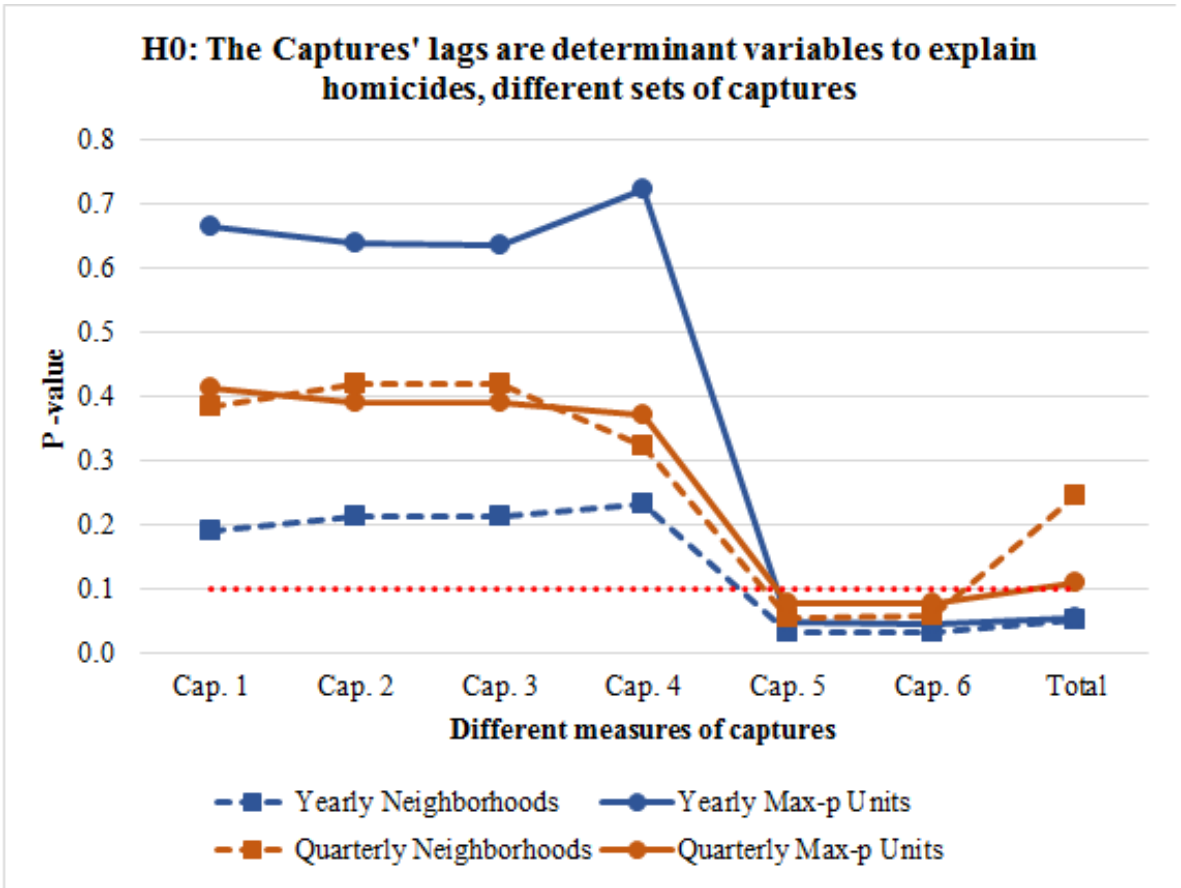
# Robustness test: Endogeneity of captures

$$Hom_{i,t} = \alpha_0 + \sum_{j=1}^{p} \rho_j Hom_{i,t-j} + \sum_{m=0}^{q} \beta_m Cap_{i,t-m}^{(k)} + u_{i,t} \tag{9}$$

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