The Effect of Conditional Cash Transfer Policies on Regional Crime Levels:

Evidence from a Synthetic Controls Framework

Felipe Santos-Marquez
https://felipe-santos.rbind.io

Research Assistant / PhD Student
Chair of International Economics
Technische Universität Dresden
Germany

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[slides available at: https://ersa-felipe-santos.netlify.app]

Motivation:

- large regional inequality between Colombian municipalities and high homicide rates.
- There is no certainty over the effect of conditional transfers on violent crime, and especially on homicides.
- **Scarce academic literature on the impact of CCT programs on crime at the municipal level in Colombia.**

Research Objective:

- Which are determinants of homicide rates for Colombian municipalities?

- **To what extent the coverage of conditional cash transfer program in Colombia (the pacific region of Colombia) may affect homicide rates?**.

Methods:

- Bayesian Model Averaging **BMA** (Fernandez et al. (2001)).
- **Synthetic control methods (Abadie and Gardeazabal (2003)).**

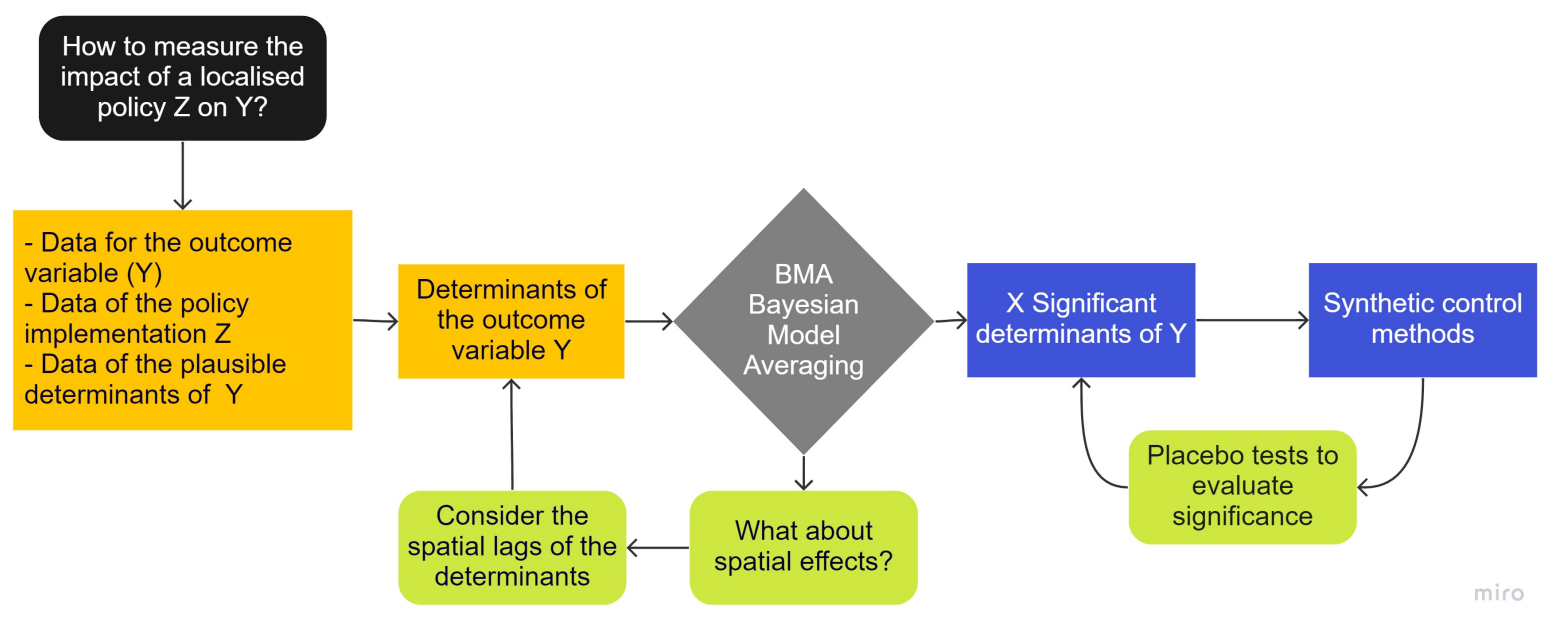
Data:

- Municipal panel dataset CEDE, released by the University of The Andes.
- **National Administrative Department of Statistics.**

Main Results:

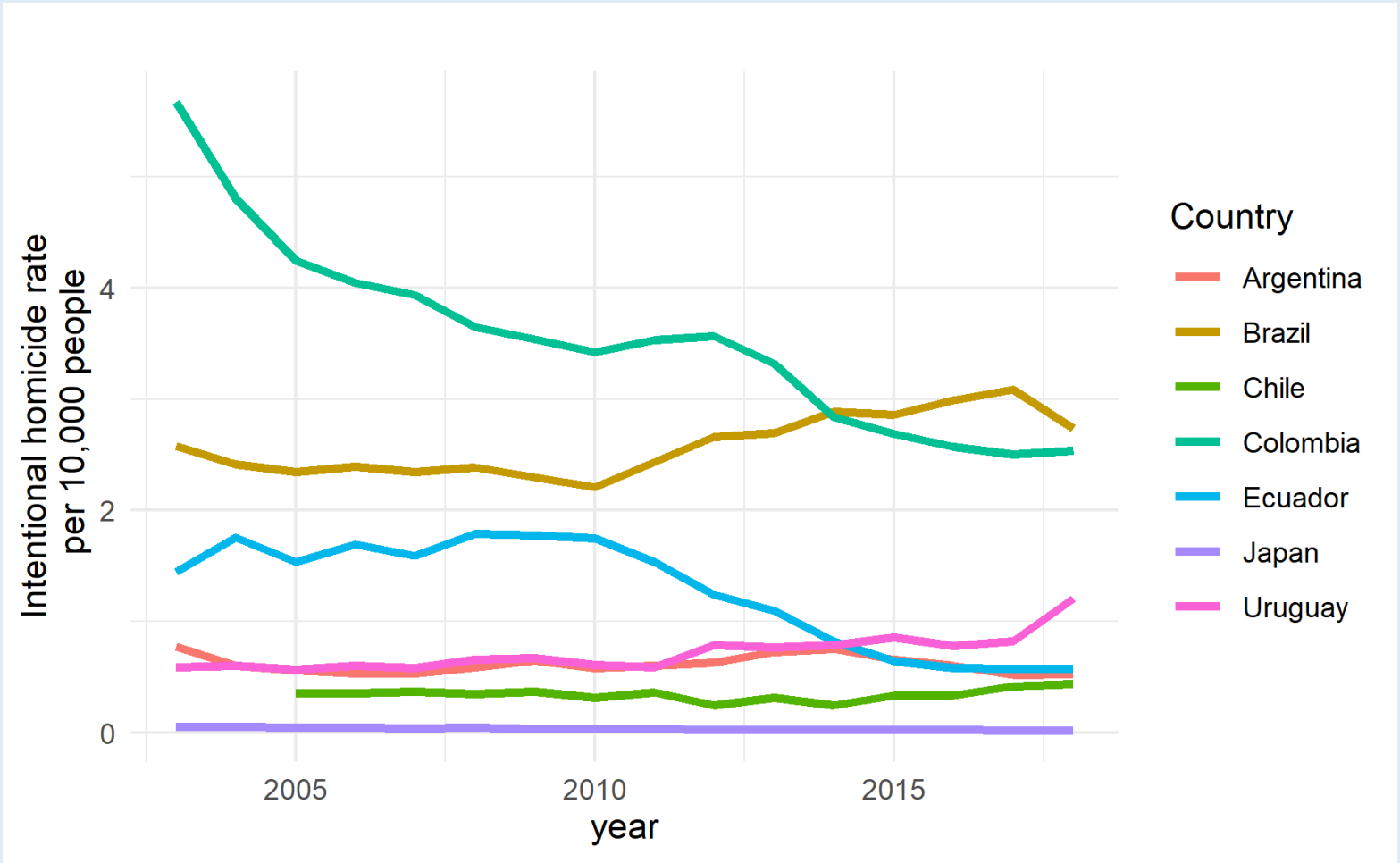
- 15 variables are found to be important determinants of homicide levels. They are related to **crime, inequality, drug-trafficking, conflict and literacy**.
- The importance of spatial effects is highlighted by the fact that out of 15 variables **9 are spatially lagged variables**.
- It was reported that by 2018, **the average homicide rates were lower for high CCTs coverage municipalities** when compared to synthetic controls ("copies" made out of a pool of low CCT coverage municipalities).

The counterfactual methodology for policy evaluation in one figure



$$BMA \rightarrow \ determinants\ of\ Y \rightarrow Synethetic\ Controls \rightarrow The\ impact\ of\ X\ on\ Y$$

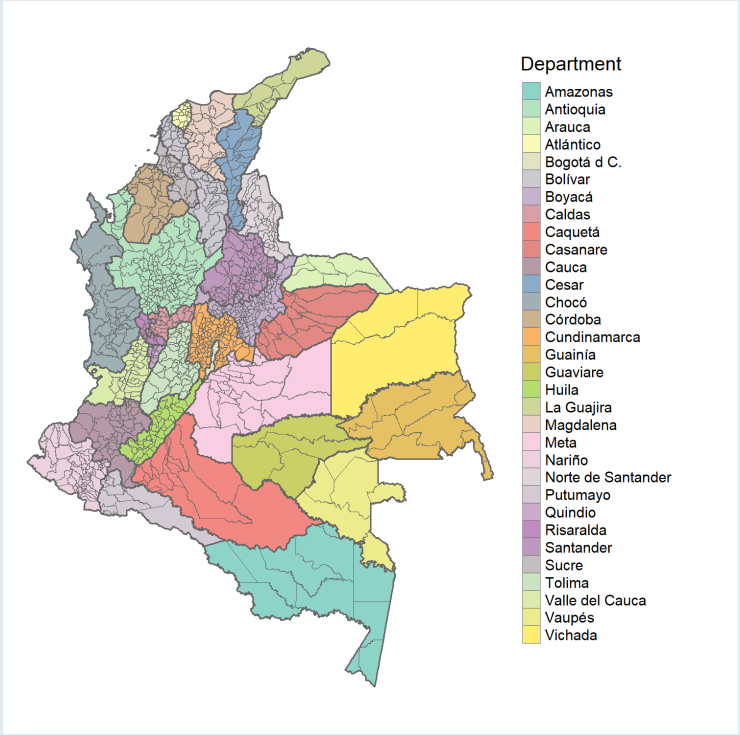
Homicide rates over time



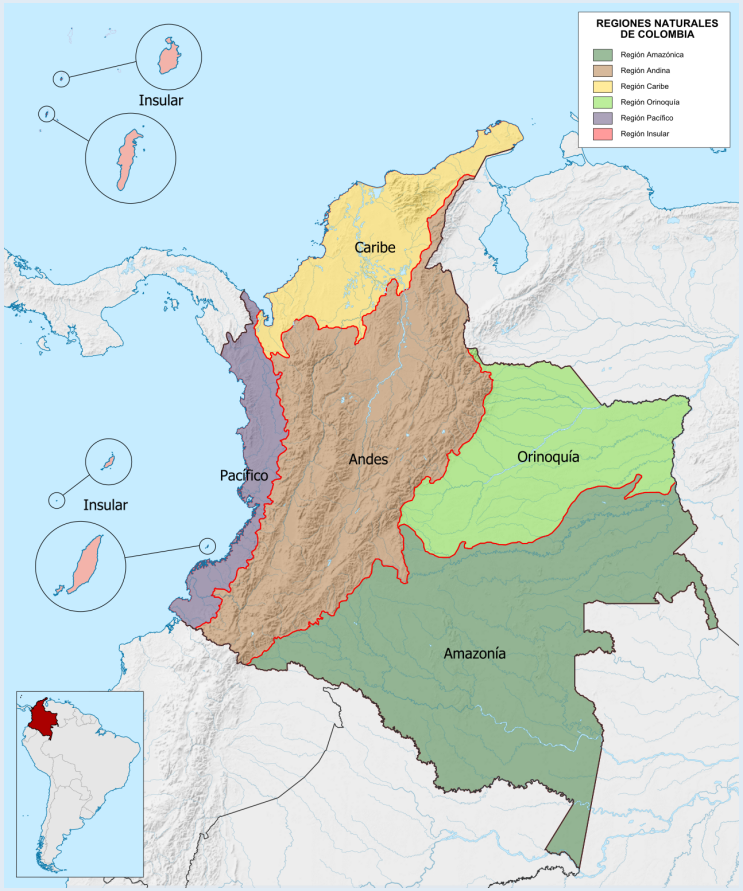
Intentional homicides for selected South American countries and Japan (Source: Author's calculations using data from the WDI World Bank (2020))

Colombian administrative levels

States and Municipalities

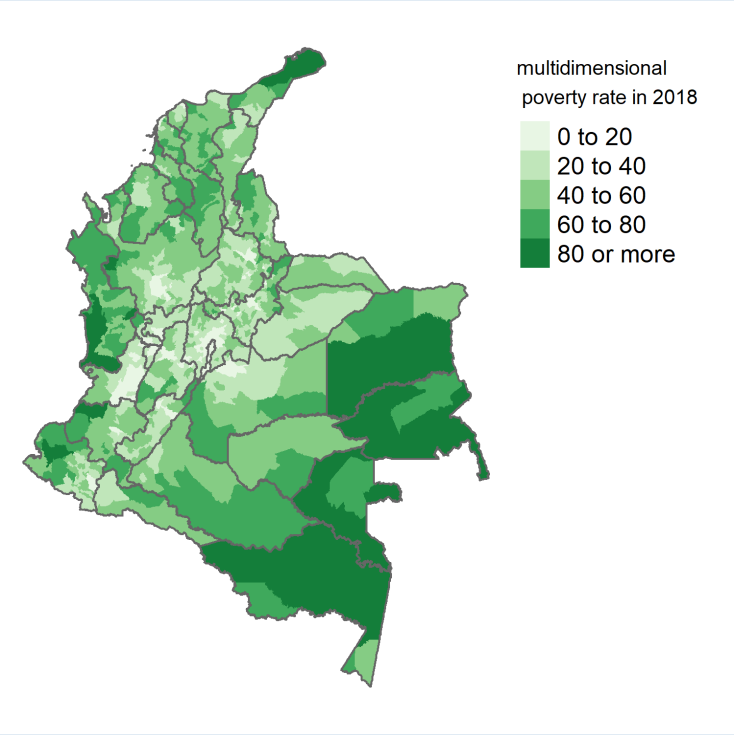


Natural Regions

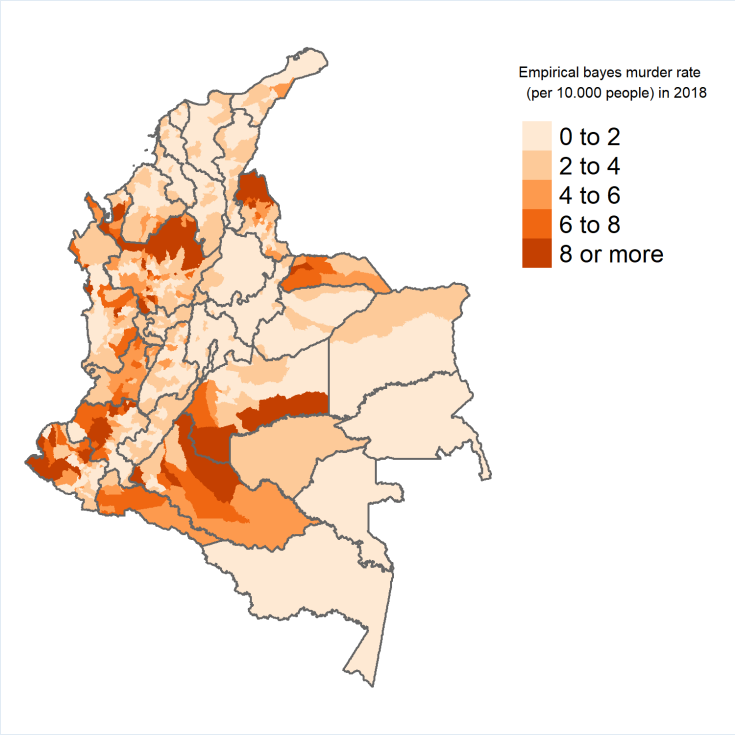


Large regional disparities in Colombia

Well-being



Crime

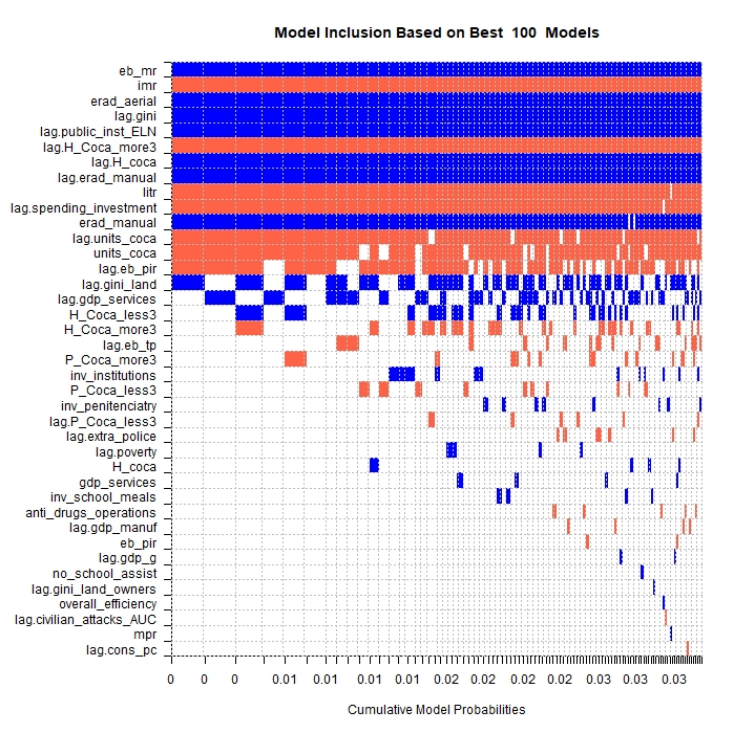


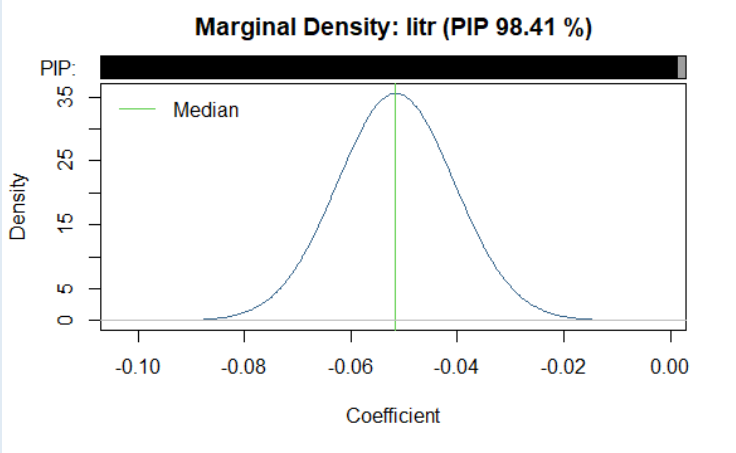
(In Germany = about 0.1 per 10.000 people)

Bayesian Model Averaging BMA - methods and results:

$$y = \alpha_i + X_i\beta_i + \varepsilon, \quad \varepsilon \sim N\left(0, \sigma^2 I\right)$$

- **how can researchers select just a handful of determinants?**
- **how to evaluate the importance of the inclusion of specific determinants in the model?**
- Bayesian Model Averaging (BMA) methods attempt to overcome these problems by estimating linear models for all (**MANY**) possible combinations of determinants X_i





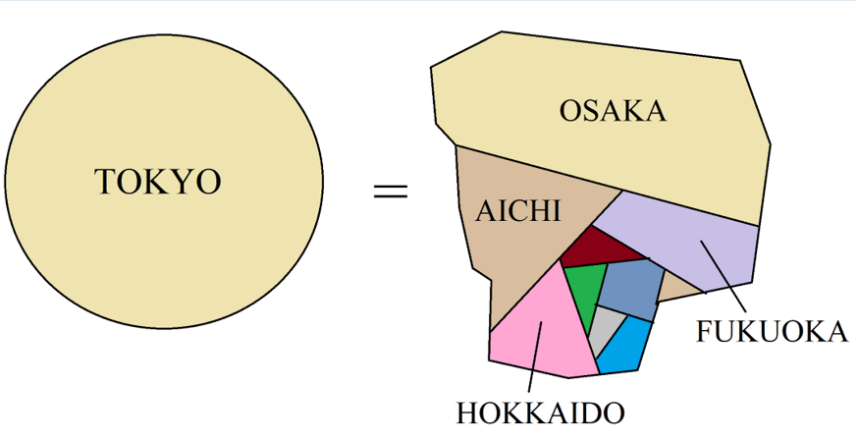
212 variables between original and spatially lagged variables were tested as determinants of 2018 homicide rates.

After running 2 million regressions...

description	PIP all variables	Post mean all
murder rate	1.000	0.356 (0.031)
infant mortality rate	1.000	-0.058 (0.011)
Coca H aerial eradication	1.000	0.001 (0)
Lag. Coca crops with more than 3 H	1.000	-0.041 (0.006)
Lag. Coca hectares	1.000	0.023 (0.003)
Lag Attacks against public institutions by rebels	1.000	36.062 (7.46)
Lag. H manual eradication	1.000	0.004 (0.001)
Lag. Income Gini	1.000	0.25 (0.041)
H manual eradication	0.990	0.002 (0.001)
Lag. Spending on investment local government	0.986	-0.095 (0.025)
Literacy rate	0.984	-0.051 (0.013)
Number of land units with coca crops	0.961	-0.004 (0.003)
Lag. Number of land units with coca crops	0.943	-0.015 (0.004)
Lag. Personal injury rates	0.681	-0.034 (0.025)
Lag. Land Gini	0.564	0.022 (0.021)

Synthetic control methods

visual intuition (In terms of GDP per capita)



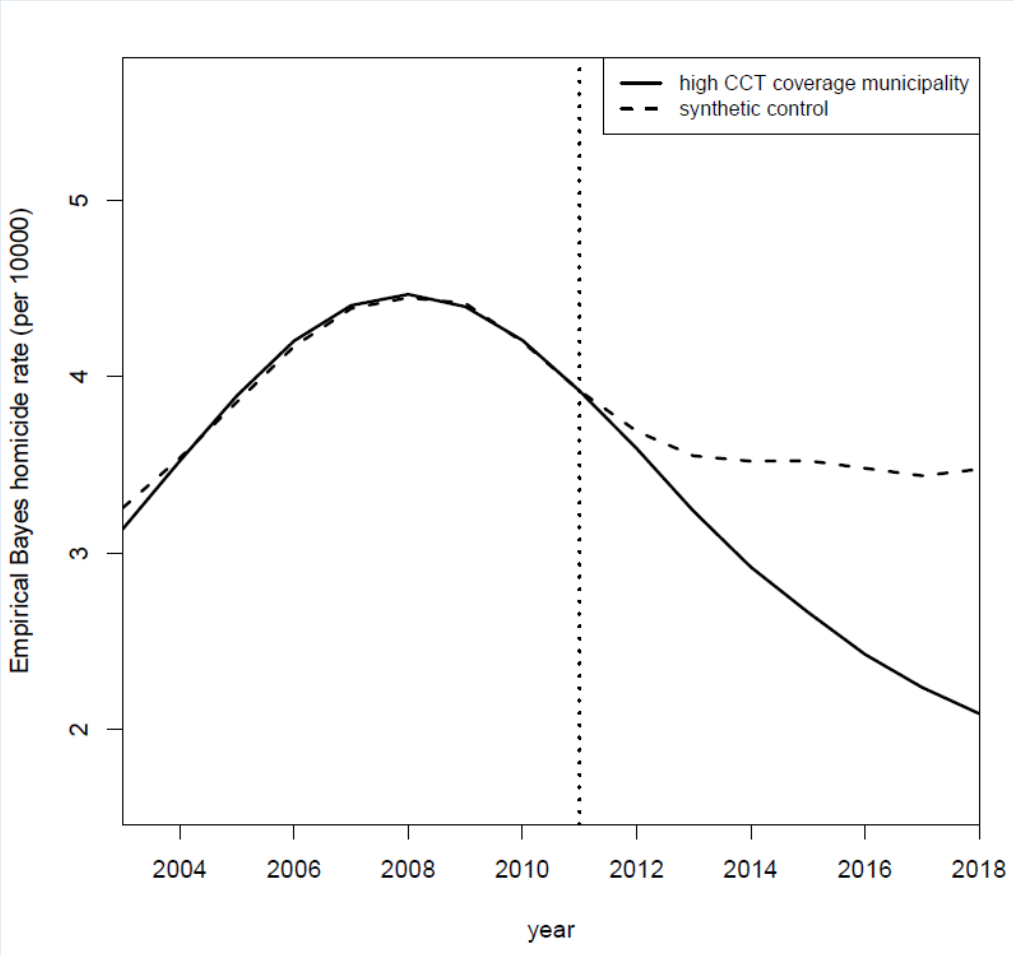
$$TOKYO = 0.4 * OSAKA + 0.2 * AICHI + 0.1 * FUKUOKA + \ldots$$

In terms of crime

The weights are found so that the synthetic municipality has a similar crime trend compared to the treatment municipality (2003-2011) and similar determinants of crime.

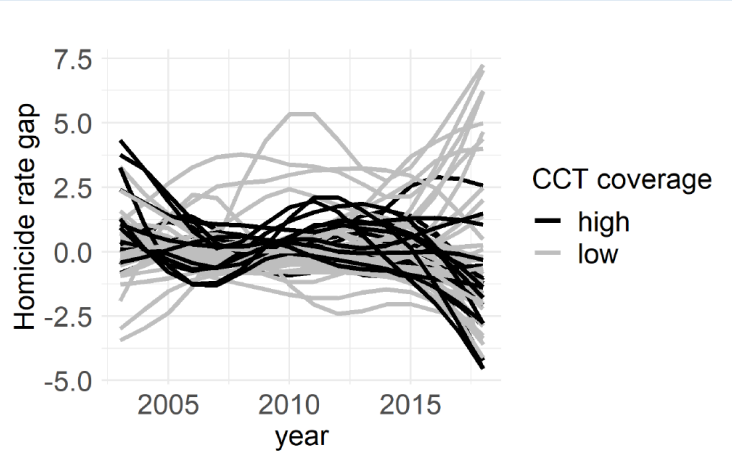
Results: Synthetic control methods

$high - CCT - coverage > 70\%$ $low - CCT - coverage < 30\%$

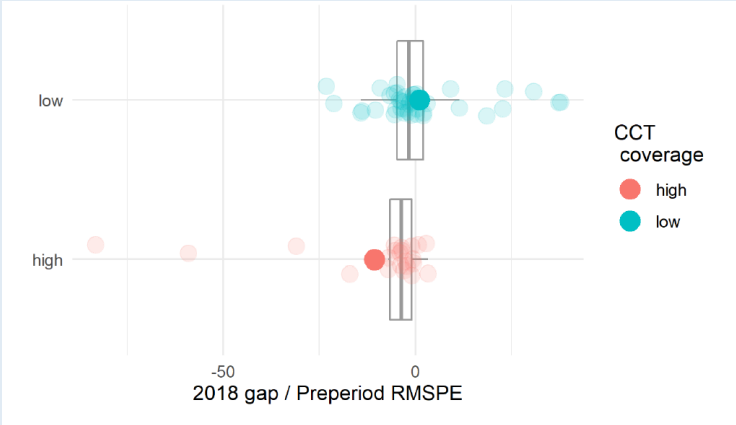


The effect of CCTs on crime

Crime gaps for treatment municipalities and control placebos



Overall effects = the gap in 2018 / Root mean squared predicted error



A t-test shows that the mean effect (lower crime) is statistically lower for the treatment group.

The results of the synthetic controls methods are fully reproducible.
https://github.com/quarcs-lab/Tutorial-synthetic-control-methods-Felipe-thesis-chapter5

Sensitivity analysis: Policy coverage threshold

Pop	high CCT%	#regions	low CCT%	#regions	Postperiod RMSPE / Preperiod RMSPE	2018 gap	2018 gap / Preperiod RMSPE
larger than 10K	65	31	35	48	0.7	0.8	0.1
	70	22	30	41	0.5	0.04	0.03
	75	18	25	36	0.05	0.1	0.4
	80	14	20	28	0.5	0.3	0.2
	85	13	15	24	0.4	0.05	0.3
	90	12	10	18	0.4	0.4	0.3
all	65	43	35	70	0.4	0.8	0.09
	70	32	30	60	0.3	0.5	0.1
	75	26	25	53	1	0.7	0.5
	80	22	20	36	0.8	0.5	0.3
	85	19	15	30	0.1	0.3	0.08
	90	17	10	19	0.5	0.3	0.2
larger than 10K	65	31	35	57	0.7	0.7	0.1
	70	22	30	50	0.3	0.1	0.04
	75	18	25	45	0.1	0.2	0.08
	80	14	20	37	0.03	0.4	0.3
	85	13	15	33	0.7	0.09	0.2
	90	12	10	27	0.03	0.8	0.5
	includes municipalities without CCT data as 0% coverage (low group)						

Sensitivity analysis: in-time placebos

Pop	high CCT%	#regions	low CCT%	#regions	Postperiod RMSPE / Preperiod RMSPE	2018 gap	2018 gap / Preperiod RMSPE	time treatment	predictors up to
larger than 10K	70	22	30	41	0.5	0.06	0.06	2012	2010
	70	22	30	41	0.6	0.04	0.06	2010	2010
	70	22	30	41	0.8	0.1	0.02	2009	2010
	70	22	30	41	0.4	0.07	0.07	2008	2010
	70	22	30	41	0.3	0.02	0.1	2007	2010
	70	22	30	41	0.5	0.07	0.6	2008	2007
	70	22	30	41	0.6	0.03	0.04	2007	2007
	70	22	30	41	0.7	0.04	0.3	2006	2007
	70	22	30	41	0.3	0.06	0.1	2005	2003
	70	22	30	41	1	0.4	0.2	2004	2003

- If the time of treatment is changed the effect becomes **consistently not significant**.
- For instance, the p-values become larger than 0.1 if the treatment is assigned in **2008, 2006 or 2004**.

Concluding Remarks

- Supporting previous studies, variables related to **inequality, literacy rates, previous crime levels, institutional capabilities, conflict and drug-trafficking** were reported as significant determinants of homicide rates.
- By 2018, **the average homicide rates were lower for high CCT coverage municipalities** when compared to synthetic copies made out of a pool of low CCT coverage municipalities.

Implications

- CCT programs appear to be comprehensive policies as they can tackle multiple issues such as **poverty, low education outcomes and violence**.
- Given funding constraints, it seems that investing in the expansion of this policy in the Pacific region can be an effective ways to improve developmental outcomes in several areas.
- The framework of this paper can be considered a **data science framework to test the impact of regional policies**

$$BMA \rightarrow \ determinants\ of\ Y \rightarrow Synethetic\ Controls \rightarrow The\ impact\ of\ X\ on\ Y$$

Further research

- A dataset of determinants of crime based on previous literature (instead of the determinants found with the BMA) can be assembled. **This new dataset can be used as the input for the synthetic control analysis.**
- **How can we integrate spatial effects and Synthetic Controls?** Spatial filtering? Adding a distance indicator as one of the determinants in the Synthetic Controls framework?

Thank you very much for your attention

personal website: https://felipe-santos.rbind.io

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Quantitative Regional and Computational Science lab

https://quarcs-lab.org

Chair of International Economics
Technische Universität Dresden
Germany

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