DIW GRADUATE CENTER

The political economy of fossil-fuel subsidy removal

Theory and empirical evidence from presidential democracies in Latin America

Mariza Montes de Oca, Franziska Holz, and Achim Hagen

June 1, 2021

Fossil-fuel subsidies (FFS) and their removal

Compelling climate measure

- Compelling economics: Pricing externalities Externalities

Fossil-fuel subsidies (FFS) and their removal

Compelling climate measure

- Compelling economics: Pricing externalities Externalities
- Efficient pricing could lower global carbon emissions by as much as 28 % (Coady et al. 2019)

Fossil-fuel subsidies (FFS) and their removal

Compelling climate measure

- Compelling economics: Pricing externalities Externalities
- Efficient pricing could lower global carbon emissions by as much as 28 % (Coady et al. 2019)

Politically difficult to remove

- Unpopular & politically costly
- Subsidies persist in post-Paris era

Fossil-fuel subsidies (FFS) and their removal

Compelling climate measure

- Compelling economics: Pricing externalities Externalities
- Efficient pricing could lower global carbon emissions by as much as 28 % (Coady et al. 2019)

Politically difficult to remove

- Unpopular & politically costly
- Subsidies persist in post-Paris era

Research question:

- What are the political costs of removing FFS?
  - Do costs vary disproportionately with the speed of reform (one-shot vs. gradual)?
  - What explains the unexpected strong costs?

- Hypothesis: Political costs of removal are positive, differ by income group, and depend on how the reform is implemented.

Literature

Growing body of literature on how reelection motives affect environmental policy-making:

- U.S. Governors in states with large env-friendly voters (List and Sturm 2006)
- Reelection incentives officials & commitment (Pani and Perroni 2018)
- Fossil-fuels as visible redistribution mechanism (Boix 2003; Overland 2010; Overland and Kutschera 2011)

Gap: Policy phase-out, quasi-experimental evidence, theory-empirical evidence of political costs of reform.

Contribution

- First evidence of political costs of FFS removal
  - Evaluate the causal effects of rising gasoline prices (as conseq. of removal) on presidential approval
  - Look at heterogeneity of removal policy: gradual in Mexico vs. one-shot in Bolivia.
- Explain why removing subsidies is largely unpopular.
  - Simple probabilistic voting model of redistribution.
  - Provide empirical evidence on model predictions: Heterogeneous effects by income groups provide insights into mechanism.

Subsidies in Latin America

- Widespread use of FFS: 2% GDP, (Coady et al. 2019). Overview LA
- Implicit subsidies: gap btwn. government-fixed & stable prices and prices of reference. Implicit subsidies
- Various subsidy reform efforts: Bolivia, Ecuador, Mexico (fiscal pressures).
- Predominance of presidential democracies
  - Approval data easier to detect Vs. other regimes (e.g. Arabic countries).
  - Person at the top of the state, president, deciding on fuel prices

Presidential approval changes: Proxying political costs

- Approval ratings indicate which percentage of the population approve the president's job (Berlemann and Enkelmann 2013).

Plot approval

- A (representative) sample of citizens are regularly asked:

Survey question

Do you approve or disapprove of the way [President' name] is handling his job as president?
☐*Approve*
☐*Disapprove*
☐*No opinion*

- Approval ratings affect the political capital, correlates with intention to vote, and impacts the negotiation margin of the president with other political actors (Romero 2012)

Synthetic control (SC) design

Synthetic Control

- Idea: Reconstructs the outcome of a counterfactual using a convex combination of countries with similar outcome trajectories that did not select into treatment. Basic SC setting SC estimation

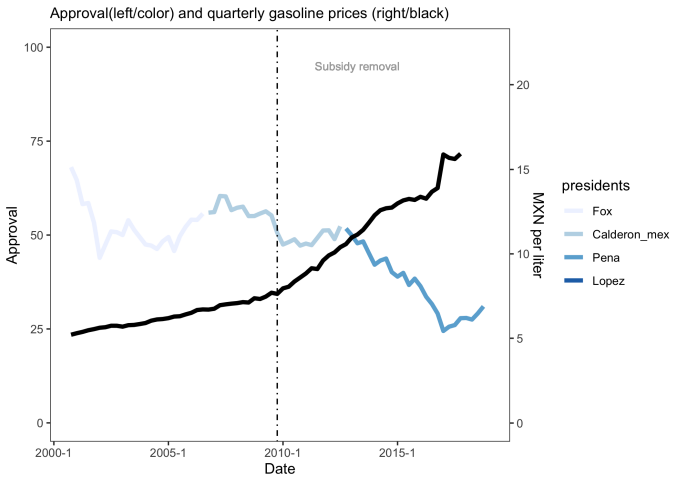
$$SC = \hat{Y}^{N}_{1,t} = \sum_{j=2}^{J+1} w_j^* Y_{j,t} \tag{1}$$

where $W^* = (w_2^*, ..., w_{J+1}^*)$ is a vector non-negative country optimal weights that sum up to one and $Y_{j,t}$ is the outcome variable for each control in time t.

- We build a Syntetic Control for two countries, Mexico and Bolivia, to reconstruct the post-treatment outcome of the treatment unit had it not been treated.

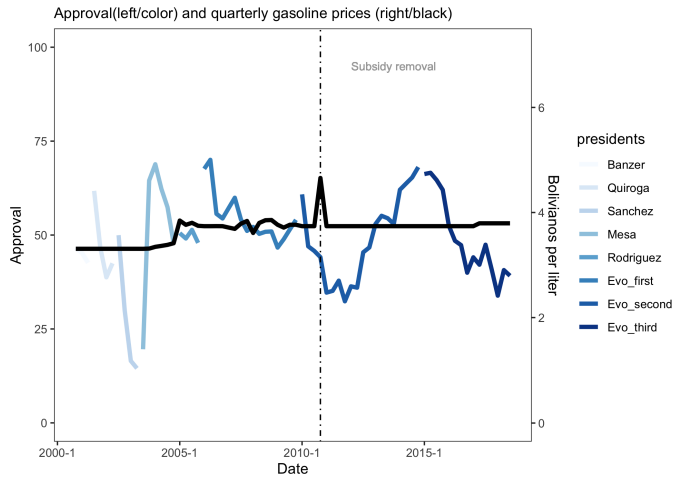
SC for Mexico and Bolivia

Subsidy removal and approval in Mexico



- Treatment: Gradual phase-out starts 12.2009
- Monthly price hikes 1%.
- Subsidy phased-out by 12.2014

Subsidy removal and approval in Bolivia



- Treatment: One-off phase-out starts 12.2010.
- Change in price of 70%
- Revoked after widespread protests.

Data & country pool

We construct a unique, balanced quarterly panel dataset for 14 LAC+ countries [unbalanced 18 countries], 2010.Q3-2018.Q3 Sources Descriptives :

Outcome variable

- Mean-centered presidential approval ratings by presidential term (in log).

Predictors (in log)

- Price of gasoline
- GDP Growth
- Inflation
- Duration of presidential term
- Set of outcome lags

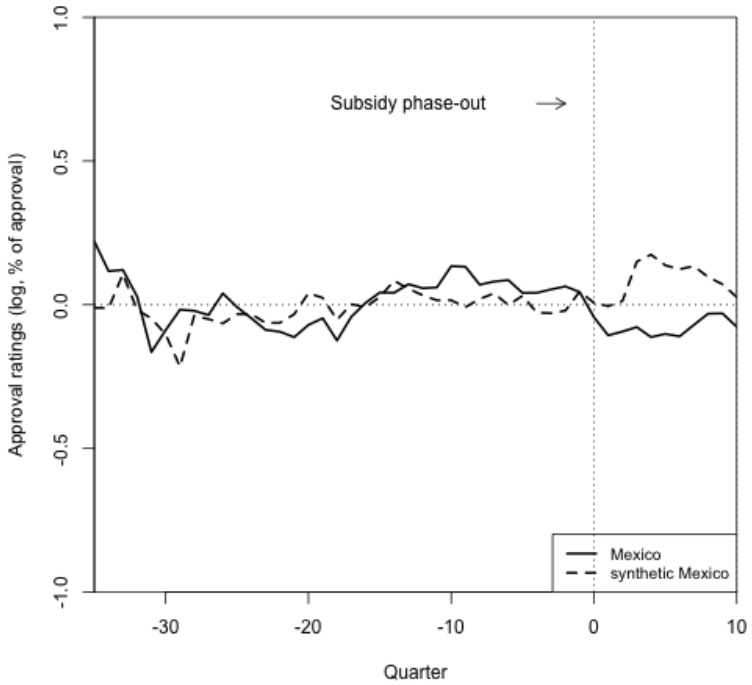
Country pool

- All countries in the sample

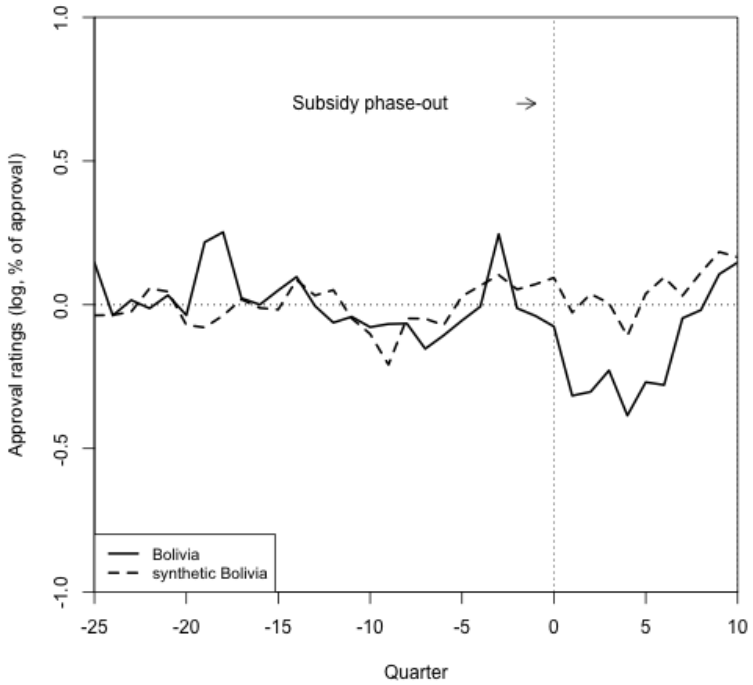
Results: SC visualization, path ploth

- ATT: On average, approval is 14% and 18% lower than it would have been in the absence of treatment in Mexico and Bolivia respectively.

SC Mexico



SC Bolivia



Results: Country weights

- Positive weights indicate the endogenously selected countries that form the linear combination that best reproduces the SC.

Mexico	
Bolivia	0
Brazil	0.01
Chile	0.01
Colombia	0.66
Costa Rica	0
Dominican Republic	0.04
Ecuador	0
Guatemala	0
Panama	0.11
Paraguay	0
Peru	0.07
United States	0.07
Uruguay	0.02

Bolivia	
Brazil	0
Chile	0
Colombia	0.01
Costa Rica	0
Dominican Republic	0
Ecuador	0.35
Guatemala	0.58
Mexico	0
Panama	0.01
Paraguay	0.04
Peru	0
United States	0
Uruguay	0

Predictor means before treatment and predictor weights

- Means between treated and the synthetic Mexico are close, and in most instances, they are a better approximation than the simple sample mean. Bolivia

Mexico: Predictor means before treatment and predictor weights

Predictor	v.weights	Treated	Synthetic	Sample Mean
Ln low-oct gasoline	0.163	4.532	4.537	4.652
Ln GDP growth	0.001	0.659	1.339	1.399
Ln CPI	0.186	4.386	4.38	4.335
Duration	0.004	10.833	9.128	8.87
Duration squared	0.003	158.833	107.206	106.135
Lag ln approval	0.024	3.971	3.865	3.697
Ln approval (-15)	0.082	0.043	0.027	0.038
Ln approval (-23)	0.233	-0.088	-0.063	-0.143
Ln approval (-5)	0.303	0.041	0.031	-0.128
Ln approval (-3)	0.003	0.053	-0.029	-0.027

Robustness and Placebo tests

Our results are robust to a series of tests:

Placebo checks

- Placebos in-time ◂ Mexico ◂ Bolivia
- Placebos in-space ◂ Mexico ◂ Bolivia
- MSPE ratio test ◂ Mexico ◂ Bolivia

Country pool

- Country pool A: Market pricing or subsidies with no phase-out. ◂ Mexico ◂ Bolivia
- Country pool B: Subsidies with no phase-out. ◂ Mexico ◂ Bolivia

A Simple Probabilistic Voting Model of Redistributive Fossil Fuel-Subsidies

Environment:

Electorate:
voter in income group j preferences over party platform $\propto^j$ and ξ^{ij} ideological prefs.

Parties A and B:
choose party platform $\propto_A$ and $\propto_B$ to maximize their probability of winning elections

Stages:

i) Parties announce policy platforms

ii) Relative popularity of parties is realized

iii) Elections

iv) Elected party implements policy platform

Solve subgame perfect Nash eq by backward induction

Relevant eq:

$$W^j(\propto_A) > W^j(\propto_B) + \xi^{ij} + \delta$$

Proposition:

i) Removing subsidies will result in a loss of expected political support.

(ii) If high income groups have moderate ideological preferences and FFS are regressive, this loss in support will be driven by a decline in support from high income groups.

Empirical evidence: A simple DD approach

We present evidence supporting the hypothesis that the negative effect of subsidy phase-out on approval ratings is

- [lab] Driven by high-income households because these
- [lbb] Have a higher voter density around the median and
- [lcb] because FFS are regressive.

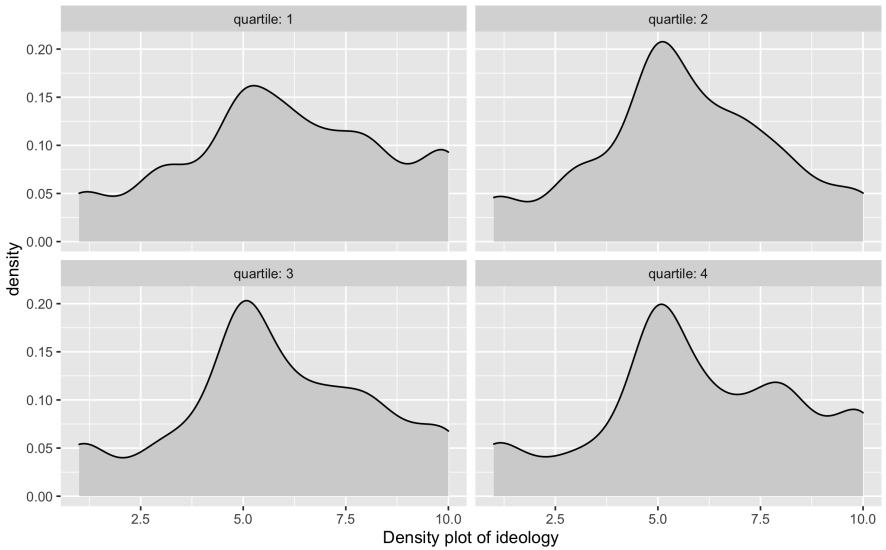
Data:

- We rely on survey data from the *LAPOP/AmericasBarometer* and the Expenditures Survey (ENIGH, Mexico)
- Provides voting-age adults' public opinion survey data between 2004-2019 from more than 20 countries
- With over 40,000 interviews per round.

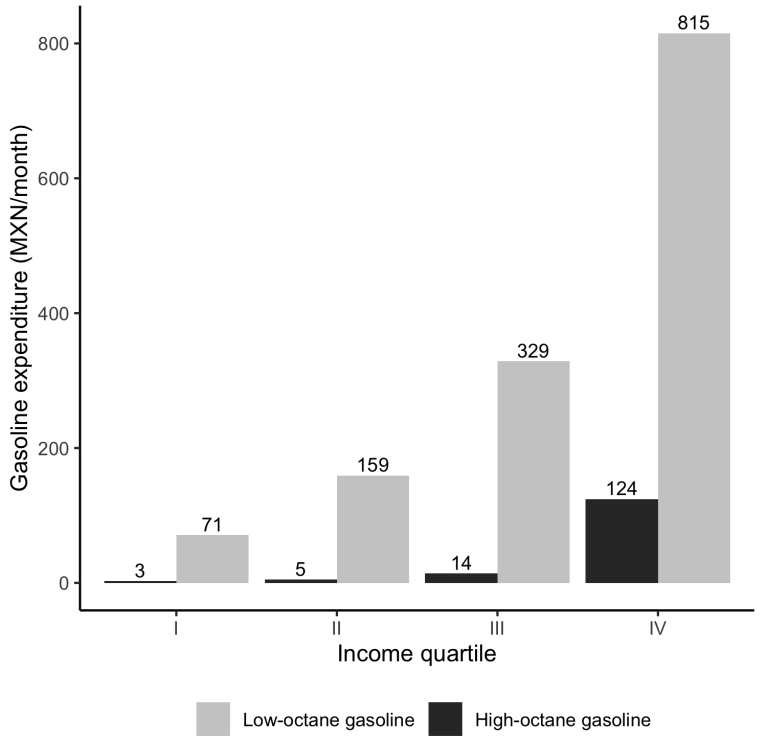
Empirical evidence

- High-income groups show larger density around the median, *i.e.* a larger share of this group is moderate on their political preferences (b).
- High income households expenditure on gasoline is higher than low-income households, and so is their economic loss due to a subsidy removal.

Mexico's ideology density by quartile



Fuel expenditure per quartile (2010)



Empirical evidence: A DD approach

- We employ a difference in difference (DD) regression to explore heterogeneous effects by income group.

$$\begin{aligned} \text{approval}_{i,t} = \alpha_0 &+ \beta_1 \text{treat}_{i,t} + \beta_2 \text{post}_{i,t} \\ &+ \beta_3 \text{treat} \times \text{post}_{i,t} \\ &+ \mathbf{X}_{i,t}\boldsymbol{\gamma} + \epsilon_{i,t} \end{aligned} \tag{2}$$

- The weights of the SC guide our choice of the control group
- Control group for Mexico is Colombia
- Controls: Economic situation, corruption, safety, ideology

DD results: Our first results confirm prediction (ii).

- Low-income groups are not responsive to FFS removal, while high-income disapprove the president as a result of the removal.

DD Results: Effect of FFS removal on approval across income quartiles

	Income quartiles				
Predictor	1Q	2Q	3Q	4Q	Pooled
post × *treat*	0.029	0.003	-0.038	-0.222*	-0.084
	(0.109)	(0.086)	(0.091)	(0.101)	(0.054)
post	-0.059	-0.019	0.002	0.076	0.031
	(0.078)	(0.063)	(0.064)	(0.067)	(0.040)
treat	0.113	0.120*	0.239***	0.282***	0.201***
	(0.074)	(0.060)	(0.060)	(0.074)	(0.035)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	842	1120	1124	1120	4762

Note: Standard errors are shown in parentheses.

Conclusions

Empirical evidence

- We find evidence of a negative effect of subsidy removal on political approval, yet with differing magnitudes depending on the phase-out design.
- Our theoretical model and related empirical results suggest that the loss in support is driven by a decline in support for high-income groups if these have moderate ideological preferences and subsidies are regressive.

Conclusions

Empirical evidence

- We find evidence of a negative effect of subsidy removal on political approval, yet with differing magnitudes depending on the phase-out design.
- Our theoretical model and related empirical results suggest that the loss in support is driven by a decline in support for high-income groups if these have moderate ideological preferences and subsidies are regressive.

Policy relevance

- Reelection incentives of politicians lead to regressive and environmentally harmful FFS, yet fiscal pressure may require FFS removal
- Gradual phase-out in combination with other compensation strategies (all groups, but differentiated?) can be a feasible policy.

References I

Berlemann, Michael and Sören Enkelmann (2013). "The Economic Determinants of U.S. Presidential Approval –A Survey–". In: *University of Lüneburg. Working Paper Series in Economics* 271.

Boix, Carles (2003). *Democracy and redistribution*. Cambridge University Press.

Coady, David et al. (2019). "Global Fossil Fuel Subsidies Remain Large: An Update Based on Country-Level Estimates". In: *IMF Working Paper* 19/89.

List, John A and Daniel M Sturm (2006). "How elections matter: Theory and evidence from environmental policy". In: *The Quarterly Journal of Economics* 121.4, pp. 1249–1281.

Overland, Indra (2010). "Subsidies for fossil fuels and climate change: a comparative perspective.". In: *International Journal of Environmental Studies*. 67.10, pp. 303–317.

References II

Overland, Indra and Hilde Kutschera (2011). "Pricing Pain: Social Discontent and Political Willpower in Russia's Gas Sector.". In: *Europe-Asia Studies*. 63.2, pp. 311–331.

Pani, Marco and Carlo Perroni (2018). "Energy subsidies and policy commitment in political equilibrium.". In: *Energy Economics* 71.C, pp. 149–160.

Romero, Vidal (2012). "Impacto De Los Temas De Seguridad Pública En Aprobación Presidencial.". In: *Política y Gobierno, volumen temático*. Pp. 139–160.

To do's

Synthetic Control

- SC: Obtain average effects using a Penalized Synthetic Control
- Sensitivity: IV regression with international reference price as instruments
-

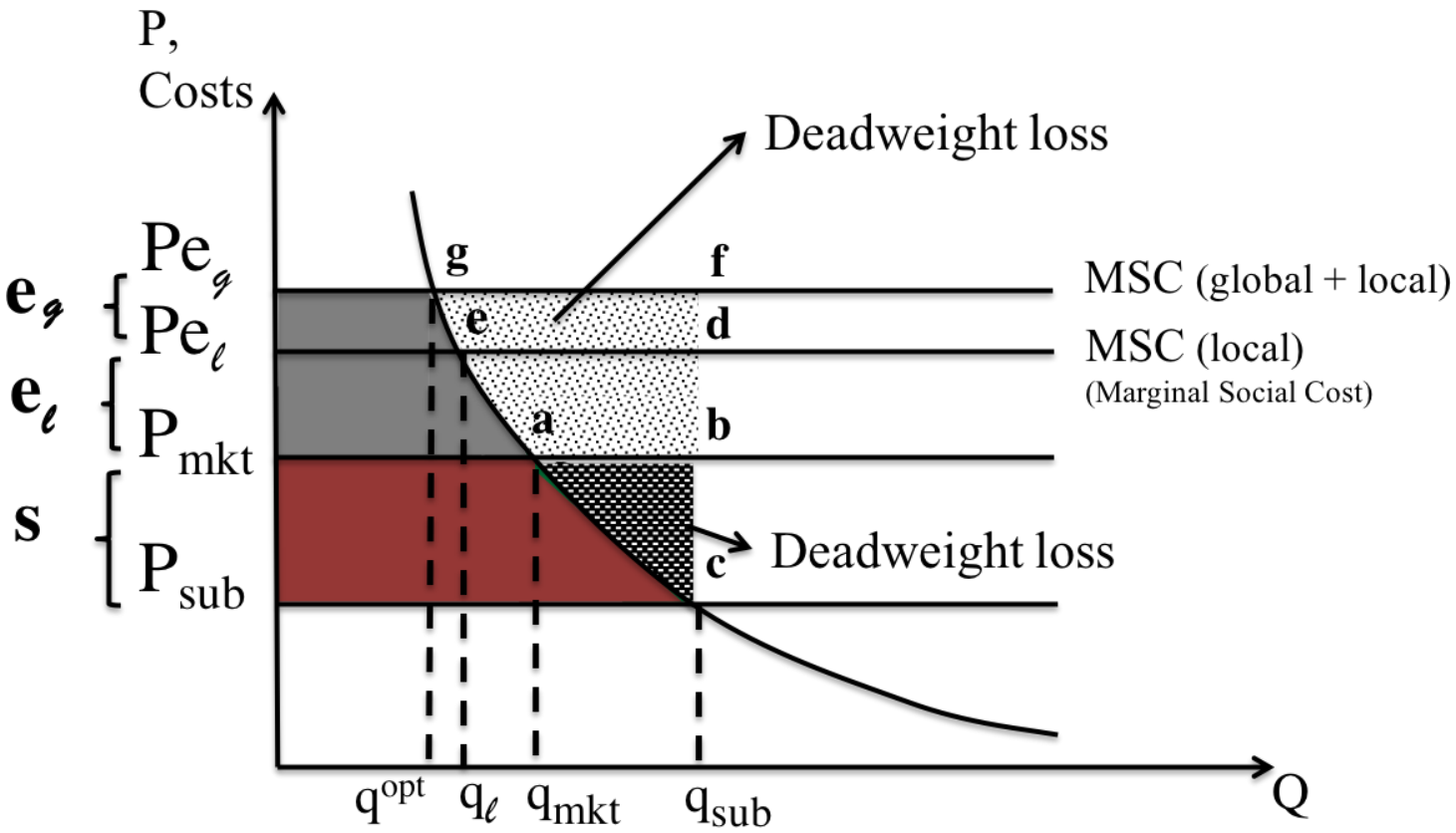
Probabilistic Voting Model

- Generalization to n groups
- Ideology distribution: extend from uniform to single peaked

Difference in Difference

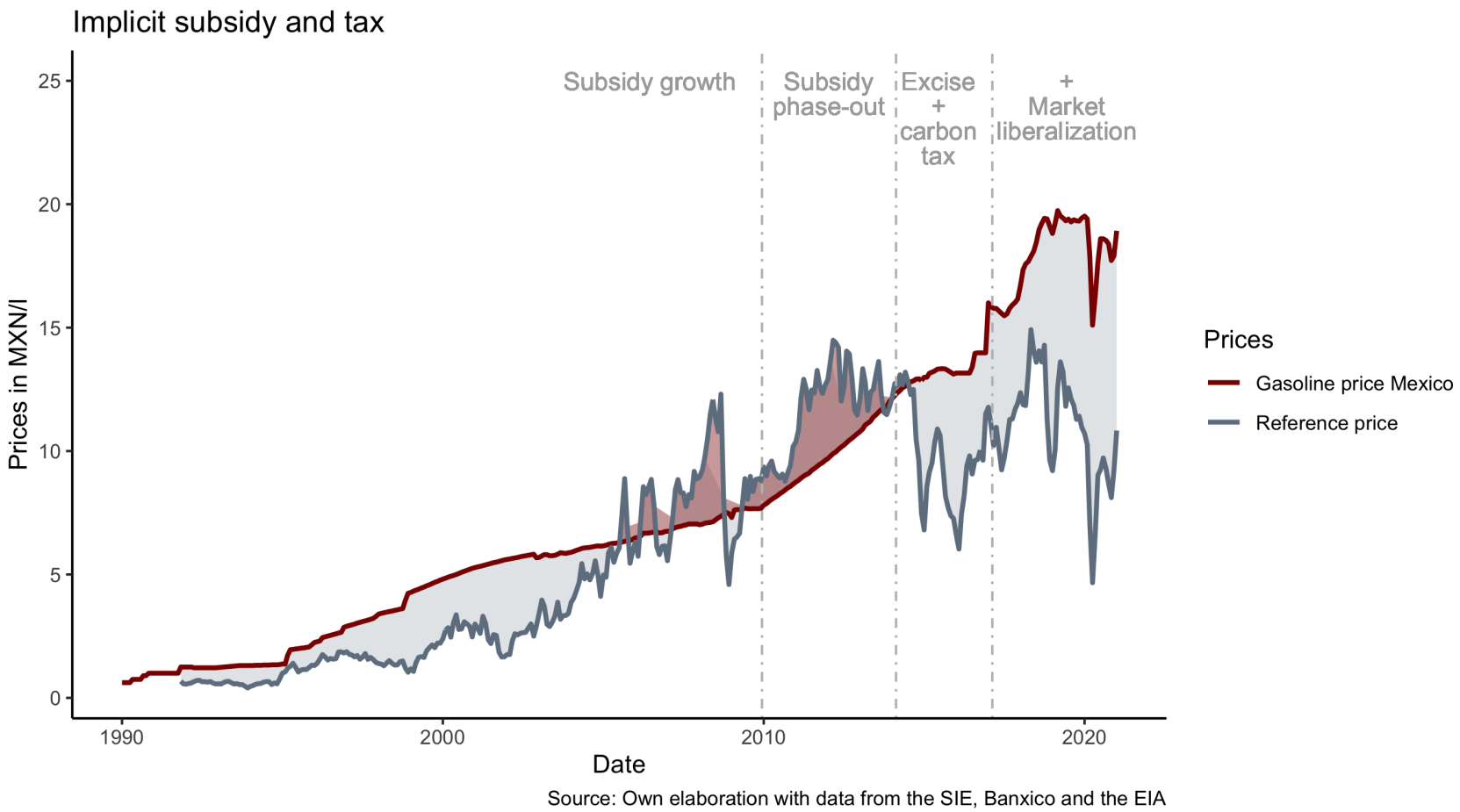
- Placebos: change time span, eliminate outliers, placebo subsidy phase-out.

Environmental externalities



Back

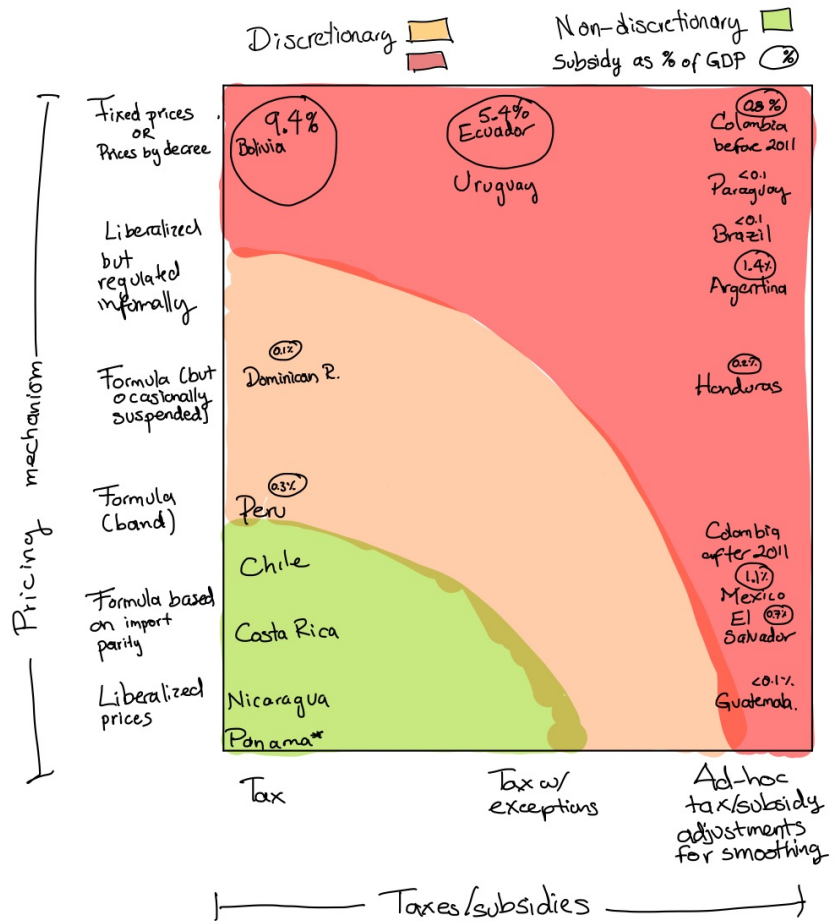
Implicit subsidy in Mexico



Source: Own elaboration with data from the SIE, Banxico and the EIA

Back

Fuel pricing mechanisms by country: 2008-14



Source: own elaboration with data from IDB.2017

◂ Back

Descriptive statistics SC

Descriptive statistics: Synthetic Control

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max	Units
President-related								
Approval	2,414	45.7	14.3	2.9	36.7	55.1	86.9	% of citizens
Duration (of presidential term)	2,421	9.0	5.7	1	4	13	32	No. of quarters
Duration squared	2,421	112.9	124.1	1	16	169	1,024	No. of quarters
Prices								
Low-octane gasoline	1,880	109.3	54.8	15.0	67.4	142.6	309.7	USD/BBL
Economic								
GDP growth	1,278	3.5	4.2	−20.9	1.8	5.6	22.5	Year-to-year %
Consumer price index	2,053	68.8	43.3	0.0	32.2	103.4	192.0	Index
Consumer price index growth	2,041	60.3	445.1	−3.0	3.3	11.4	9,411.9	Year-to-year %
Industrial production	677	2.6	5.2	−17.9	−0.2	5.3	38.5	Index
Unemployment	1,031	7.5	3.2	1.5	5.3	9.1	20.2	%
Unemployment growth	670	−0.4	15.8	−66.7	−9.6	5.8	79.2	Year-to-year %

◂ Back

Data sources

Presidential Approval ratings

- Quarterly approval ratings from the Executive Approval Project (EAP) Prices
  - Real quarterly gasoline prices (USD and local currency) from the Latin American Energy Organization (OLADE)

Economic data

- GDP growth, inflation and employment rates from the IMF Financial Statistics

Political data

- Presidential administration terms and duration from country administrative data.

Back

Empirical challenge and the synthetic control method

- Let $j = 1, ..., J + 1$ be the number of countries in our sample
- Let $j = 1$ denote the *treated unit* and Y_{jt}^N with $j = 1$ be the presidential approval of Mexico(Bolivia) in time t if not exposed to subsidy phase-out.
- Let $t = 1, 2, ..., T$ be time periods. Where $1, 2, ..., T_0$ are time periods prior to treatment and, $T_0 + 1, T_0 + 2, ..., T$ refer to posttreatment periods.
- The phase-out's causal effect to be estimated is given by the Treatment effect on the Treated (TT):

$$TT_t = Y_{1t} - Y_{1t}^N \tag{3}$$

- Empirical challenge!: Reconstruct the post-treatment outcome of the treated unit had it not been treated.

Back

Synthetic Control (SC) II

- To address this empirical challenge, we build the counterfactual (synthetic control) as a linear combination of untreated units.

$$SC = \hat{Y}^N_{1,t} = \sum_{j=2}^{J+1} w_j^* Y_{j,t} \tag{4}$$

where $W^* = (w_2^*, ..., w_{J+1}^*)$ is a vector non-negative country optimal weights that sum up to one and $Y_{j,t}$ is the outcome variable for each control in time t.

- Our objective is to obtain the Average Treatment Effect (ATT) over the post-treatment periods as:

$$\text{ATT} = \frac{1}{T - T_0} \sum_{t > T_0} [Y_{1,t} - \hat{Y}^N_{1,t}] \tag{5}$$

Back

SC Estimation III

- Our estimation of the SC, $\hat{Y}^N_{1,t}$, follows a nested optimization procedure:
  - First, we choose W^* by minimizing the euclidean distance between X_1 and $X_0 W$ as follows:

$$W^* =_w ||X_1 - X_0 W||v = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \qquad (6)$$

    where X_1 is a $(r+k)x(1)$ matrix of k covariates and r linear combinations of pre-treatment outcomes used as predictors, X_0 is an $(r+k)x(J)$ matrix; and V is a diagonal matrix in which the diagonal elements $v = (v_1, ..., v_{r+I})$ are non-negative predictor weights, and
  - Second, V^* is chosen such that the Mean Squared Error (MSE) of the presidential approval outcomes is minimized for pre-treatment periods as:

$$V^* =_V (Y_1 - Y_0 W^*(V))' V (Y_1 - Y_0 W^*(V)) \qquad (7)$$

    where Y_1 denotes pre-treatment approval of Mexico(Bolivia) and Y_0 denotes linear combinations of pre-treatment approval of control countries.

Back

Predictor means before treatment and predictor weights

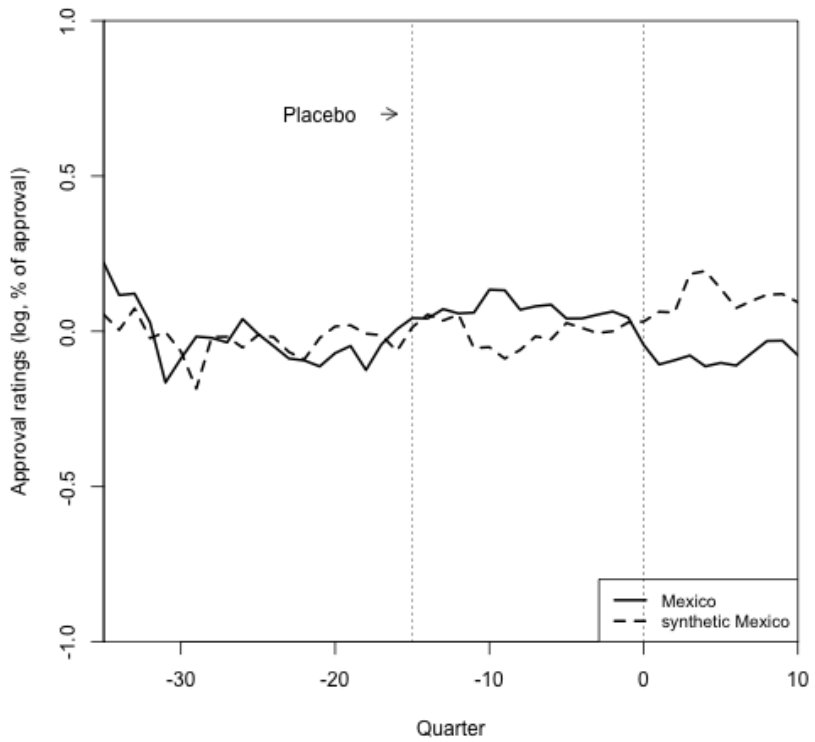
Bolivia: Predictor means before treatment and predictor weights

Predictor	v.weights	Treated	Synthetic	Sample Mean
Ln low-octane gasoline	0.281	4.343	4.376	4.692
Ln GDP	0.093	1.251	1.252	1.405
Ln CPI	0.173	4.347	4.35	4.359
Duration	0	5.61	7.454	9.086
Duration squared	0	50.537	73.585	111.176
Lag ln approval	0.048	3.858	3.788	3.738
Ln approval (-26)	0.104	0.228	0.087	-0.119
Ln approval (-22)	0.048	-0.013	0.057	-0.013
Ln approval (-16)	0.253	0	-0.011	0.103

- Means between treated and the synthetic Bolivia are close, and in most instances, they are a better approximation than the simple sample mean.

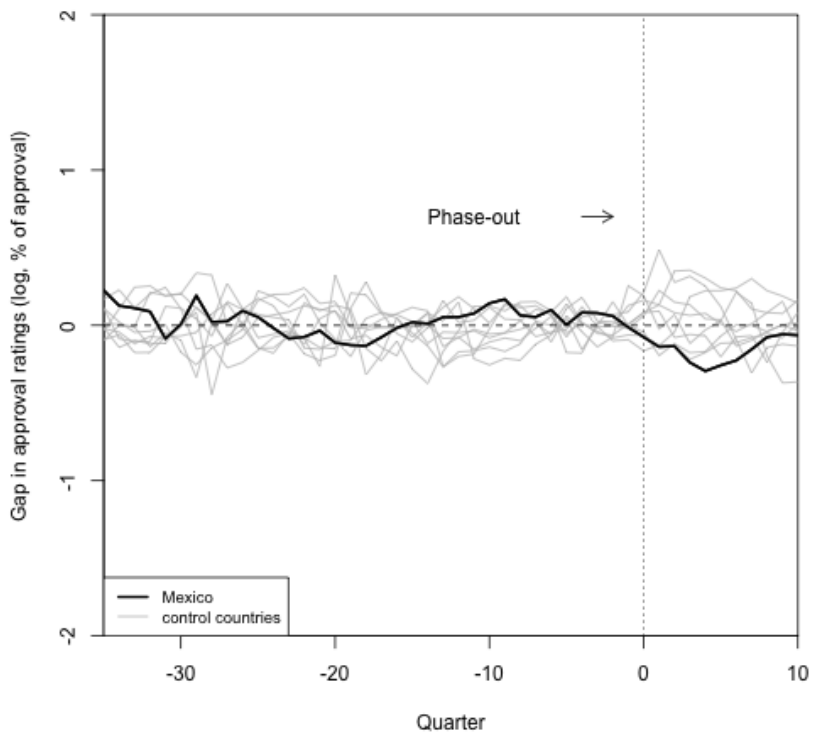
Back

Placebo in-time Mexico



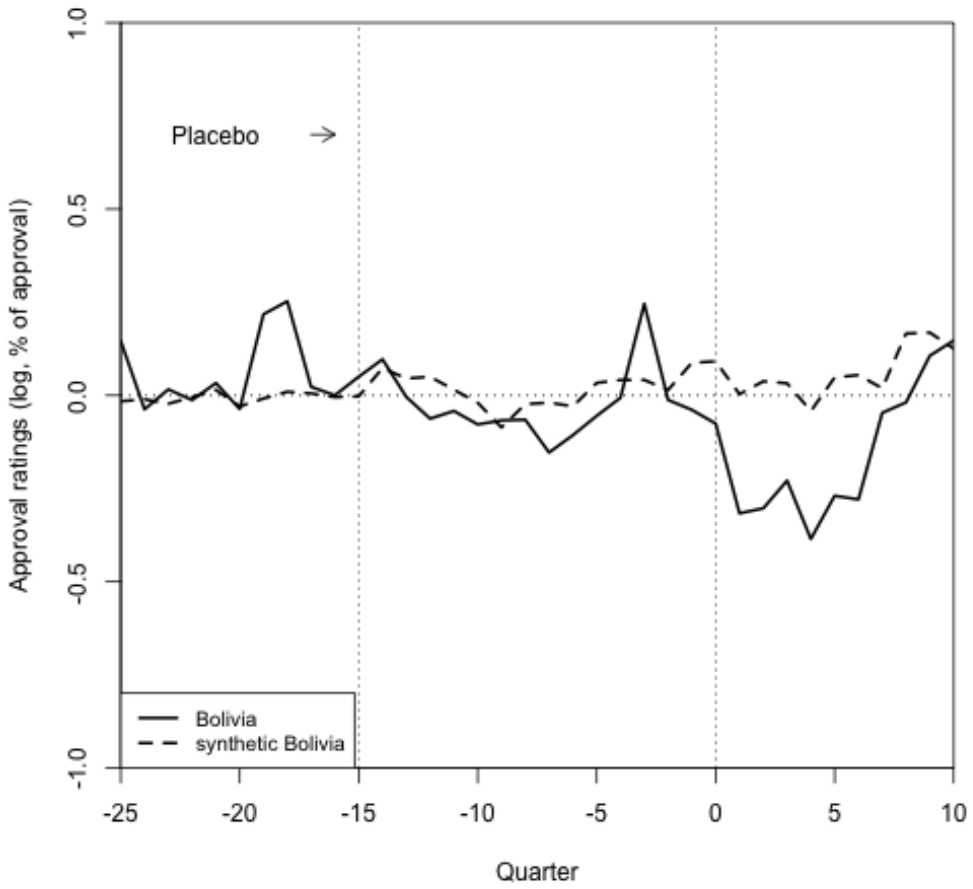
Back

Placebo in-space Mexico



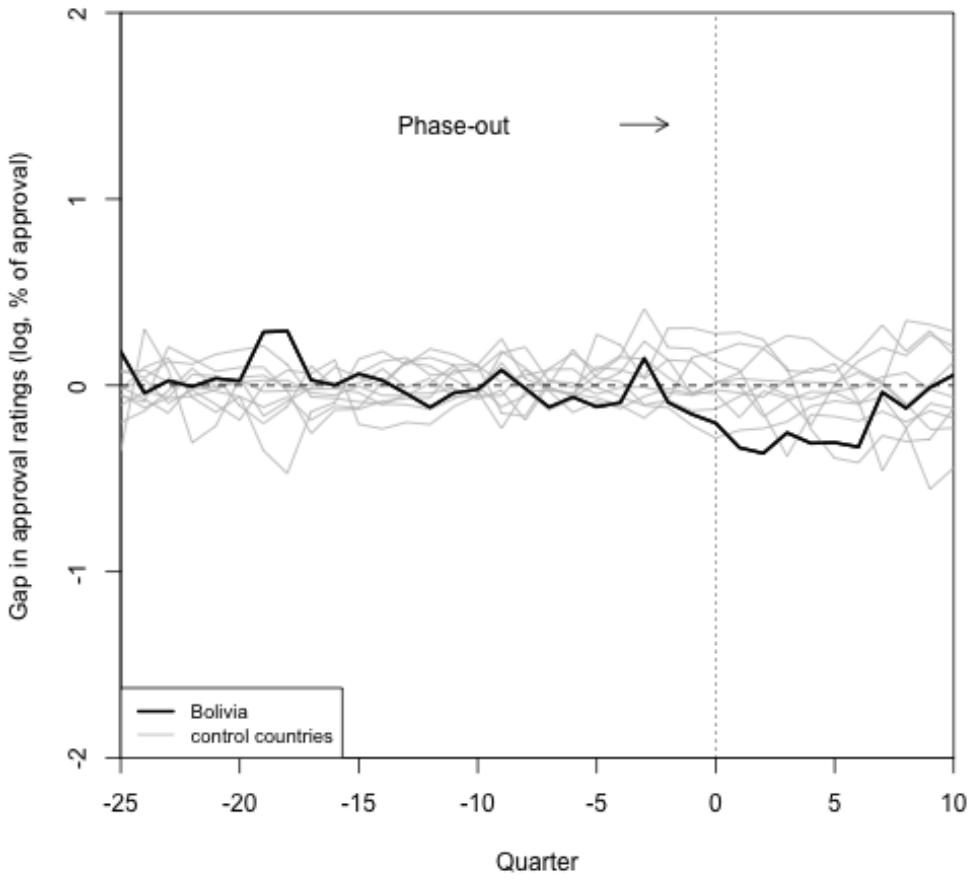
Back

Placebo in-time Bolivia



Back

Placebo in-space Bolivia

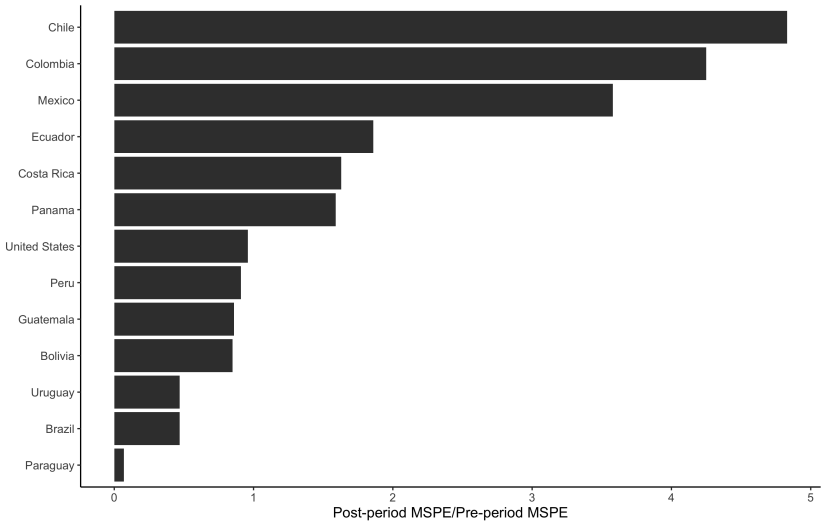


Back

MSPE test Mexico

- Mexico has the third largest ratio of all sample countries.
- When restricting to a negative effect on approval, Mexico has the largest ratio of all the countries.
- The probability of finding a ratio of this size is $1/10{=}0.10$.

Ratio test: Ratios of posttreatment MSPE to pretreatment MSPE: Mexico and control countries.

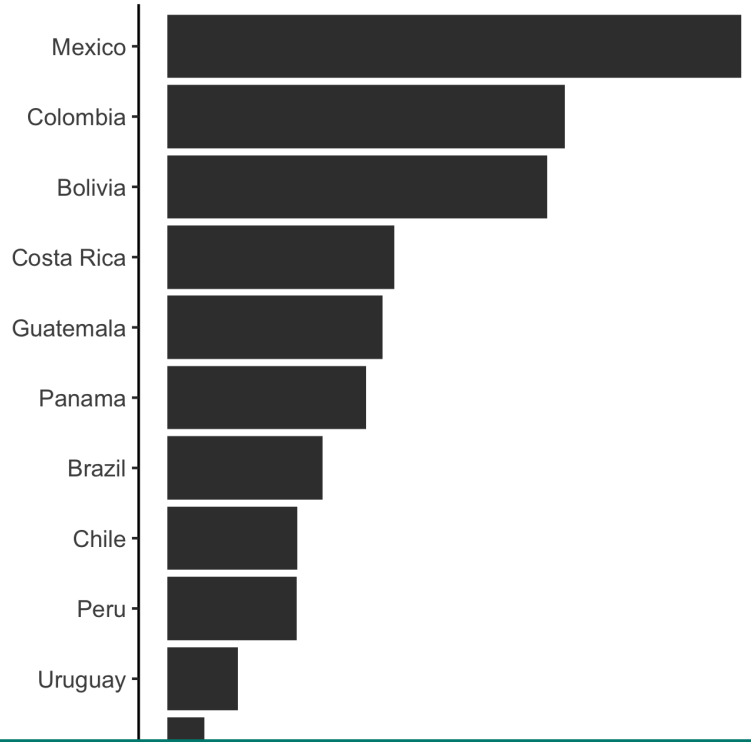


Back

MSPE test Bolivia

- Bolivia has the third-largest ratio of all countries in the sample.
- When restricting to a negative effect on approval, Bolivia has the second-largest ratio.
- The probability of finding a ratio this large is 2/10=0.20.

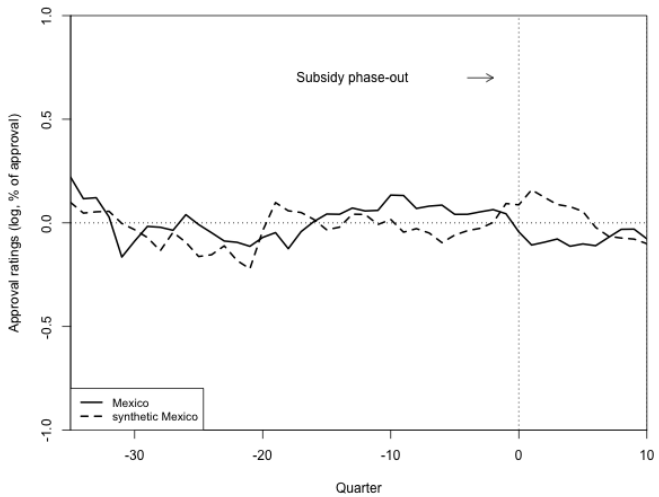
Ratio test: Ratios of posttreatment MSPE to pretreatment MSPE: Bolivia and control countries.



Control pools: A

In the case of Mexico's SC built from control A and B, approval is, on average, 9% and 10% lower, respectively, than in the absence of treatment. This means that, although roughly in the same magnitude, the SC from alternative pool of controls provide more conservative estimates of the effect.

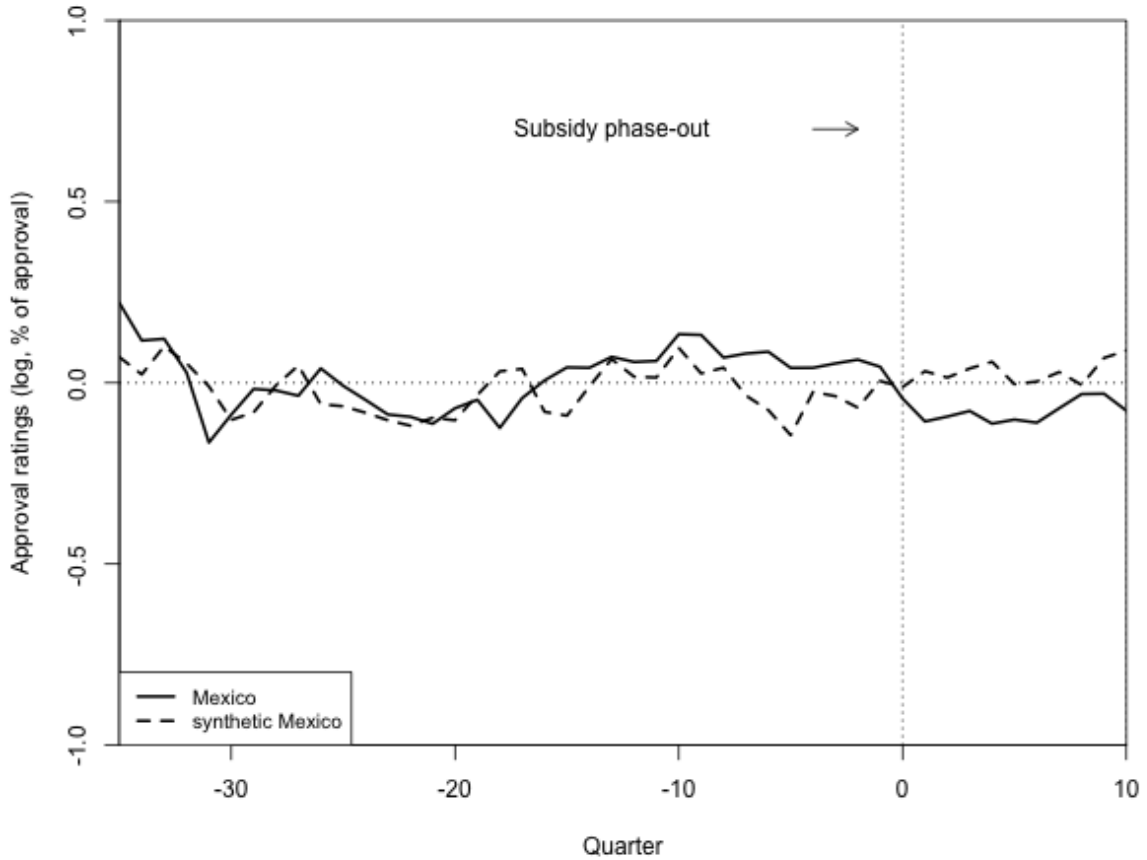
SCM for Mexico with control pool A: Path plot



Back

Control pools: B

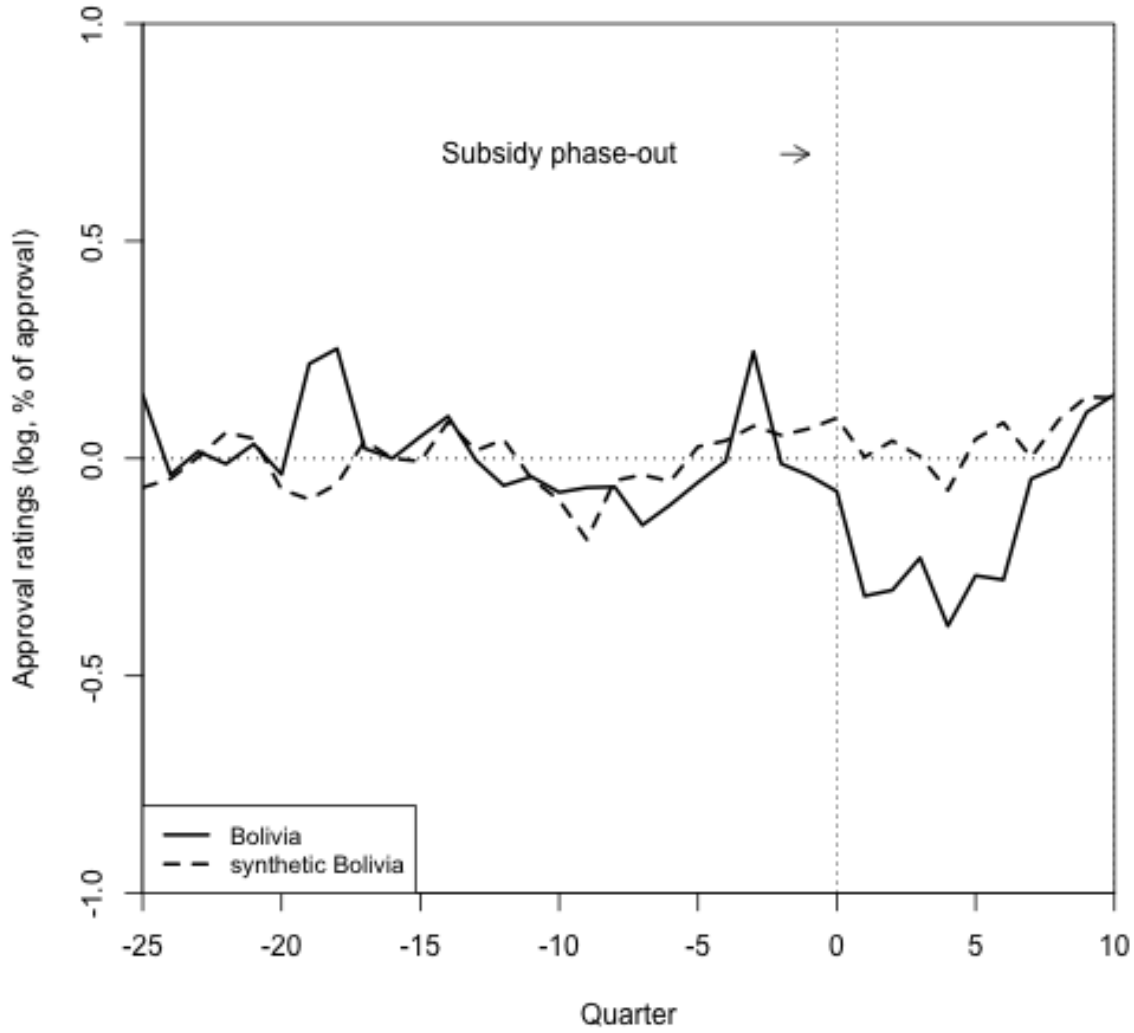
SCM for Mexico with control pool B: Path plot



Back

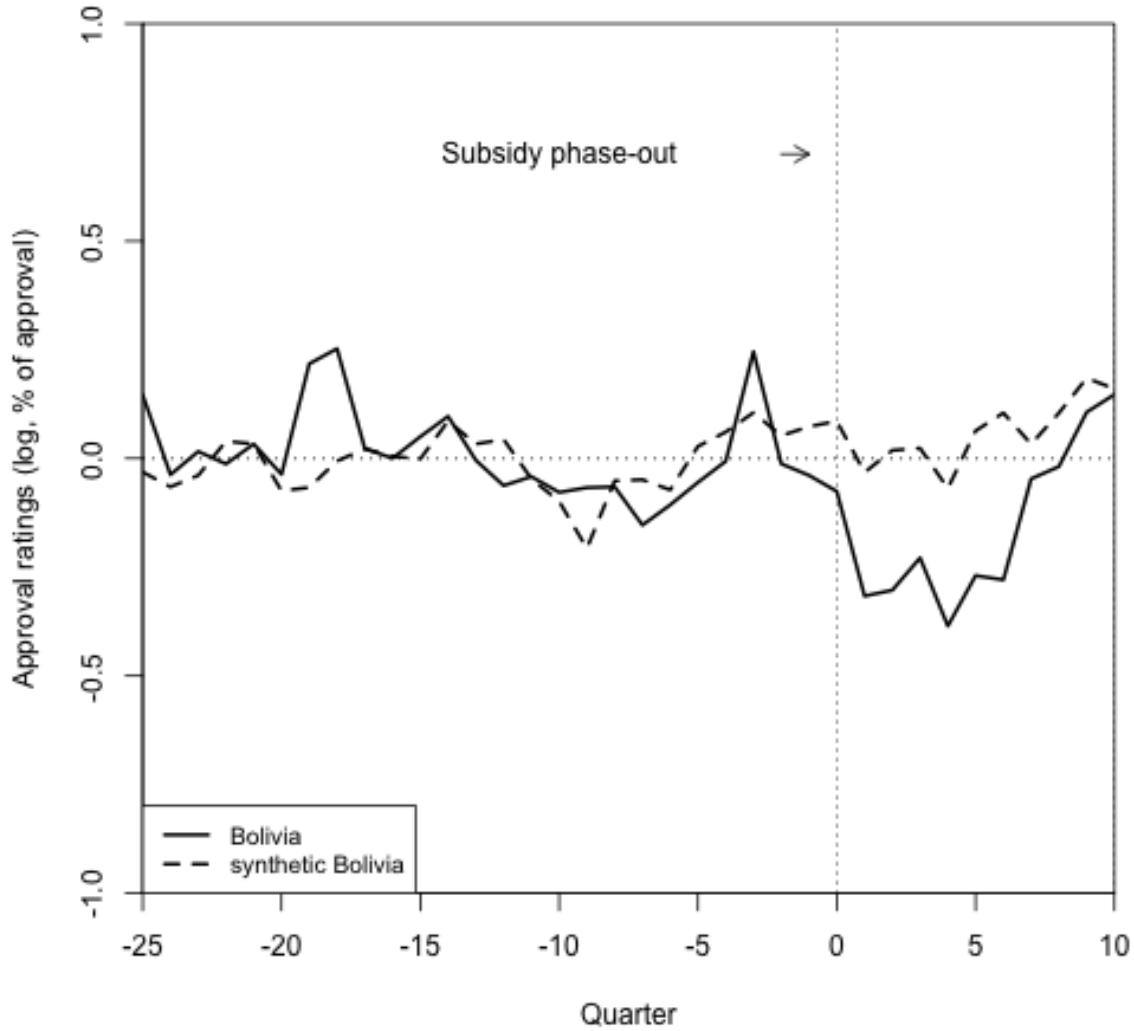
Control pool A: Bolivia

SCM for Bolivia with control pool A: Path plot



Control pool B: Bolivia

SCM for Bolivia with control pool B: Path plot



Bolivia

Bolivia: Predictor means before treatment and predictor weights

Predictor	v.weights	Treated	Synthetic	Sample Mean
Ln low-octane gasoline	0.281	4.343	4.376	4.692
Ln GDP	0.093	1.251	1.252	1.405
Ln CPI	0.173	4.347	4.35	4.359
Duration	0	5.61	7.454	9.086
Duration squared	0	50.537	73.585	111.176
Lag ln approval	0.048	3.858	3.788	3.738
Ln approval (-26)	0.104	0.228	0.087	-0.119
Ln approval (-22)	0.048	-0.013	0.057	-0.013
Ln approval (-16)	0.253	0	-0.011	0.103

Back

Regressivity: Expenditure as income share

Back