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
Fossil-fuel subsidies (FFS) and their removal

Compelling climate measure

- Compelling economics: Pricing 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.
Fossil-fuel subsidies (FFS) and their removal

Compelling climate measure

- Compelling economics: Pricing 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
- 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
- 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.
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)
- Re-election incentives officials & commitment (Pani and Perroni 2018)
- Fossil-fuels as visible redistribution mechanism (Boix 2003; Overland 2010; Overland and Kutschera 2011)

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).


- 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).

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

<table>
<thead>
<tr>
<th>Survey question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you approve or disapprove of the way [President’s name] is handling his job as president?</td>
</tr>
<tr>
<td>☐ Approve</td>
</tr>
<tr>
<td>☐ Disapprove</td>
</tr>
<tr>
<td>☐ No opinion</td>
</tr>
</tbody>
</table>

- 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

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

where \( W^* = (w_2^*, \ldots, w_{J+1}^*) \) 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 Synthetic 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

- 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.
Results: Country weights

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

<table>
<thead>
<tr>
<th>Mexico</th>
<th>Bolivia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolivia</td>
<td>0</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.01</td>
</tr>
<tr>
<td>Chile</td>
<td>0.01</td>
</tr>
<tr>
<td>Colombia</td>
<td>0.66</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>0</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>0.04</td>
</tr>
<tr>
<td>Ecuador</td>
<td>0</td>
</tr>
<tr>
<td>Guatemala</td>
<td>0</td>
</tr>
<tr>
<td>Panama</td>
<td>0.11</td>
</tr>
<tr>
<td>Paraguay</td>
<td>0</td>
</tr>
<tr>
<td>Peru</td>
<td>0.07</td>
</tr>
<tr>
<td>United States</td>
<td>0.07</td>
</tr>
<tr>
<td>Uruguay</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Means between treated and the synthetic Mexico are close, and in most instances, they are a better approximation than the simple sample mean.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>v.weights</th>
<th>Treated</th>
<th>Synthetic</th>
<th>Sample Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln low-oct gasoline</td>
<td>0.163</td>
<td>4.532</td>
<td>4.537</td>
<td>4.652</td>
</tr>
<tr>
<td>Ln GDP growth</td>
<td>0.001</td>
<td>0.659</td>
<td>1.339</td>
<td>1.399</td>
</tr>
<tr>
<td>Ln CPI</td>
<td>0.186</td>
<td>4.386</td>
<td>4.38</td>
<td>4.335</td>
</tr>
<tr>
<td>Duration</td>
<td>0.004</td>
<td>10.833</td>
<td>9.128</td>
<td>8.87</td>
</tr>
<tr>
<td>Duration squared</td>
<td>0.003</td>
<td>158.833</td>
<td>107.206</td>
<td>106.135</td>
</tr>
<tr>
<td>Lag ln approval</td>
<td>0.024</td>
<td>3.971</td>
<td>3.865</td>
<td>3.697</td>
</tr>
<tr>
<td>Ln approval (-15)</td>
<td>0.082</td>
<td>0.043</td>
<td>0.027</td>
<td>0.038</td>
</tr>
<tr>
<td>Ln approval (-23)</td>
<td>0.233</td>
<td>-0.088</td>
<td>-0.063</td>
<td>-0.143</td>
</tr>
<tr>
<td>Ln approval (-5)</td>
<td>0.303</td>
<td>0.041</td>
<td>0.031</td>
<td>-0.128</td>
</tr>
<tr>
<td>Ln approval (-3)</td>
<td>0.003</td>
<td>0.053</td>
<td>-0.029</td>
<td>-0.027</td>
</tr>
</tbody>
</table>
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 $\alpha^j$ and $\xi^{ij}$ ideological prefs.
- Parties A and B: choose party platform $\alpha_A$ and $\alpha_B$ to maximize their probability of winning elections

Stages:
1. Parties announce policy platforms
2. Relative popularity of parties is realized
3. Elections
4. Elected party implements policy platform

Relevant eq:
$$W^i(\alpha_A) > W^i(\alpha_B) + \xi^{ij} + \delta$$

Proposition:
- Removing subsidies will result in a loss of expected political support.
- 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

1. Driven by high-income households because these
2. Have a higher voter density around the median and
3. 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.

\[
\text{approval}_{i,t} = \alpha_0 + \beta_1\text{treat}_{i,t} + \beta_2\text{post}_{i,t} \\
+ \beta_3\text{treat} \times \text{post}_{i,t} \\
+ \mathbf{X}_{i,t}\gamma + \epsilon_{i,t}
\]  

- 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

<table>
<thead>
<tr>
<th>Predictor</th>
<th>1Q</th>
<th>2Q</th>
<th>3Q</th>
<th>4Q</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>post × treat</td>
<td>0.029</td>
<td>0.003</td>
<td>-0.038</td>
<td>-0.222*</td>
<td>-0.084</td>
</tr>
<tr>
<td></td>
<td>(0.109)</td>
<td>(0.086)</td>
<td>(0.091)</td>
<td>(0.101)</td>
<td>(0.054)</td>
</tr>
<tr>
<td>post</td>
<td>-0.059</td>
<td>-0.019</td>
<td>0.002</td>
<td>0.076</td>
<td>0.031</td>
</tr>
<tr>
<td></td>
<td>(0.078)</td>
<td>(0.063)</td>
<td>(0.064)</td>
<td>(0.067)</td>
<td>(0.040)</td>
</tr>
<tr>
<td>treat</td>
<td>0.113</td>
<td>0.120*</td>
<td>0.239***</td>
<td>0.282***</td>
<td>0.201***</td>
</tr>
<tr>
<td></td>
<td>(0.074)</td>
<td>(0.060)</td>
<td>(0.060)</td>
<td>(0.074)</td>
<td>(0.035)</td>
</tr>
</tbody>
</table>

**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


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

![Diagram showing costs, prices, and deadweight loss in the context of environmental externalities.](image)

- Costs: \( P \)
- Prices: \( P_{\text{sub}} \), \( P_{\text{mkt}} \), \( P_{\ell} \), \( P_{\text{c}} \)
- Levels: \( Q_{\text{opt}} \), \( Q_{\ell} \), \( Q_{\text{mkt}} \), \( Q_{\text{sub}} \)

MSC (global + local)
MSC (local)
(Marginal Social Cost)

Deadweight loss
Implicit subsidy in Mexico

Implicit subsidy and tax

Source: Own elaboration with data from the SIE, Banxico and the EIA
Fuel pricing mechanisms by country: 2008-14

Source: own elaboration with data from IDB.2017
# Descriptive statistics: Synthetic Control

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

- Let \( j = 1, \ldots, J + 1 \) 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 \( t = 1, 2, \ldots, T \) be time periods. Where \( 1, 2, \ldots, T_0 \) are time periods prior to treatment and, \( T_0 + 1, T_0 + 2, \ldots, T \) refer to posttreatment periods.
- The phase-out’s causal effect to be estimated is given by the Treatment effect on the Treated (TT):

\[
TT_t = Y_{1t} - Y_{1t}^N
\]  

(3)

- Empirical challenge!: Reconstruct the post-treatment outcome of the treated unit had it not been treated.
To address this empirical challenge, we build the counterfactual (synthetic control) as a linear combination of untreated units.

\[
SC = \hat{Y}_{1,t}^N = \sum_{j=2}^{J+1} w^*_j Y_{j,t}
\]  

(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:

\[
ATT = \frac{1}{T - T_0} \sum_{t>T_0} [Y_{1,t} - \hat{Y}_{1,t}^N]
\]

(5)
Our estimation of the SC, $\hat{Y}_{1,t}^N$, follows a nested optimization procedure:

- First, we choose $W^*$ by minimizing the euclidean distance between $X_1$ and $X_0W$ as follows:

$$
W^* = \underset{w}{\text{argmin}} \|X_1 - X_0W\|v = \sqrt{(X_1 - X_0W)'V(X_1 - X_0W)}
$$  \hspace{1cm} (6)

where $X_1$ is a $(r + k) \times (1)$ matrix of $k$ covariates and $r$ linear combinations of pre-treatment outcomes used as predictors, $X_0$ is an $(r + k) \times (J)$ matrix; and $V$ is a diagonal matrix in which the diagonal elements $v = (v_1, ..., v_{r+l})$ 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:

$$
V^* = \underset{v}{\text{argmin}} (Y_1 - Y_0W^*(V))'V(Y_1 - Y_0W^*(V))
$$  \hspace{1cm} (7)

where $Y_1$ denotes pre-treatment approval of Mexico(Bolivia) and $Y_0$ denotes linear combinations of pre-treatment approval of control countries.
### Bolivia: Predictor means before treatment and predictor weights

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

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

Placebo in-time: Mexico

Approval ratings (log. % of approval)

Quarter

Mexico

synthetic Mexico
Placebo in-space Mexico
Placebo in-time Bolivia

Placebo in-time: Bolivia
Placebo in-space Bolivia

Placebo in-space: Bolivia

![Graph showing gap in approval ratings over quarters with a phase-out period.](chart.png)
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 \( \frac{1}{10} = 0.10 \).

Ratio test: Ratios of posttreatment MSPE to pretreatment MSPE: Mexico and control countries.
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 $\frac{2}{10}=0.20$.

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
Backup

Control pools: B

SCM for Mexico with control pool B: Path plot

![Graph showing approval ratings over quarters with a subsidy phase-out milestone.](image-url)
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

![Graph showing approval ratings over time with a subsidy phase-out marked at quarter 0. The graph compares Bolivia and a synthetic Bolivia.]
### Bolivia: Predictor means before treatment and predictor weights

<table>
<thead>
<tr>
<th>Predictor</th>
<th>v. weights</th>
<th>Treated</th>
<th>Synthetic</th>
<th>Sample Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln low-octane gasoline</td>
<td>0.281</td>
<td>4.343</td>
<td>4.376</td>
<td>4.692</td>
</tr>
<tr>
<td>Ln GDP</td>
<td>0.093</td>
<td>1.251</td>
<td>1.252</td>
<td>1.405</td>
</tr>
<tr>
<td>Ln CPI</td>
<td>0.173</td>
<td>4.347</td>
<td>4.35</td>
<td>4.359</td>
</tr>
<tr>
<td>Duration</td>
<td>0</td>
<td>5.61</td>
<td>7.454</td>
<td>9.086</td>
</tr>
<tr>
<td>Duration squared</td>
<td>0</td>
<td>50.537</td>
<td>73.585</td>
<td>111.176</td>
</tr>
<tr>
<td>Lag Ln approval</td>
<td>0.048</td>
<td>3.858</td>
<td>3.788</td>
<td>3.738</td>
</tr>
<tr>
<td>Ln approval (-26)</td>
<td>0.104</td>
<td>0.228</td>
<td>0.087</td>
<td>-0.119</td>
</tr>
<tr>
<td>Ln approval (-22)</td>
<td>0.048</td>
<td>-0.013</td>
<td>0.057</td>
<td>-0.013</td>
</tr>
<tr>
<td>Ln approval (-16)</td>
<td>0.253</td>
<td>0</td>
<td>-0.011</td>
<td>0.103</td>
</tr>
</tbody>
</table>
Regressivity: Expenditure as income share

Expenditure as income share (2010)