The Presource Curse

Anticipation, Disappointment, and Governance after Oil Discoveries

Erik Katovich
PhD Candidate

University of Wisconsin-Madison
Department of Agricultural and Applied Economics

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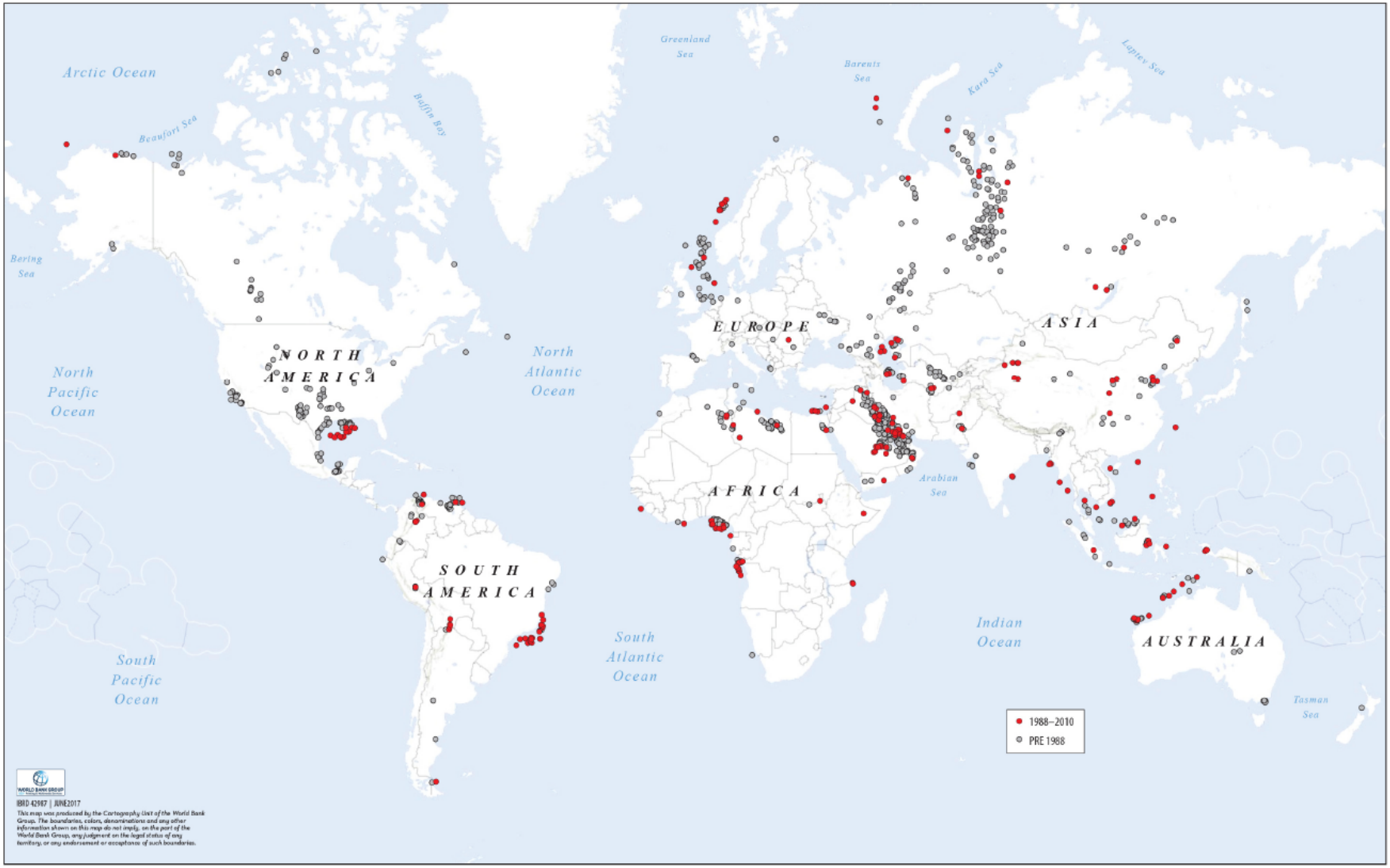
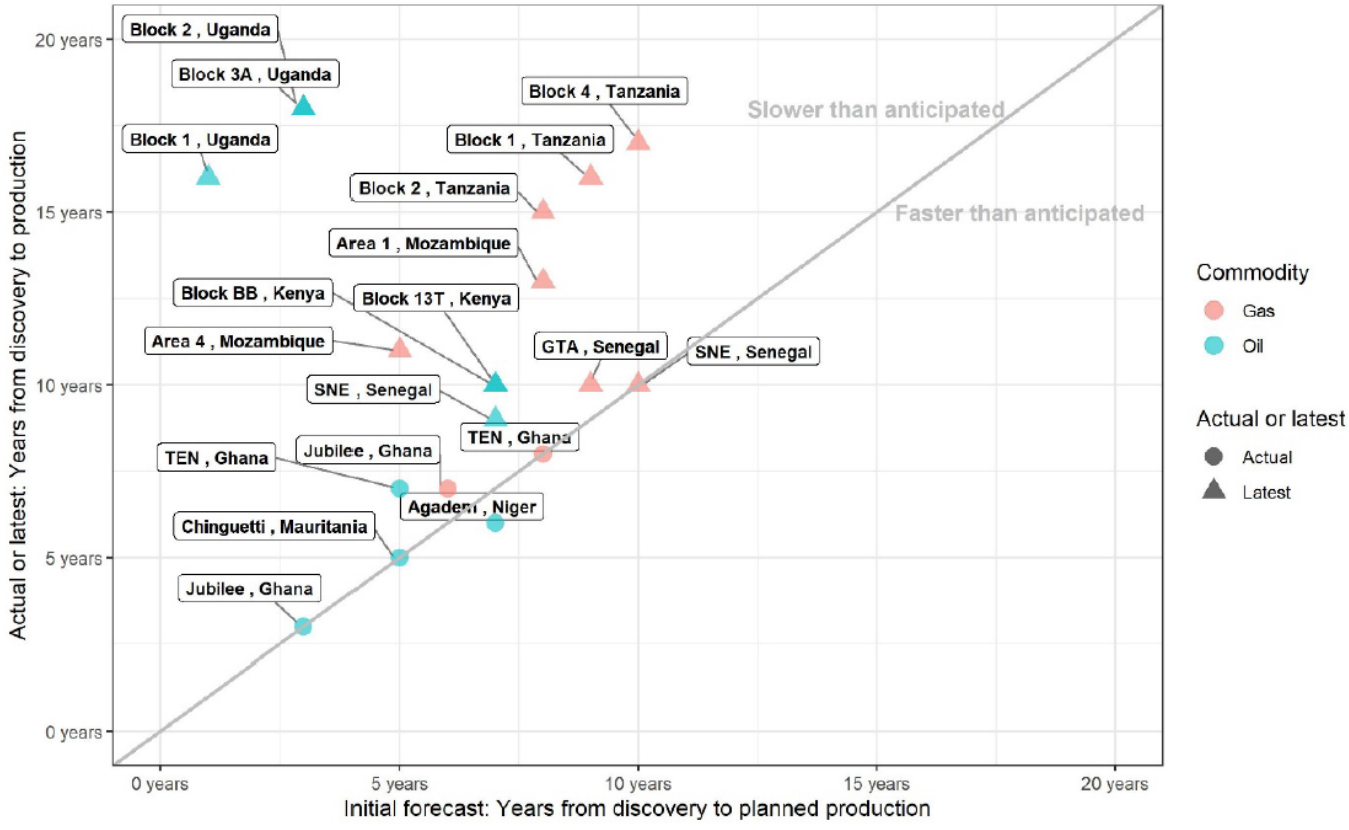
Giant Oil or Gas Discoveries Have Affected 46 Countries Since 1988



Discoveries $\geq$ 500 Million Barrels of Oil Equivalent, Cust and Mihalyi (2021)

Delay and Disappointment Are Common After Discoveries



Time to Production vs Initial Forecast, Cust and Mihalyi (2021)

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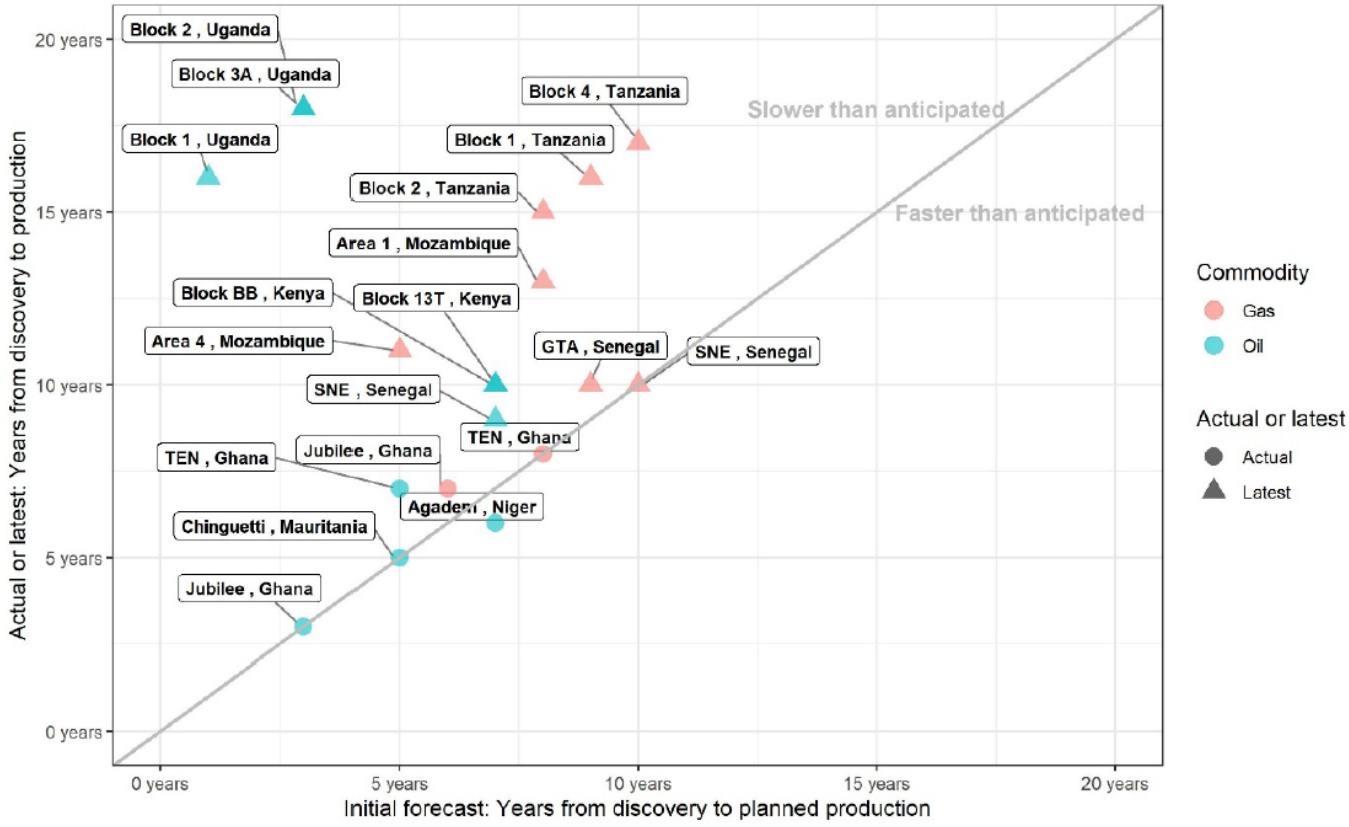

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Economy | Fossil Fuels | **Bloomberg**

Total suspends $20BN LNG project in Mozambique indefinitely

French energy giant Total SE suspended its LNG project in Mozambique indefinitely due to rising security threats in the area.

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What do I contribute?

- Use quasi-experiment at subnational level to test Presource Curse hypotheses in a new context (Brazil)
- Harness rich municipality-level datasets to explore detailed outcomes (public finance, elections, firms)

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   "Satisfied" municipalities enjoy increased per capita revenues (+75%) and spending (+21%) ten years on, but no improvement in public goods provision

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Novo poço confirma potencial de petróleo leve em Tupi

Rio de Janeiro, 04 de junho de 2009 – PETRÓLEO BRASILEIRO S/A - PETROBRAS, [Bovespa: PETR3/PETR4, NYSE: PBR/PBRA, Latibex: XPBR/XPBRA, BCBA: APBR/APBRA], uma companhia brasileira de energia com atuação internacional, comunica que a perfuração de mais um poço na área de Tupi reforça as estimativas do potencial de 5 a 8 bilhões de barris de óleo leve e gás natural recuperável nos reservatórios do pré-sal daquela área, em águas ultraprofundas da Bacia de Santos. O poço ainda encontra-se em perfuração, na busca de objetivos mais profundos.

A uma distância de 33 km a noroeste do poço pioneiro 1-RJS-628, o novo poço, denominado 4-BRSA-711-RJS (4-RJS-647), confirmou a presença de reservatórios de boa qualidade e a presença de óleo semelhante ao poço pioneiro de Tupi, o que reforça as estimativas iniciais para a área.

Informalmente conhecido como Iracema, este terceiro poço está localizado na área do Plano de Avaliação de Tupi, em lâmina d'água de 2.210 metros, e a cerca de 250 km da costa do Rio de Janeiro.

A descoberta foi comprovada através de amostragens de petróleo leve (cerca de 30º API) por teste a cabo, em reservatórios localizados em profundidade de cerca de 5.000 metros, e comunicada à Agência Nacional do Petróleo, Gás Natural e Biocombustíveis - ANP nesta data.

Após a conclusão da perfuração, o Consórcio, formado pela Petrobras (65% - Operadora), BG Group (25%) e Galp (10%), para a exploração do bloco BM-S-11, onde fica a área de Tupi, dará continuidade às atividades e investimentos previstos no Plano de Avaliação aprovado pela ANP e que prevê a perfuração de outros poços na área.

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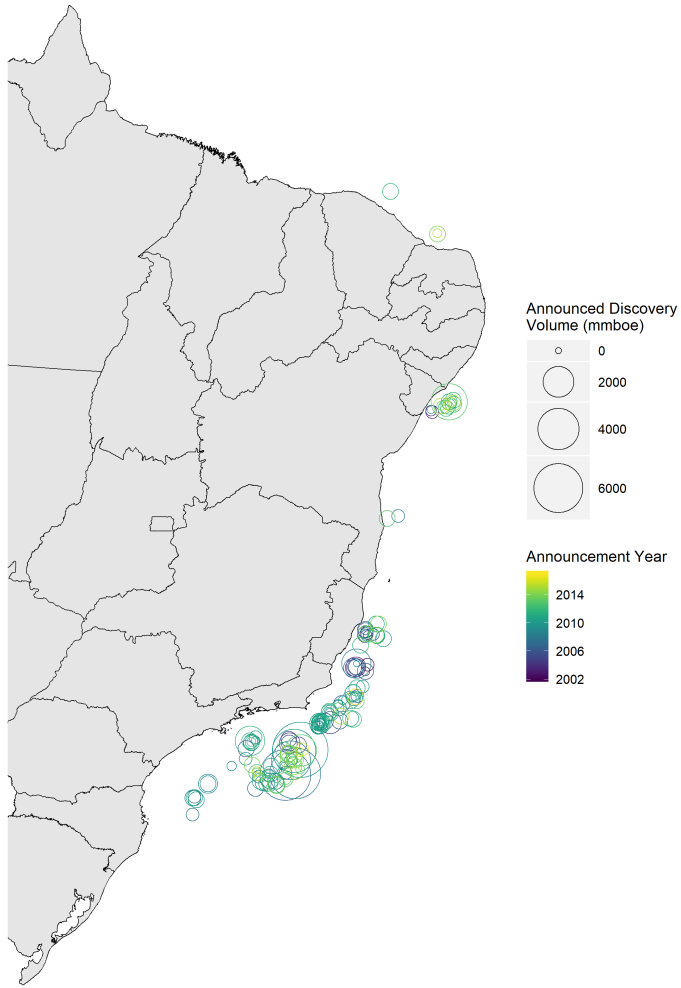

Exploiting a Quasi-Experiment II: Royalty Distribution Maps

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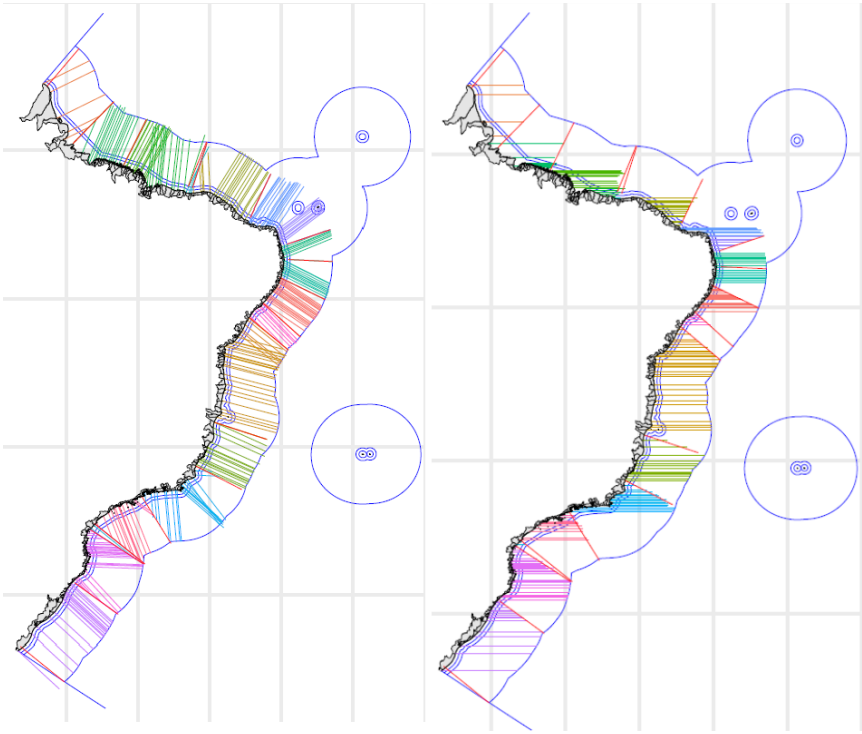

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Projections of Coastal Municipal Boundaries

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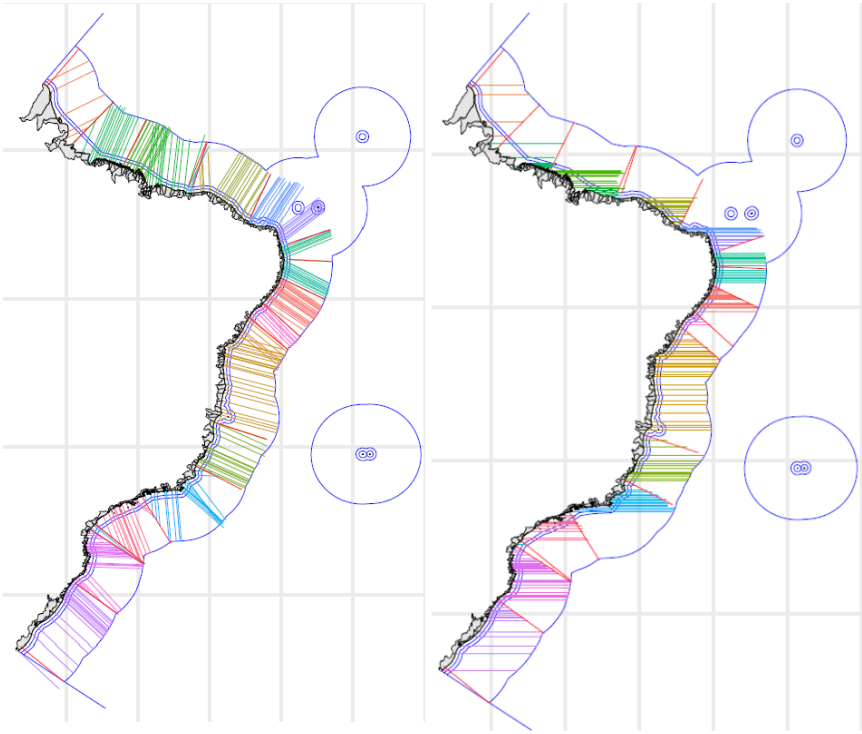
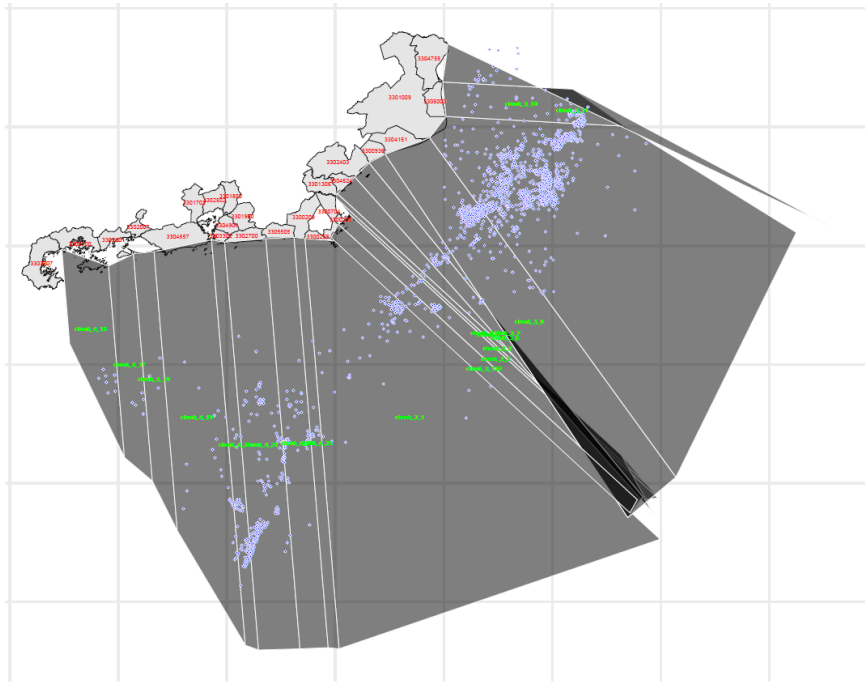


Orthogonal (Left) and Parallel (Right) Projections of Coastal Municipal Boundaries



Offshore Wells Overlaid on Orthogonal Projections (Example: Rio de Janeiro)

Exploiting a Quasi-Experiment III: Forecasting Revenue Expectations

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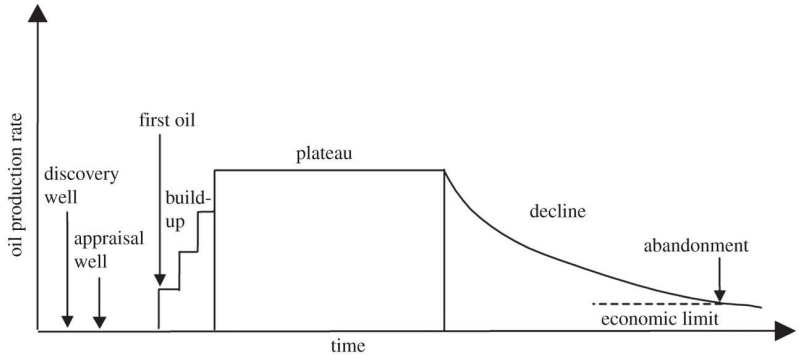

Standard Offshore Production Timeline

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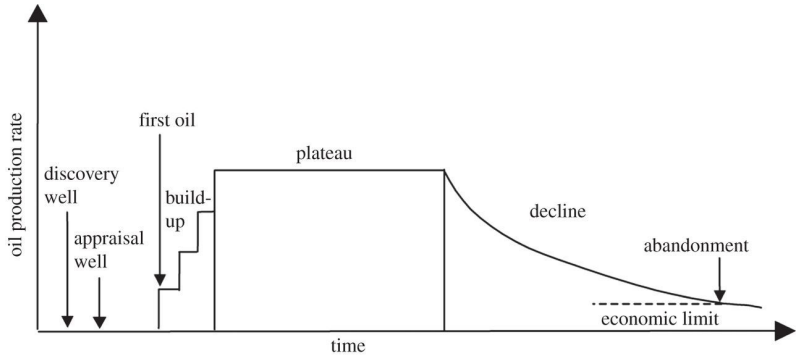

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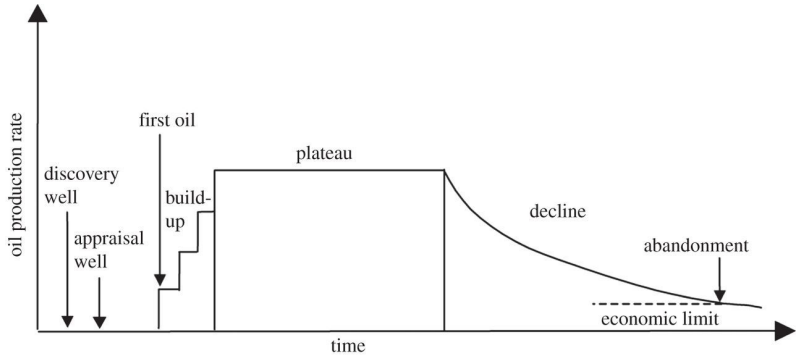

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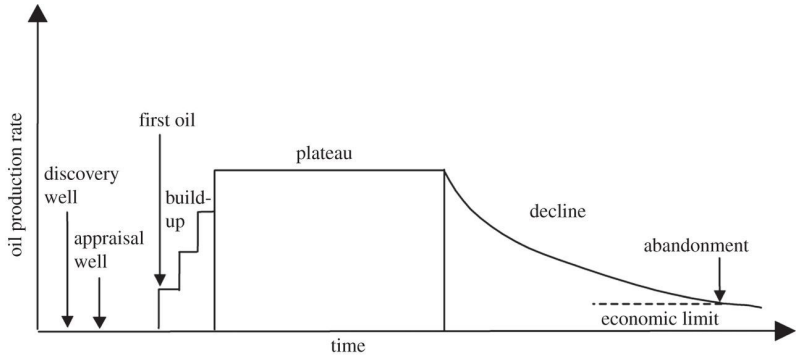

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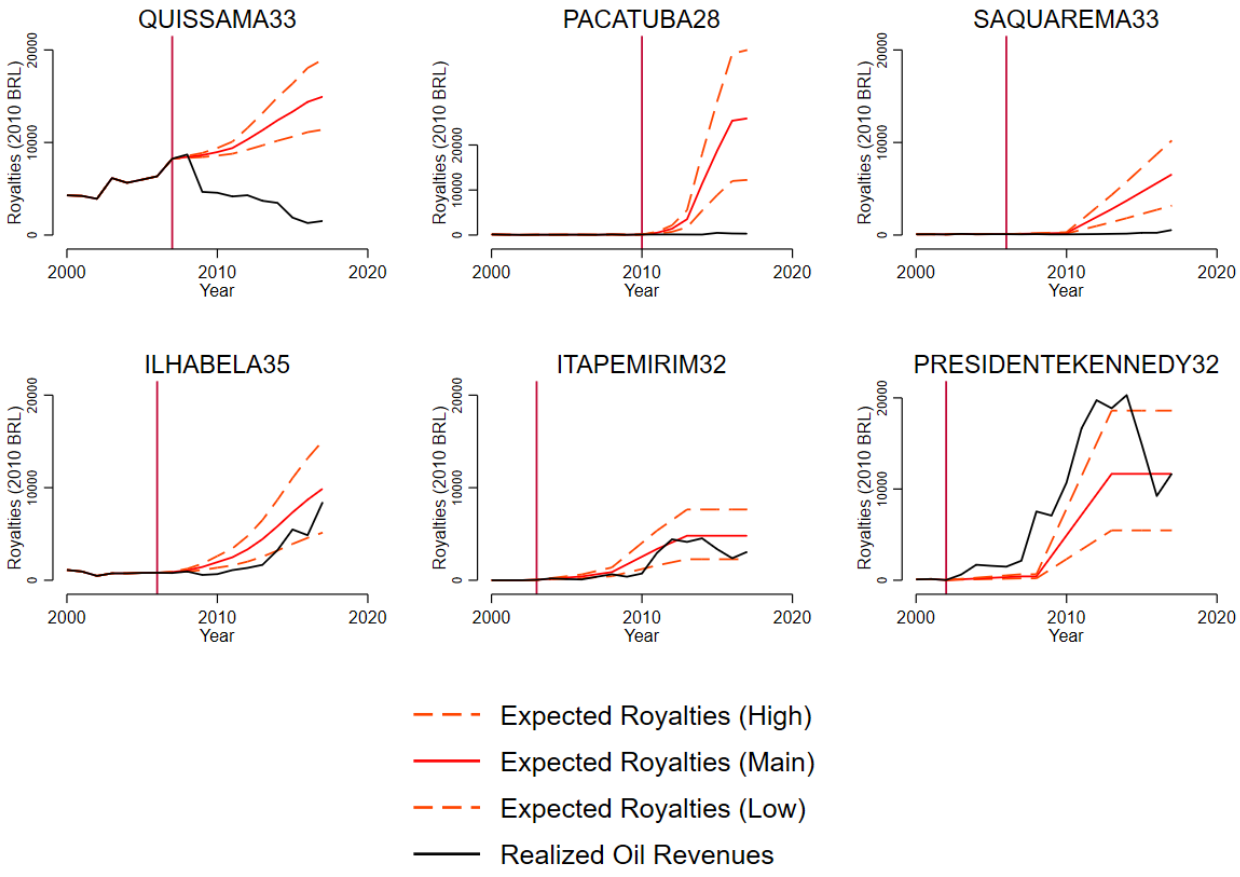
3. Compute "disappointment" for municipality m in year t:

$$Disappointment_{mt} = \frac{\frac{Royalties_{mt}}{Royalties_{m,t0}}}{\frac{E(Royalties_{mt})}{Royalties_{m,t0}}} = \frac{\text{Realized Revenue Growth Since Discovery}}{\text{Expected Revenue Growth Since Discovery}}$$

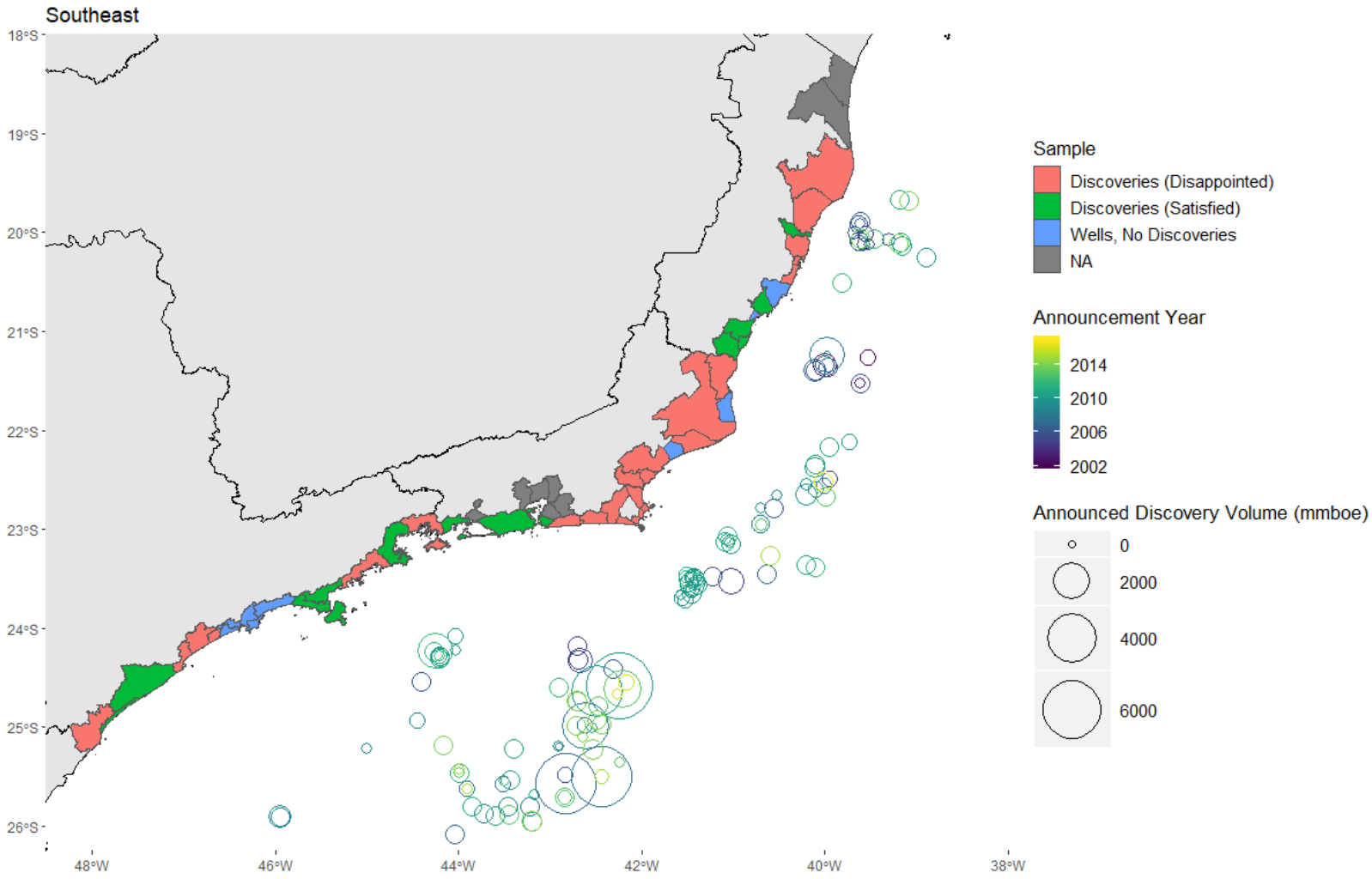
▸ Forecasting Model

Comparing Forecast vs. Realized Revenues (Selected Examples)



- For main analysis, group municipalities as "disappointed"/"satisfied" along median of distribution of $Disappointment_{m,2017}$

Mapping Discovery Realizations (Example: Southeast Brazil)



▸ Full Brazilian Coastline ▸ Conditional Random Assignment Tests

Data Sources: Constructing a Rich Municipality-Level Panel

Data	Source	Years
Discovery Announcements	CVM	2002-2017
Oil Royalties & Special Participations	ANP	1999-2017
Offshore Well Shapefiles	ANP	2000-2017
Oil and Gas Production	ANP	2005-2017
Public Finances	FINBRA & IPEA	2000-2017
Employment & Firm Entry	RAIS	2000-2017
Federal and State Transfers	Tesouro Nacional	2000-2017
Elections (Candidates and Donors)	TSE	2000-2016
Health Indicators	SUS	2000-2017
Education Indicators	Basic Ed Census	2000-2017
Education Outcomes	IDEB	2005-2017
Municipal Development Index	FIRJAN	2000, 2005-2016
Municipality Characteristics	Census	2000, 2010
Brent Crude Oil Prices	FRED	2000-2017
Currency Deflator	IPEA (INPC)	2000-2017
Interest Rate	IPEA (Selic)	2000-2017

▸ Balance Across Samples

Event Study around First Discovery Announcement

- Let E_m be period when municipality m is "treated" with event (i.e. discovery announcement). Let $K_{mt} = t - E_m$
- y_{mt} includes public finance outcomes (e.g., spending, revenue, debt) and firm outcomes (e.g., entry, hiring, wages)

$$y_{mt} = \delta_m + \lambda_t + \sum_{k \neq -1} \mathbb{1}(K_{mt} = k)\beta_k + \epsilon_{mt}$$

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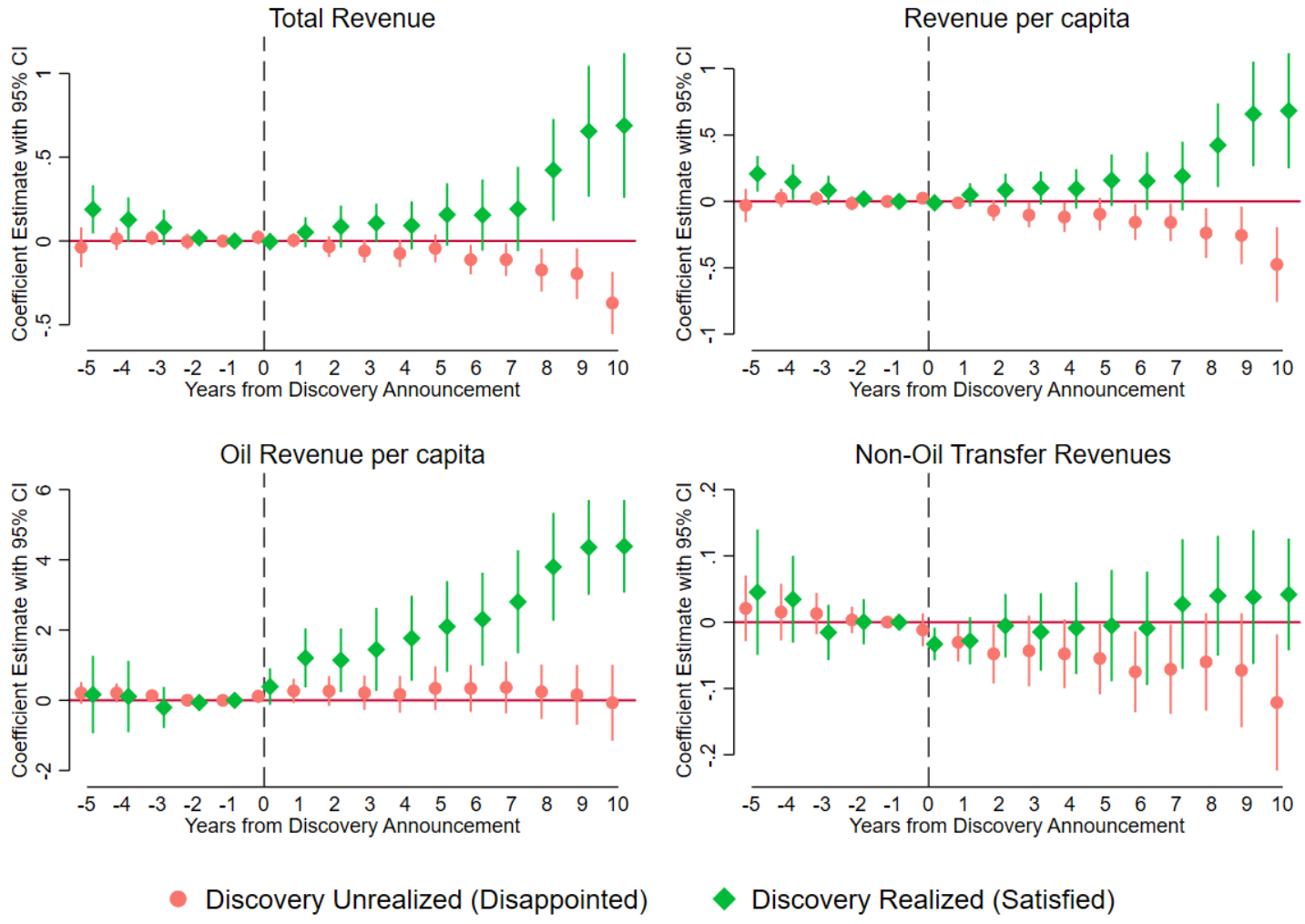
  2. Callaway and Sant'Anna (2020) staggered event study estimator (CS)

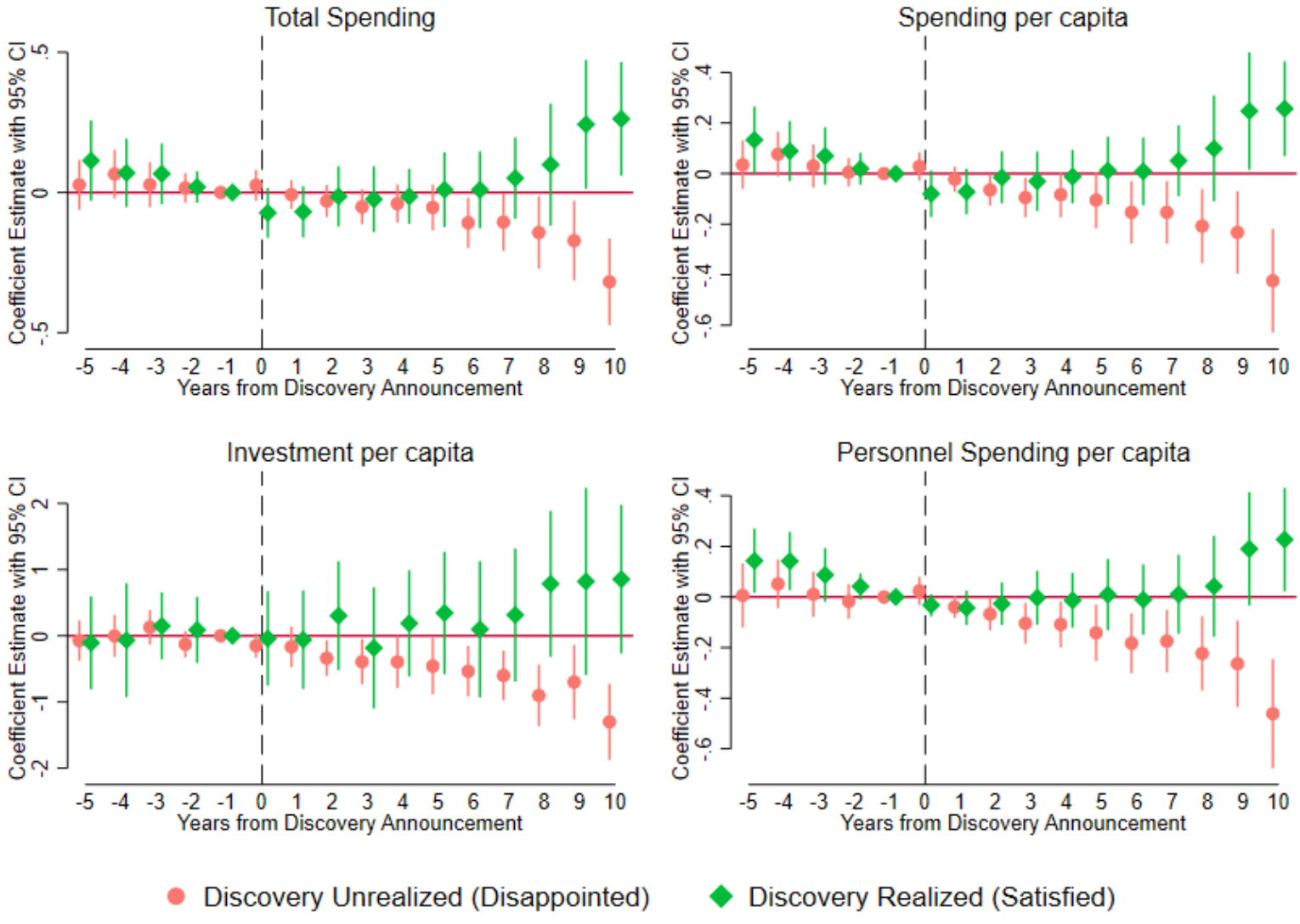
Results: Municipal Revenues after Oil Discoveries



Effects on Disappointed and Satisfied treated groups are estimated separately but graphed together. Results are reported from **TWFE-Wells** specification. Continuous outcomes use inverse hyperbolic sine transformation. Standard errors are clustered at the municipality level. Monetary values are deflated to constant 2010 BRL.

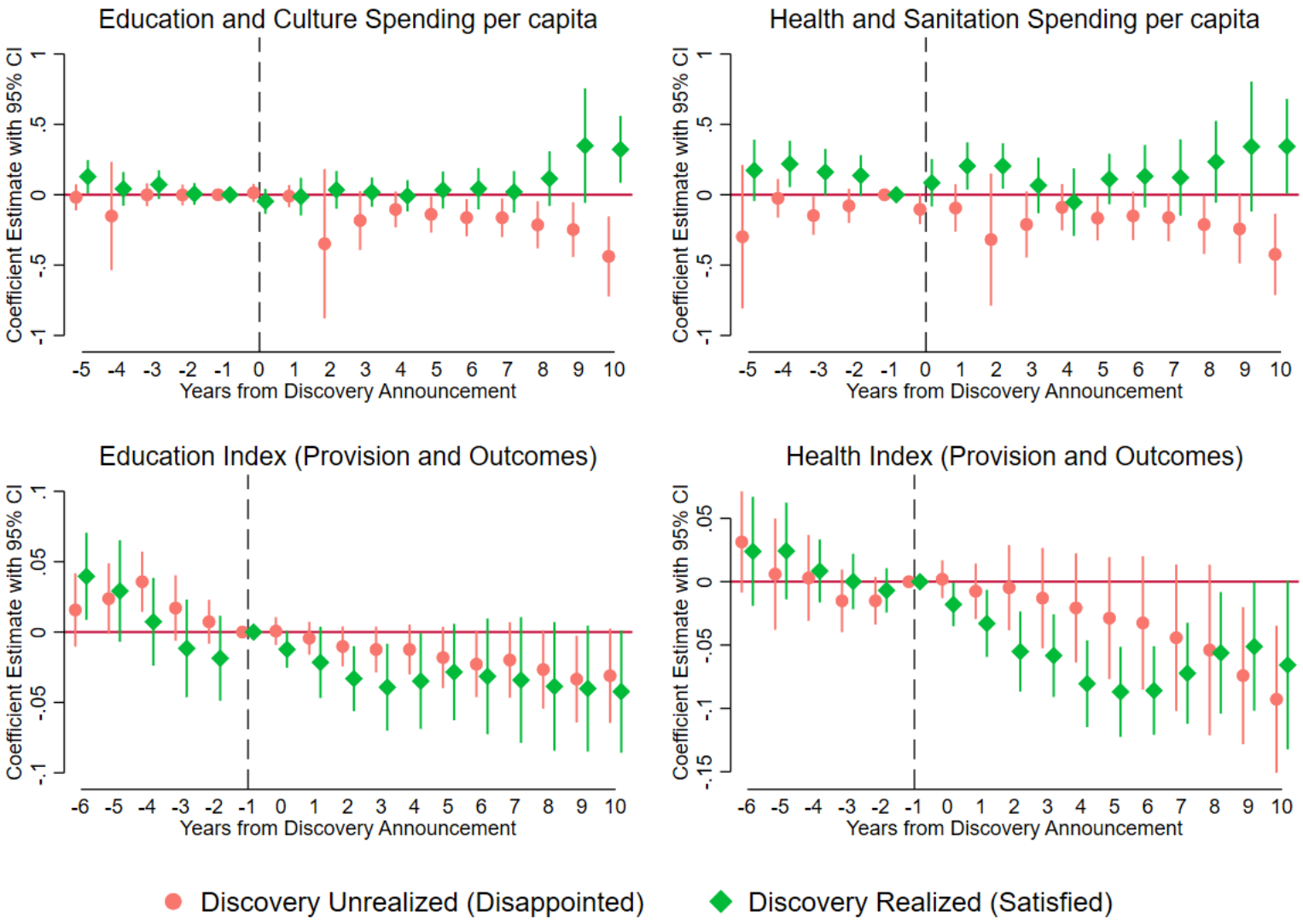
▸ Breakdown of Transfers ▸ Interpreting Coefficients ▸ Pre-Trends

Results: Municipal Spending



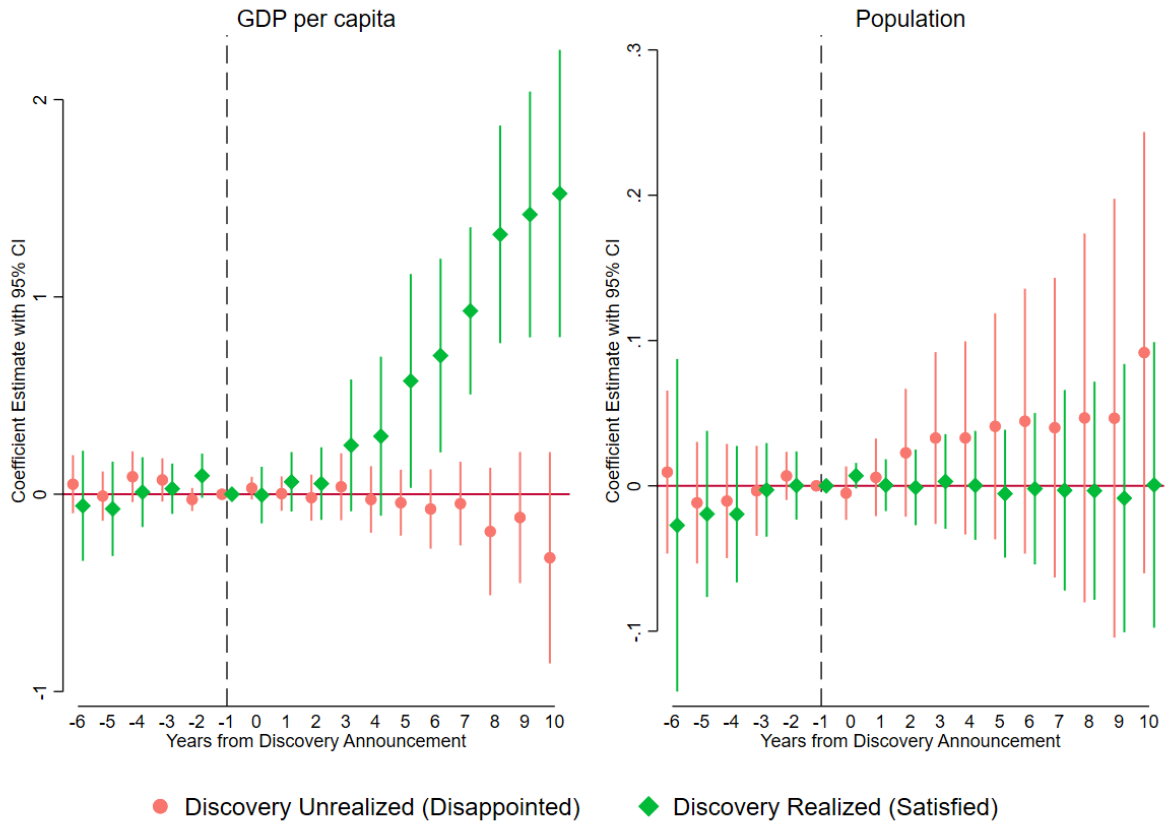
▸ Interpreting Coefficients

Results: Public Goods Spending and Provision



▸ Real Public Goods Provision and Quality ▸ Interpreting Coefficients

Results: Municipal GDP and Population



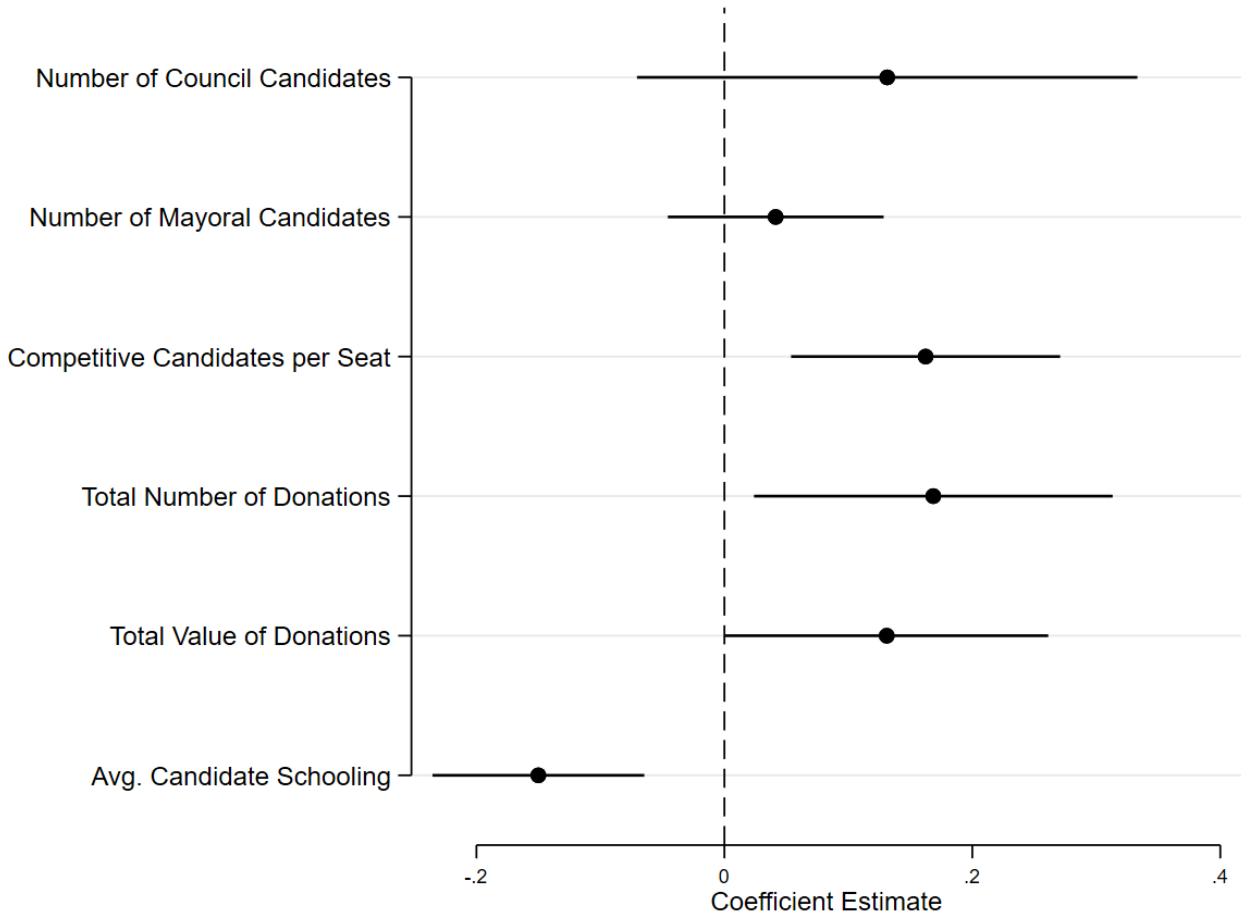
Further Robustness checks:

- Callaway and Sant'Anna (2020) Estimator ▸ Callaway and Sant'Anna
- Alternative forecasting and matching parameters ▸ Sensitivity Analysis
- Event studies with multiple events ▸ Multiple Events
- Spatial spillovers onto neighboring municipalities ▸ Spatial Spillovers

Do Discovery Announcements Affect Local Elections?

- Municipality m was treated ($T_{me} = 1$) in prior 4-year period e if it experienced a discovery during that period
- y_{mpe} measures electoral competition: number and characteristics of candidates, donations

$$y_{me} = \delta_m + \lambda_p e + \beta_1 T_{me} + \epsilon_{me}$$



▸ Robustness

Main Takeaways

- Discoveries are often delayed and disappointed – this is an important part of the "resource curse"
- When successful, offshore oil discoveries in Brazil brought huge per capita revenue windfalls (+75% after ten years); converting these windfalls into better public goods provision is challenging
- Municipalities left disappointed after discovery announcements are worse off than never-treated controls (investment $\downarrow$ 57% and public goods spending $\downarrow$ 26% after ten years)

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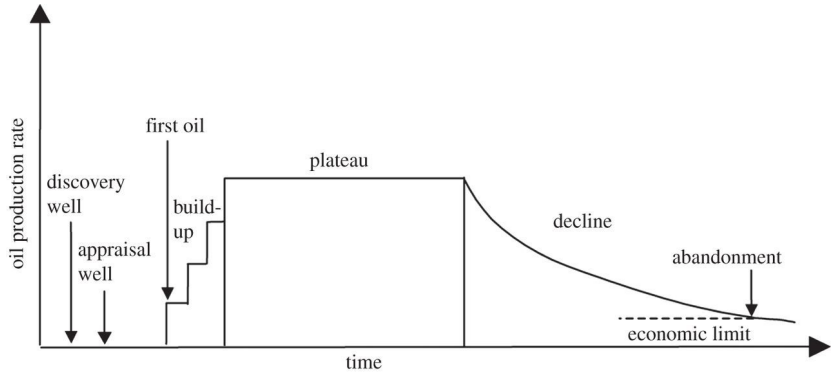
- Municipalities left disappointed after discovery announcements are worse off than never-treated controls (investment ↓ 57% and public goods spending ↓ 26% after ten years)
- **Methodological contribution: we should take heterogeneity in discovery realizations into account**
  - **Studies focused exclusively on resource revenues may lump disappointed places in with controls**
  - **Studies that treat all discovery-affected places the same may miss long-term divergence in outcomes between disappointed and satisfied places**

Forecasting Municipalities' Discovery Expectations I



Standard Offshore Production Timeline

Municipality m's **expected production stream** from discovery d in year t:

$$E(Production_{mdt}) = \begin{cases} 1(alignment_{md} = 1) \times \delta V_d \times \frac{(t - t_0)}{\theta_{st}} & \text{if} \quad t - t_0 \leq \theta_{st} \\ 1(alignment_{md} = 1) \times \delta V_d & \text{if} \quad t - t_0 > \theta_{st} \end{cases}$$

- t_0 is year of discovery announcement
- V_d is volume of the announced discovery
- δ is proportion of total reserve extracted each year (US EIA, 2015)
- θ_{st} is average discovery-to-production delay in sedimentary basin s up to year t

Value of royalties associated with expected production:

$$E(Royalties_{mdt}) = \underbrace{\left(1(alignment_{mw} = 1) \times E(Prod_{mdt}) \times (P_{t0} \times X_{t0}) \times 0.30 \times 0.05\right)}_{\text{First 5\% of Royalty Tax to Municipalities Aligned with Well}} + \underbrace{\left(E(Prod_{mdt}) \times (P_{t0} \times X_{t0}) \times 0.225 \times (R_f - 0.05) \times A_{mf}\right)}_{\text{Tax in Excess of 5\% to Municipalities Aligned with Field}}$$

- P_{t0} and X_{t0} are world oil price and BRL/USD exchange rate in year of discovery
- A_{mf} is m's share of alignment with field f
- R_f is field-specific tax rate

In each period, compute **disappointment** in municipality m in year t:

$$Disappointment_{mt} = \frac{\frac{Royalties_{mt}}{Royalties_{m,t0}}}{\frac{E(Royalties_{mt})}{Royalties_{m,t0}}}$$

This is the ratio of realized royalty growth between discovery announcement in $t0$ and current period t, and expected royalty growth over the same period. $Disappointment_{mt} = 1$ if forecast error $= 0$.

▸ Return

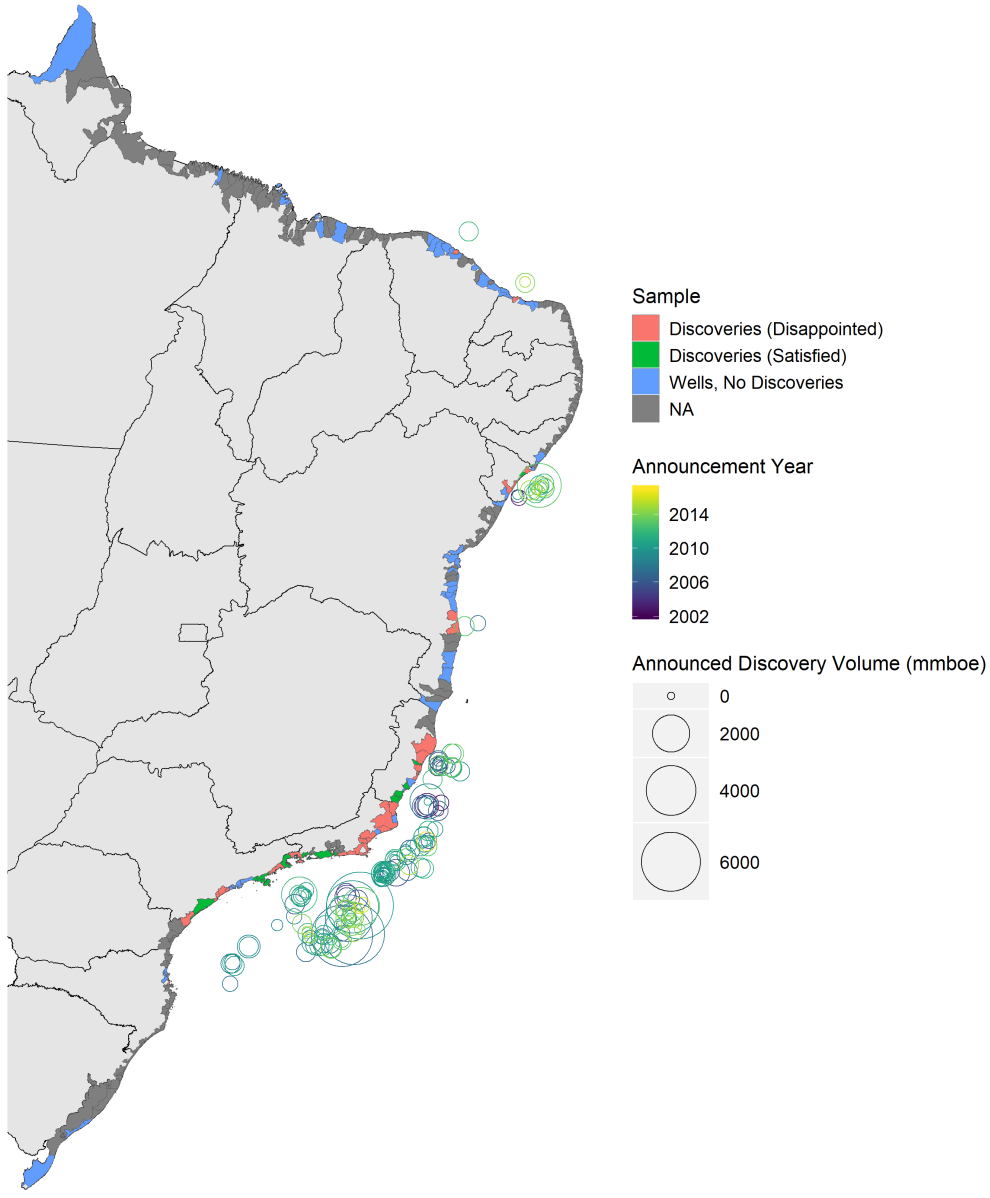
Pre-Treatment (Year 2000) Balance Between Samples

	Treated Samples		Control Samples			
	Disappoint.	**Satisfied**	**Wells**	**Match (D)**	**Match (S)**	**Coastal**
Latitude	-19.50	-21.82	-13.04	-20.21	-20.00	-16.40
	(6.25)	(3.13)	(9.59)	(7.91)	(8.13)	(9.24)
Dist. from State Capital	116.62	88.59	150.15	192.14	92.79	248.87
	(85.35)	(57.12)	(120.02)	(143.64)	(38.81)	(159.90)
Population (Thousands)	91.88	398.53	55.42	38.11	56.82	32.26
	(122.23)	(1,367.51)	(81.82)	(77.30)	(471.41)	(192.54)
GDP per capita	17,769	13,779	6,552	6,814	7,840	5,443
	(26,418)	(12,003)	(6,735)	(7,261)	(9,641)	(5,978)
Income Gini Coefficient	0.57	0.57	0.56	0.55	0.53	0.54
	(0.05)	(0.04)	(0.07)	(0.06)	(0.06)	(0.07)
Municipal Dev.Index	0.60	0.64	0.50	0.57	0.57	0.53
	(0.07)	(0.09)	(0.10)	(0.09)	(0.13)	(0.13)
Urban Share of Pop.	0.83	0.80	0.66	0.68	0.66	0.57
	(0.21)	(0.22)	(0.24)	(0.20)	(0.25)	(0.24)
% HHs w. Water/Sewer	7.76	3.63	20.56	10.03	10.67	13.64
	(8.01)	(3.95)	(19.57)	(12.19)	(15.81)	(16.19)
Municipal Revenue p.c.	1,628	1,729	1,011	969	1,220	1,000
	(1,478)	(1,047)	(809)	(2,993)	(3,840)	(1,496)
Municipal Oil Rev. p.c.	420.6	161.8	129.7	15.1	10.2	6.1
	(999.4)	(334.7)	(412.9)	(100.4)	(43.4)	(60.0)
Municipal Invest. p.c.	161.0	123.1	98.2	55.0	69.7	63.3
	(223.9)	(110.3)	(172.1)	(116.9)	(143.8)	(83.2)
n	30	18	53	836	500	3,902

Sample means with standard deviations in parentheses. Monetary values are deflated to constant 2010 Brazilian Reals.

▶ Return

Mapping Discovery Realizations (Full Brazilian Coastline)



▸ Return

Testing Conditional Random Assignment

Regress characteristic Y_m from baseline year 2000 on a vector of geographic controls, state FEs, and a treatment indicator that equals 1 if:

1. Municipality has wells drilled
2. A major discovery is announced in municipalities where wells were drilled
3. Expectations are satisfied in municipalities that received discovery announcements

$$Y_m^{2000} = \alpha + \beta_1 \mathit{Treatment}_m + X_m'\lambda + \delta_s + \epsilon_m$$

Conditional Random Assignment: Baseline Characteristics

	1(*Wells* = 1)	1(*Discovery* = 1)	1(*Satisfied* = 1)
Outcome	**p-value (FWER-adjusted)**	**p-value (FWER-adjusted)**	**p-value (FWER-adjusted)**
Population	0.261	0.661	0.206
	(0.817)	(0.994)	(0.804)
GDP	0.016	0.902	0.235
	(0.135)	(0.995)	(0.804)
Municipal Develop. Index	0.192	0.163	0.183
	(0.777)	(0.684)	(0.804)
Urban Share of Population	0.484	0.600	0.123
	(0.974)	(0.993)	(0.725)
Income per capita	0.022	0.673	0.404
	(0.135)	(0.994)	(0.804)
Income Gini Coefficient	0.858	0.017	0.192
	(0.992)	(0.119)	(0.804)
% Employed in Extractive	0.046	0.802	0.226
	(0.135)	(0.995)	(0.804)
% Formally Employed	0.667	0.496	0.450
	(0.92)	(0.988)	(0.804)
% Homes w. Water & Sewer	0.755	0.823	0.958
	(0.992)	(0.995)	(0.961)
Sample	Municipalities on Coast	Municipalities w. Wells	Municipalities w. Discoveries
Observations	277	101	48

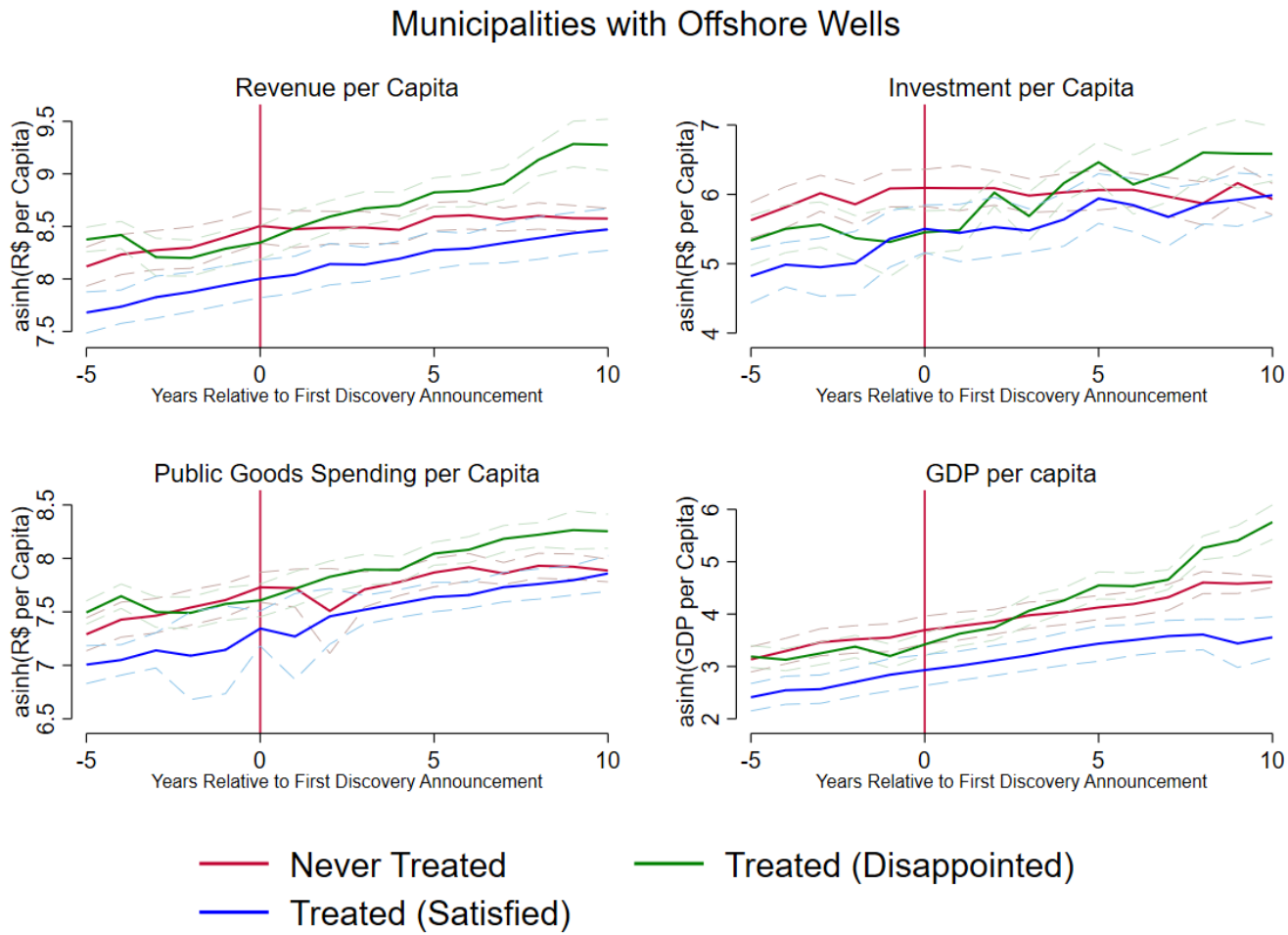
Each row is separate OLS regression with geographical controls and state FEs. Outcomes measured in 2000. FWER-corrected Romano-Wolf p-values in parentheses.

Conditional Random Assigment: Political Alignment

	1(*Wells* = 1)	1(*Discovery* = 1)	1(*Satisfied* = 1)
Outcome	**p-value (FWER-adj.)**	**p-value (FWER-adj.)**	**p-value (FWER-adj.)**
Cumulative Party Align. w. Governor	0.417	0.604	0.926
	(0.668)	(0.879)	(0.937)
Cumulative Party Align. w. President	0.953	0.680	0.160
	(0.963)	(0.879)	(0.521)
State Capital Dummy	0.091	0.745	0.198
	(0.283)	(0.879)	(0.521)
Contemp. Party Align. w. Governor	0.745	0.387	NA
Contemp. Party Align. w. President	0.558	0.550	NA
State Capital Dummy	0.000	0.973	NA
Sample	Municipalities on Coast	Municipalities w. Wells	Municipalities w. Discoveries
Observations	277	101	48

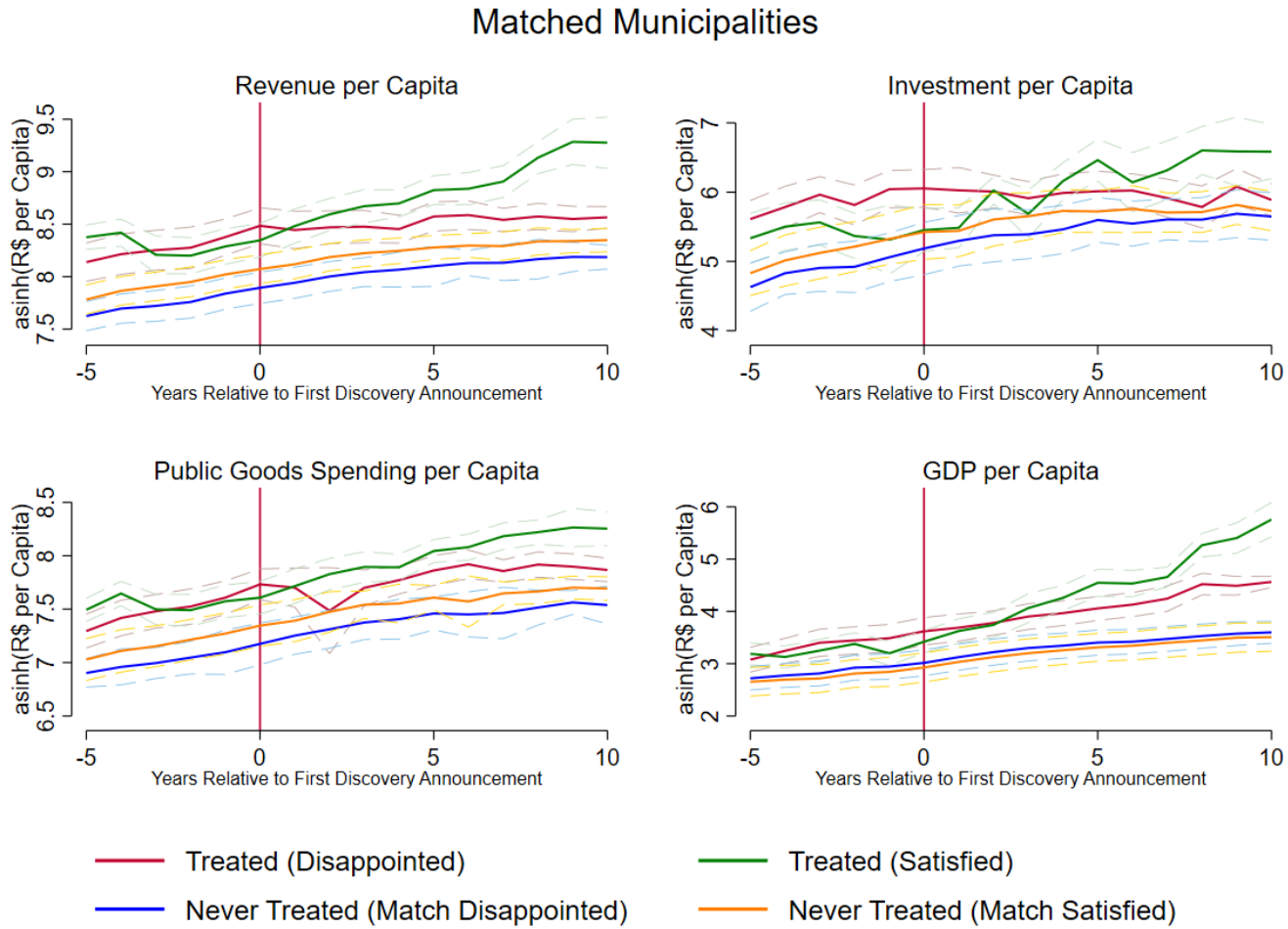
- Cumulative party alignment measures number of years between 2000-2017 in which municipal mayor was of same party as governor/president.
- Contemporaneous party alignment is indicator equal to 1 in years where municipal mayor's party is the same as governor/president's party.
- Each row is separate OLS regression with geographical controls and state FEs. FWER-corrected Romano-Wolf p-values in parentheses. ▸ Return

Pre-Trends for Disappointed, Satisfied, and Never Treated (Wells but no Discoveries) Municipalities



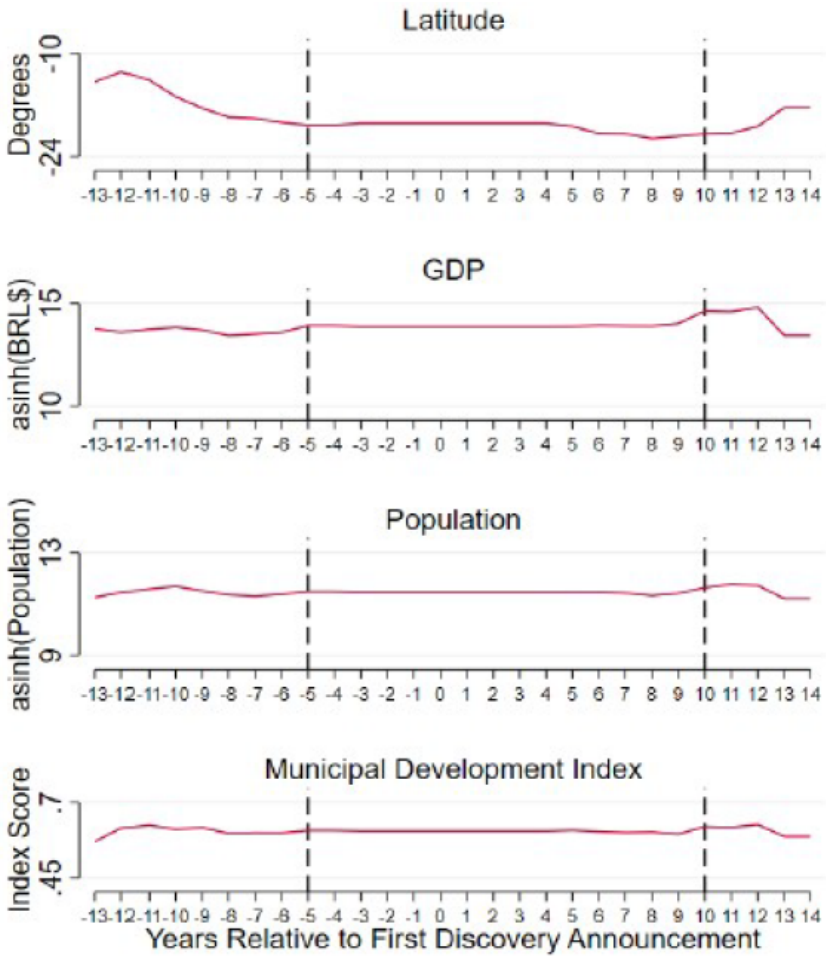
▶ Return

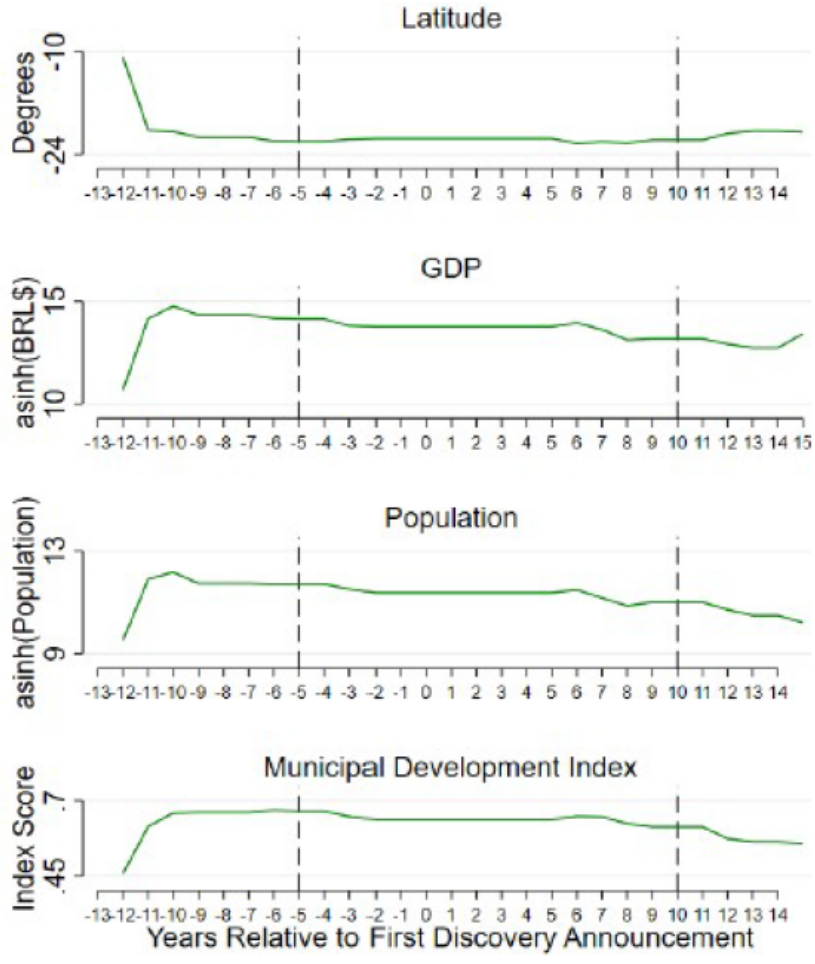
Pre-Trends for Disappointed, Satisfied, and Never Treated (Pre-Matched) Municipalities



▶ Return

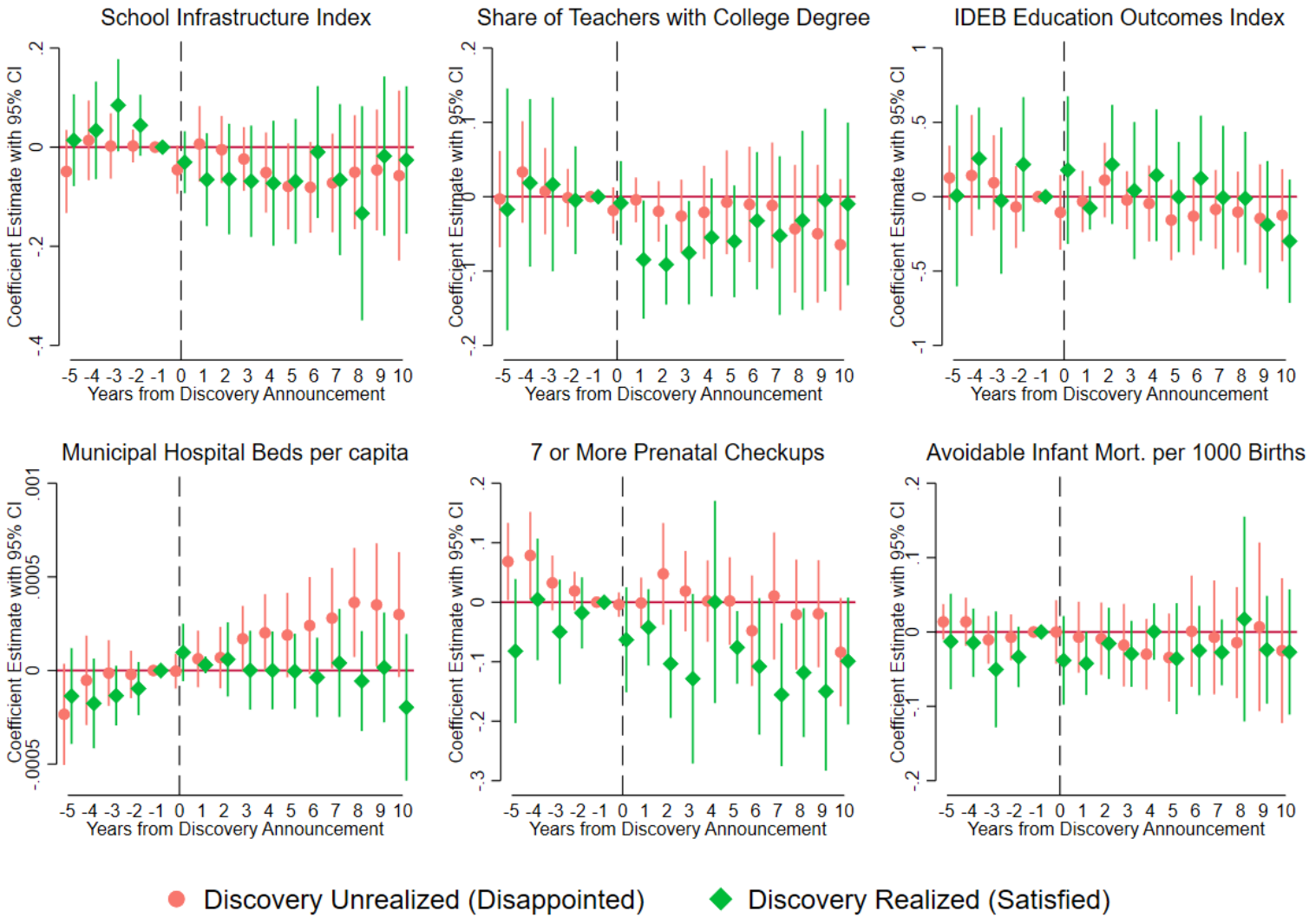
Sample Means Across Unbalanced Panel





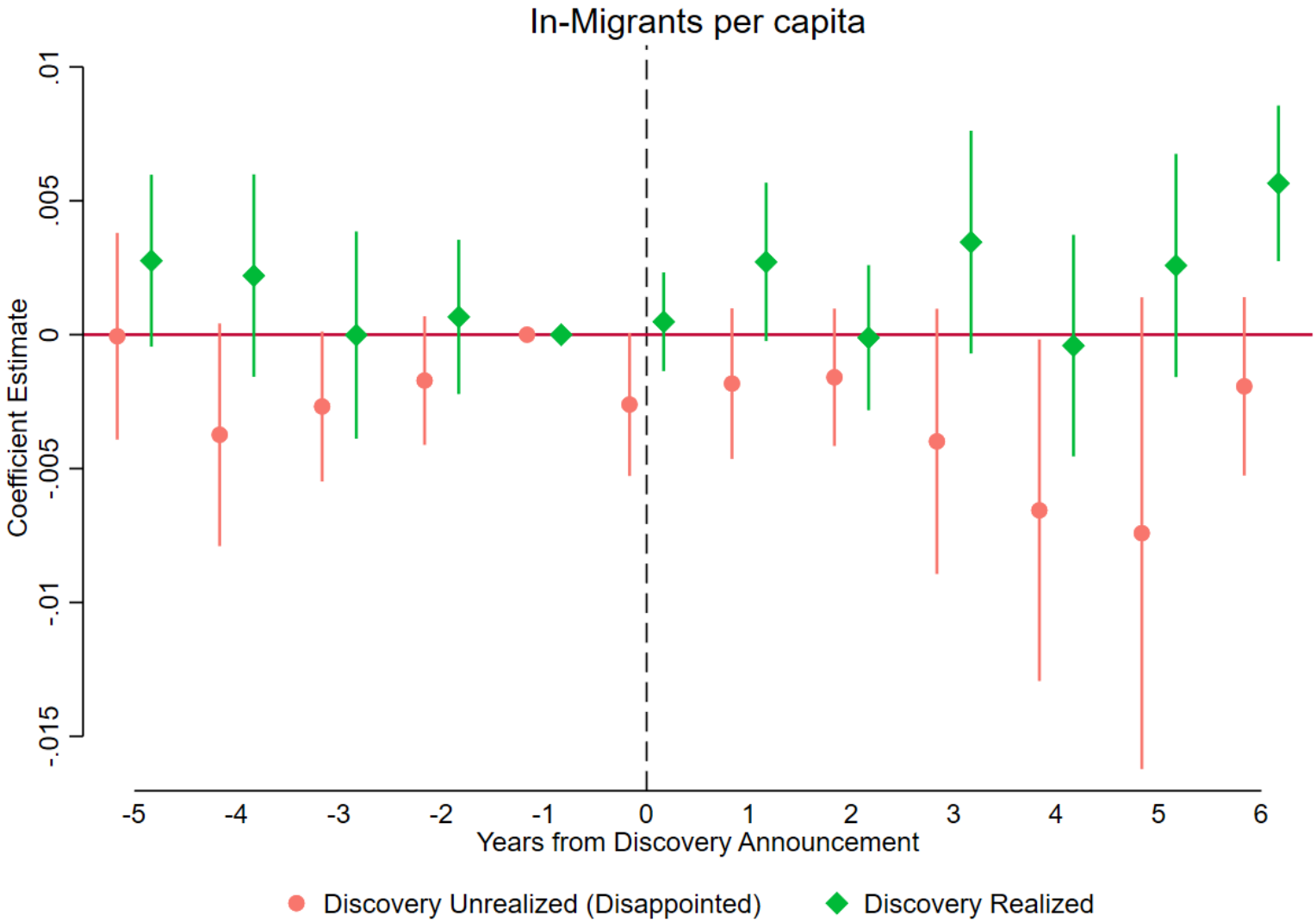
▸ Return

Results: Public Goods Provision and Quality



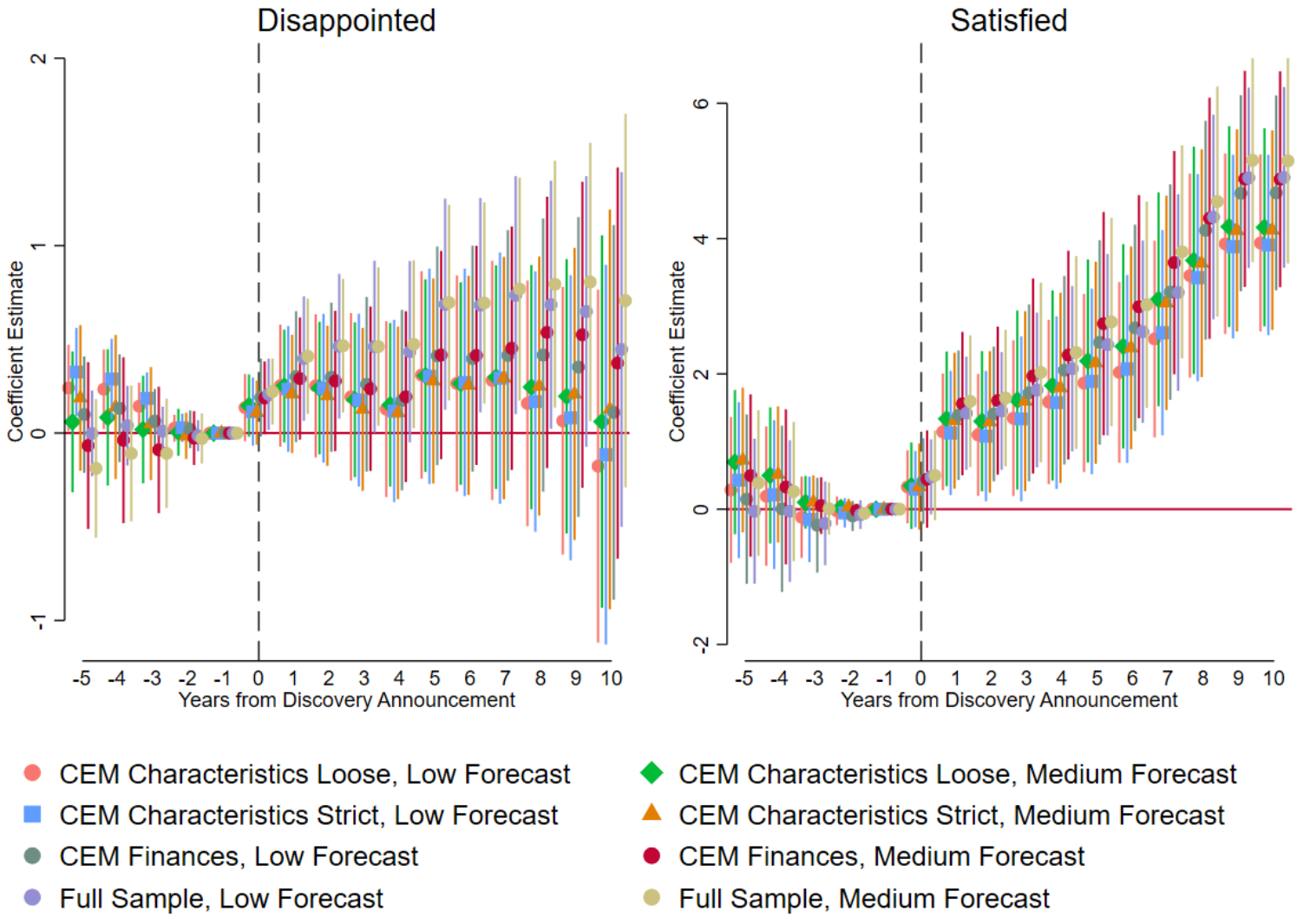
▸ Interpreting Coefficients ▸ Return

Results: In-Migration (up to 2010)

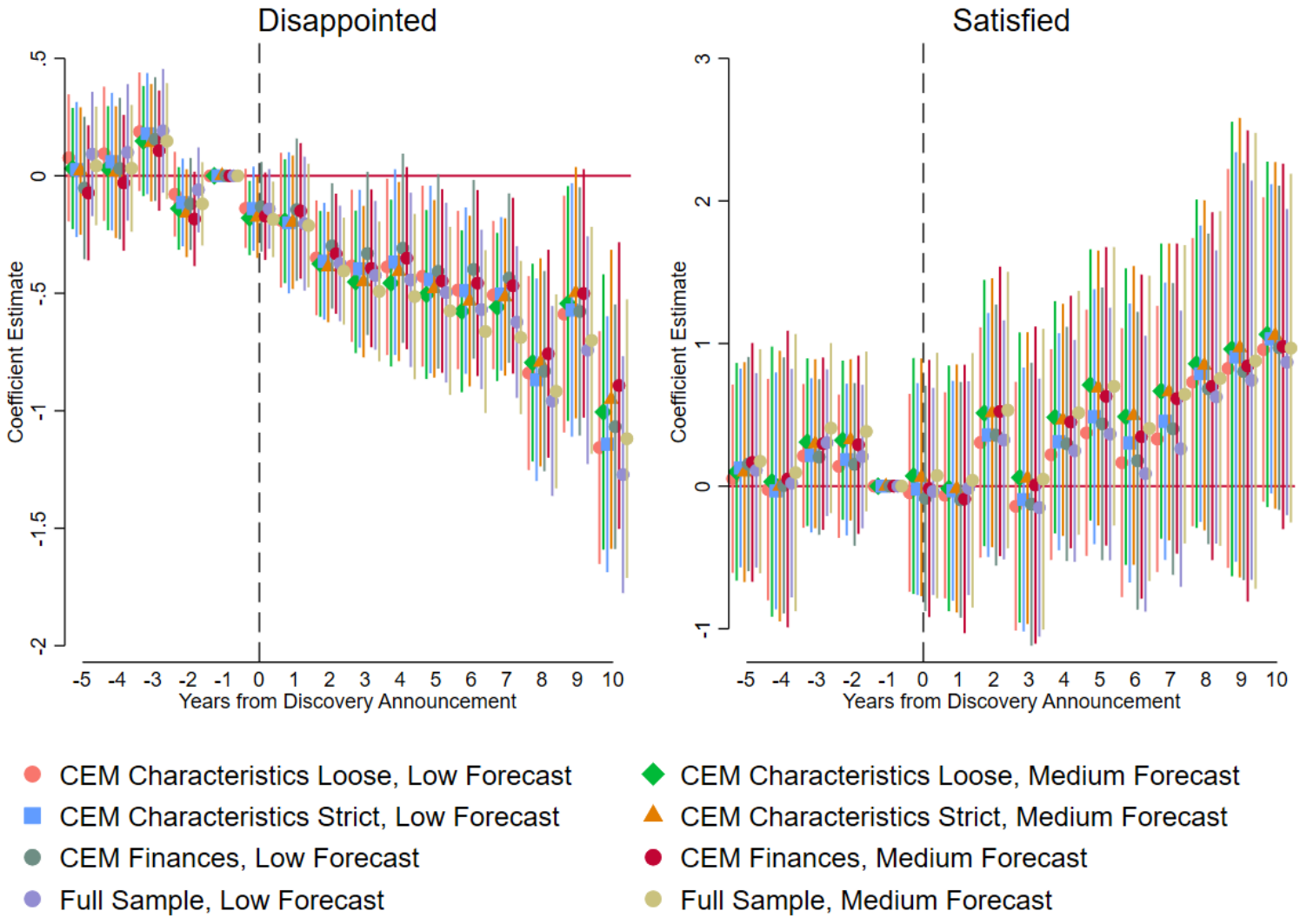


▸ Return

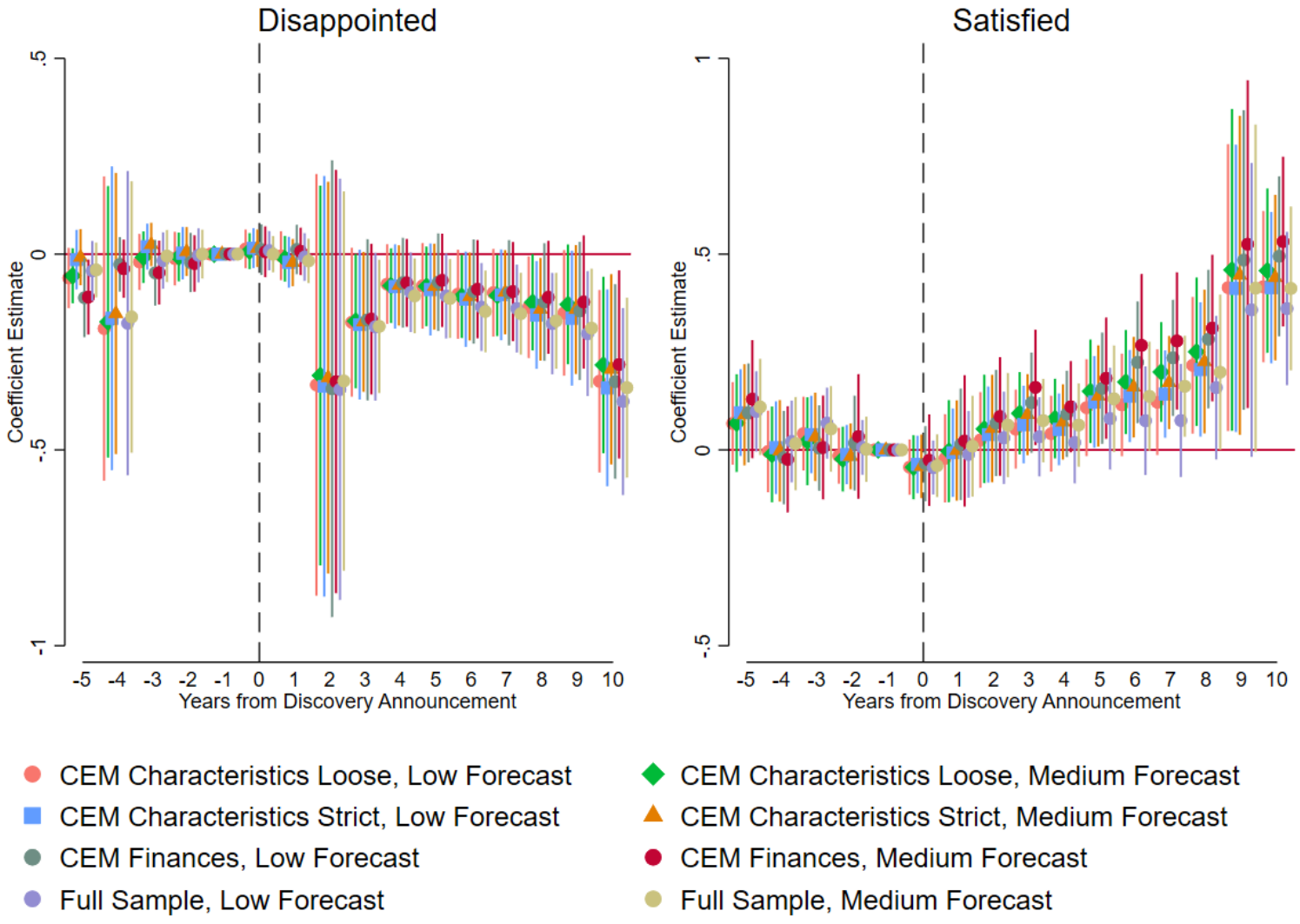
Robustness to Alternative Forecasting and Matching Parameters: Total Revenues



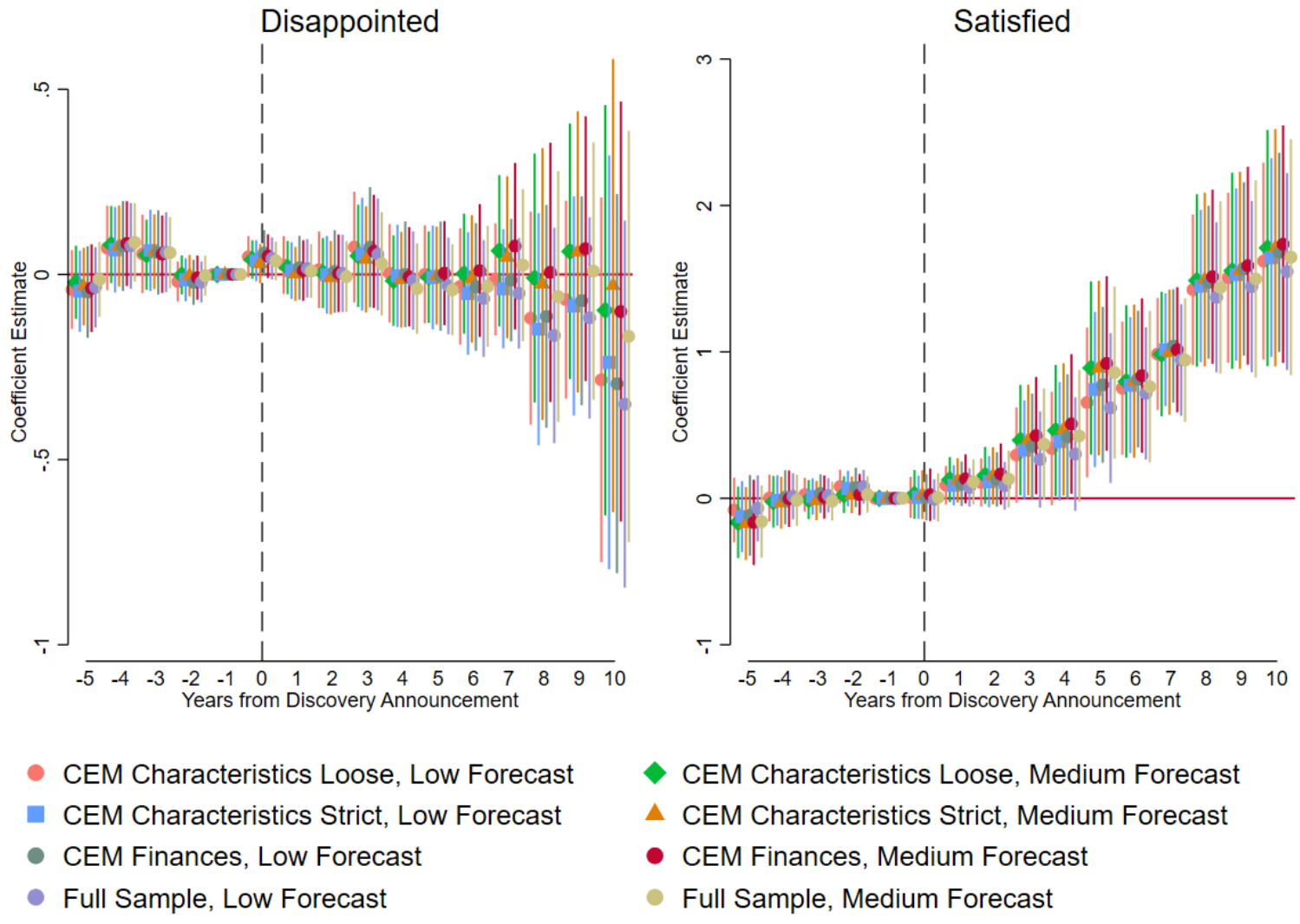
Robustness to Alternative Forecasting and Matching Parameters: Investment



Robustness to Alternative Forecasting and Matching Parameters: Education Spending

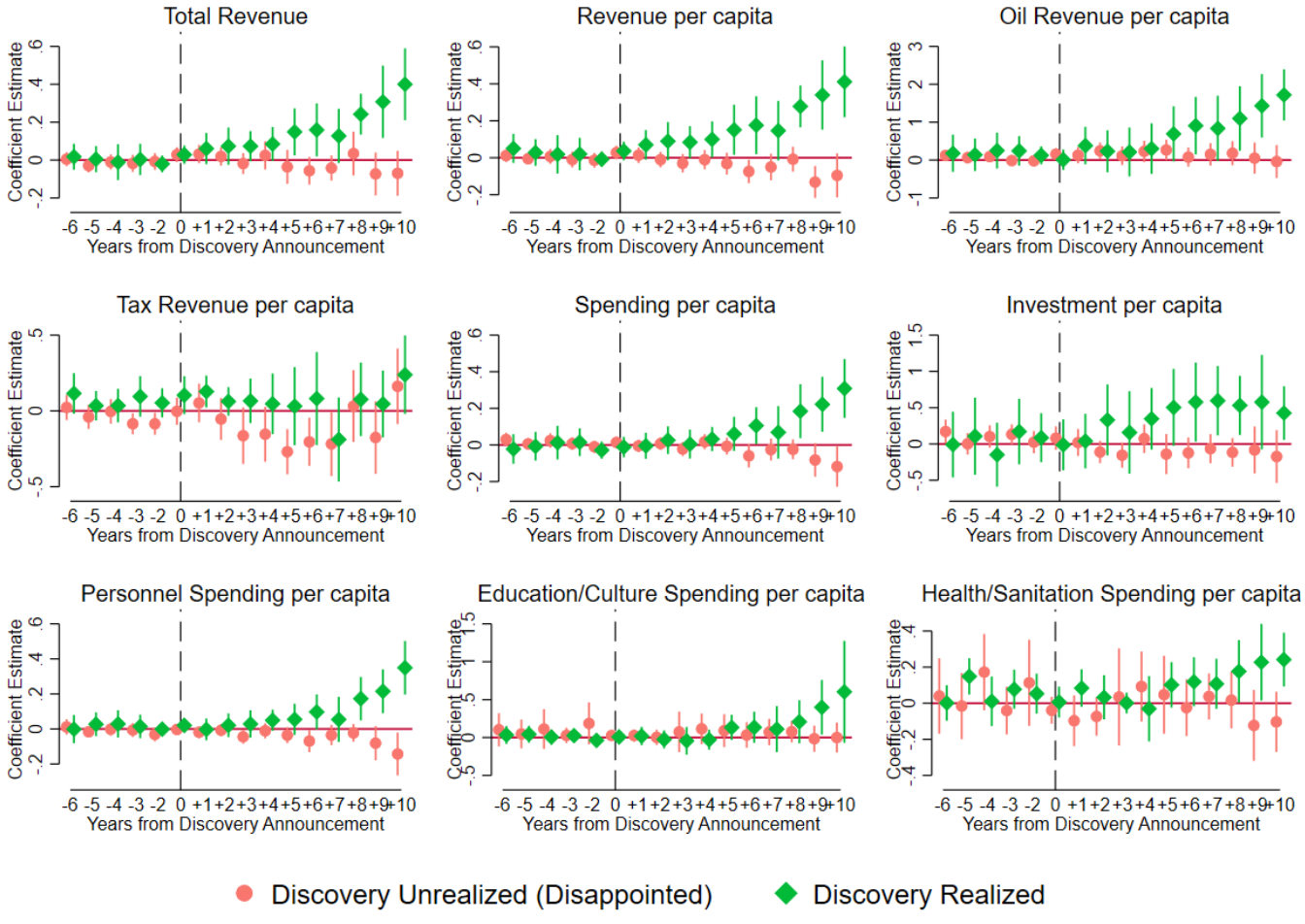


Robustness to Alternative Forecasting and Matching Parameters: GDP

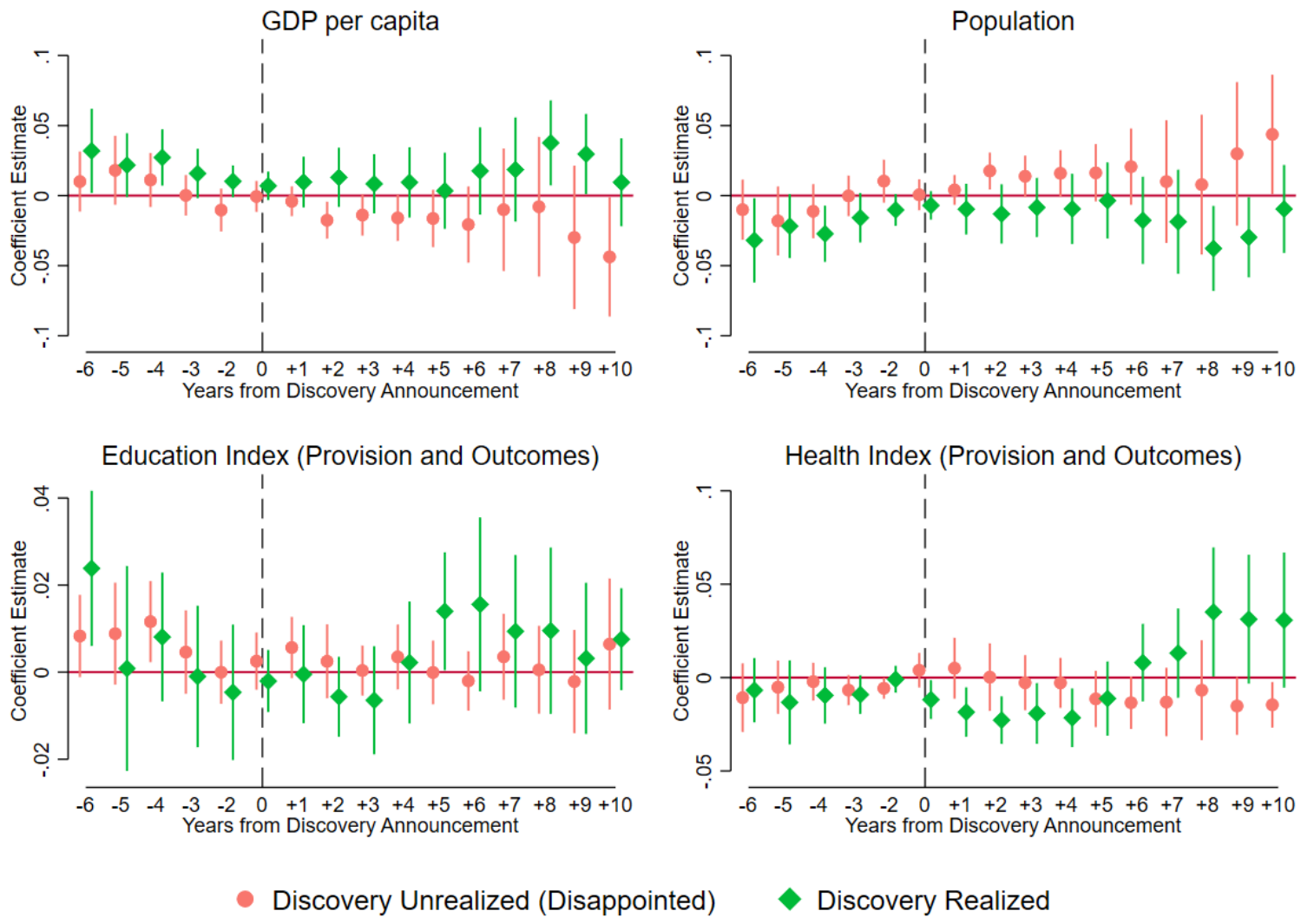


Event Studies With Multiple Events

I estimate event study specifications equivalent to those in the main study, but turn on relative time indicators for each event that affects municipality *m* during the sample period. Multiple relative time indicators can be turned on at once (e.g., if events occur in 2005 and 2010, in 2008 both t+3 and t-2 indicators will be turned on.



Event Studies With Multiple Events Continued

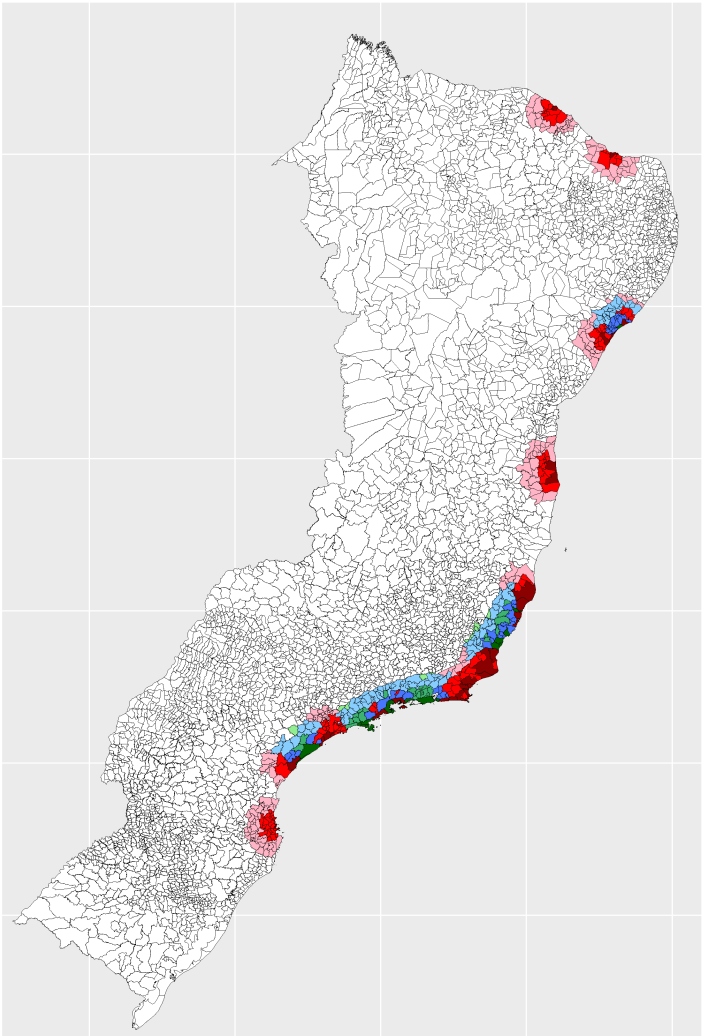


▸ Return

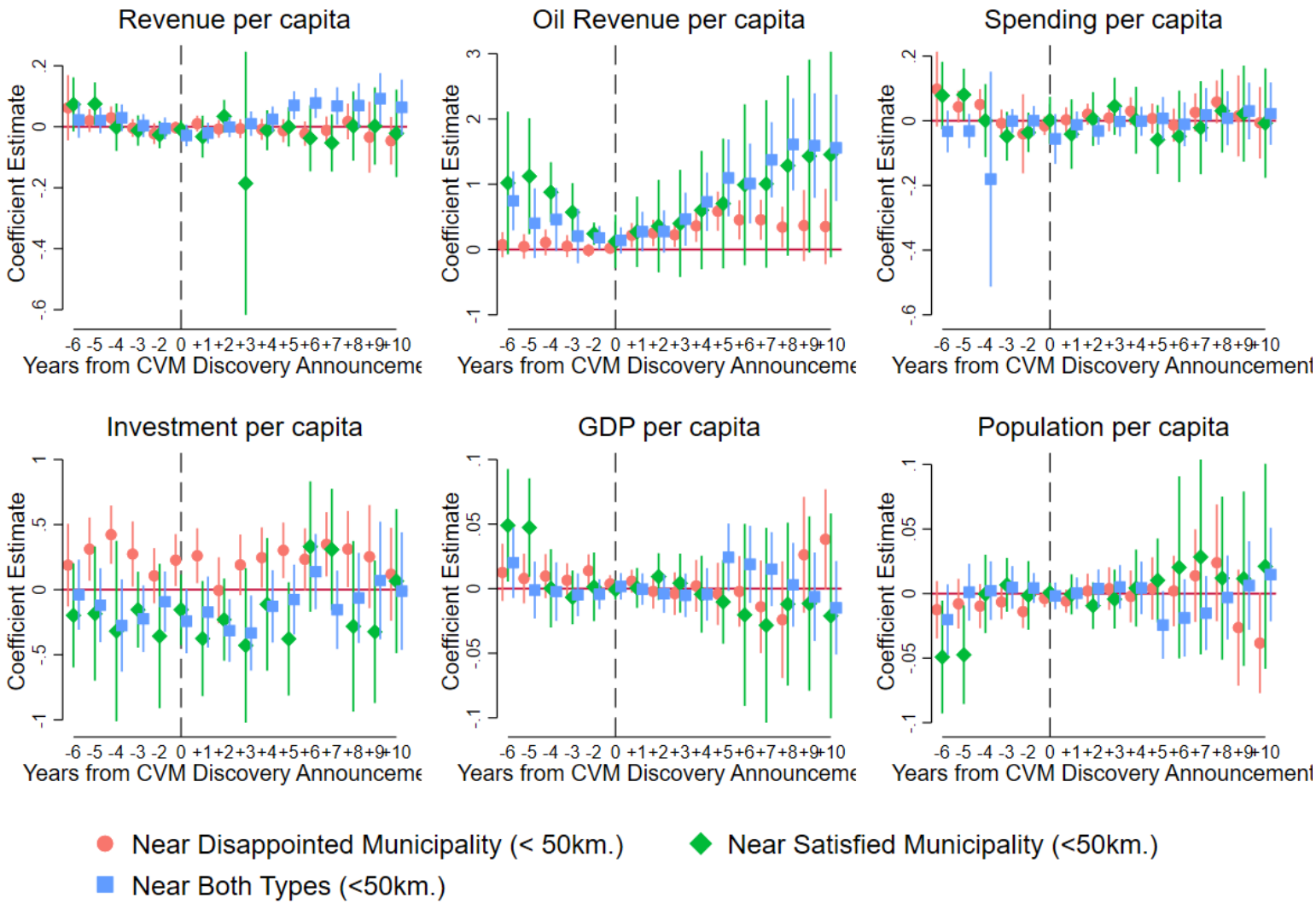
Spatial Spillovers Onto Neighboring Municipalities

- Identify municipalities that are (i) near/far (0-50 and 50-100km) from disappointed municipalities; (ii) near/far from satisfied municipalities; (iii) near/far both

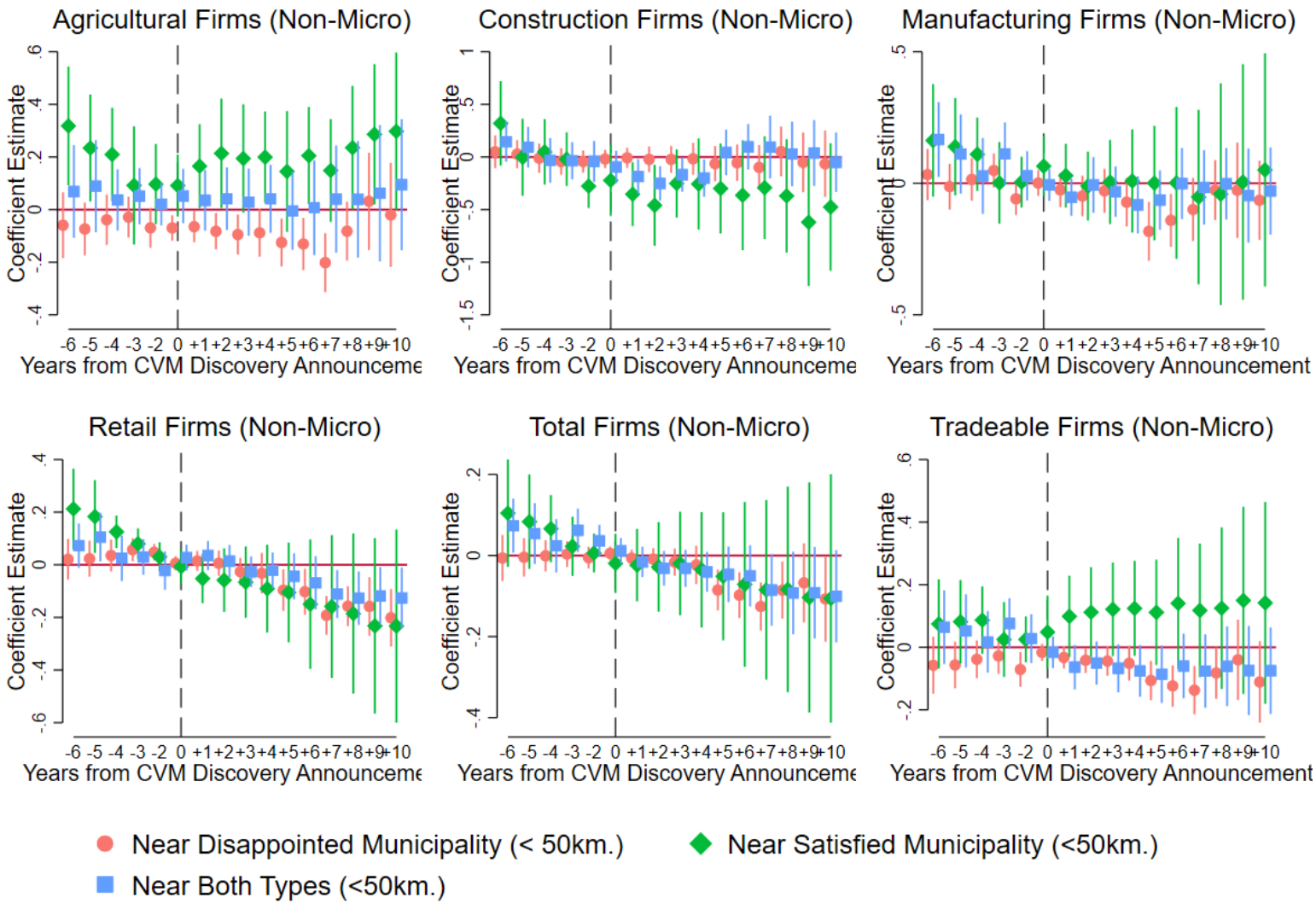
- Estimate event studies where near groups are "treated" and far groups are controls



Spatial Spillovers: Effects on Public Finances

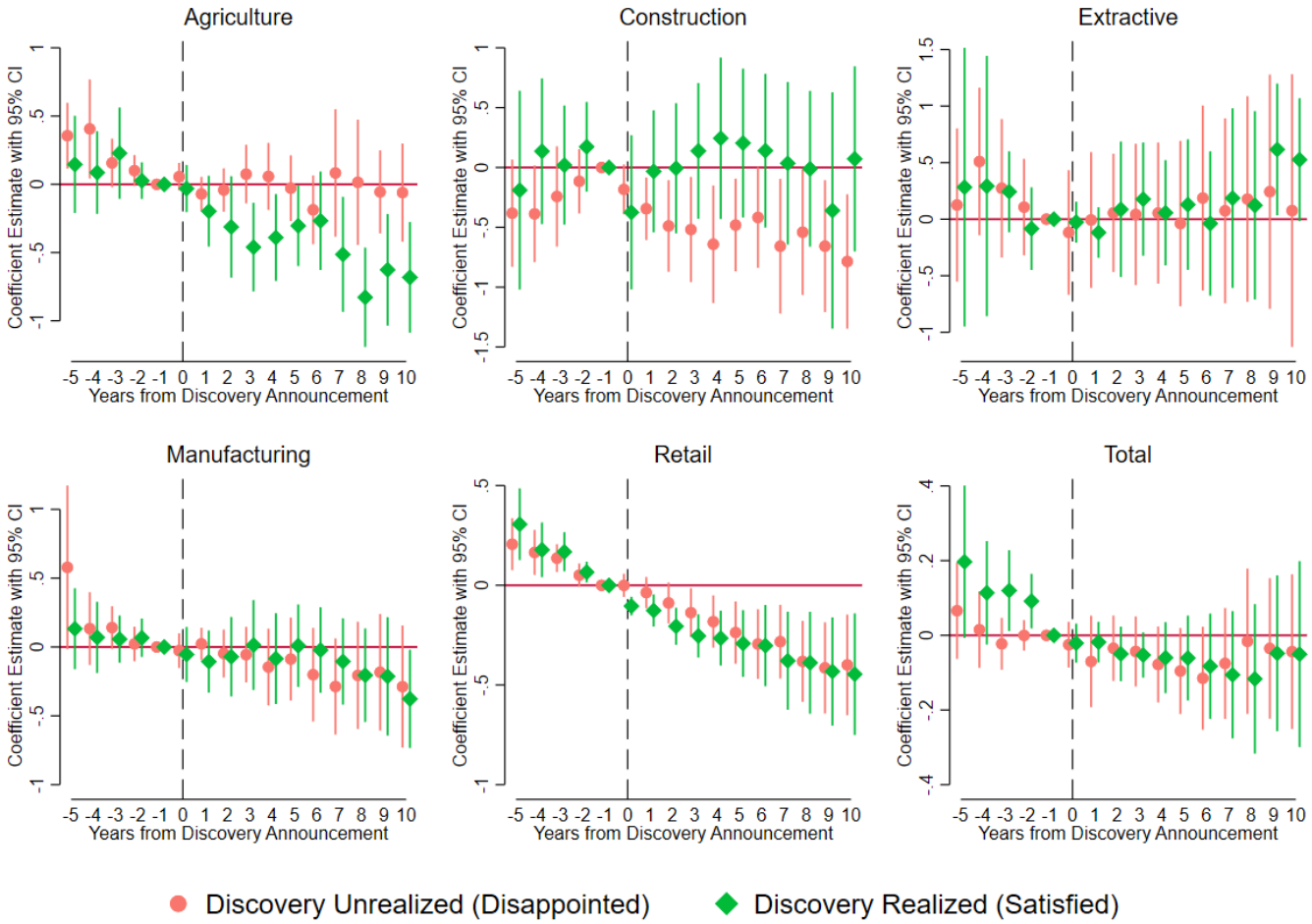


Spatial Spillovers: Effects on Firm Entry

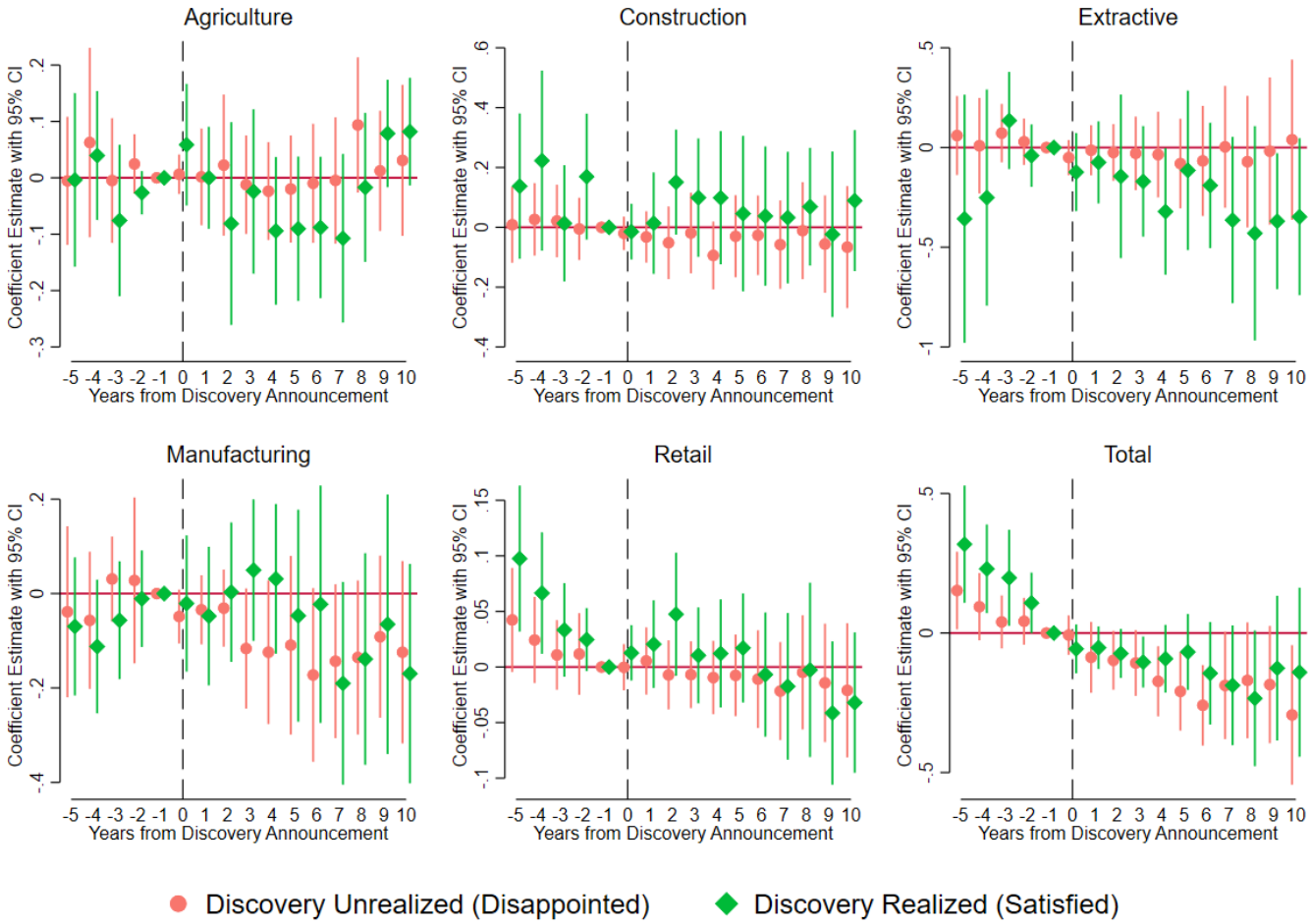


▸ Return

Discovery Effects on Formal Employment



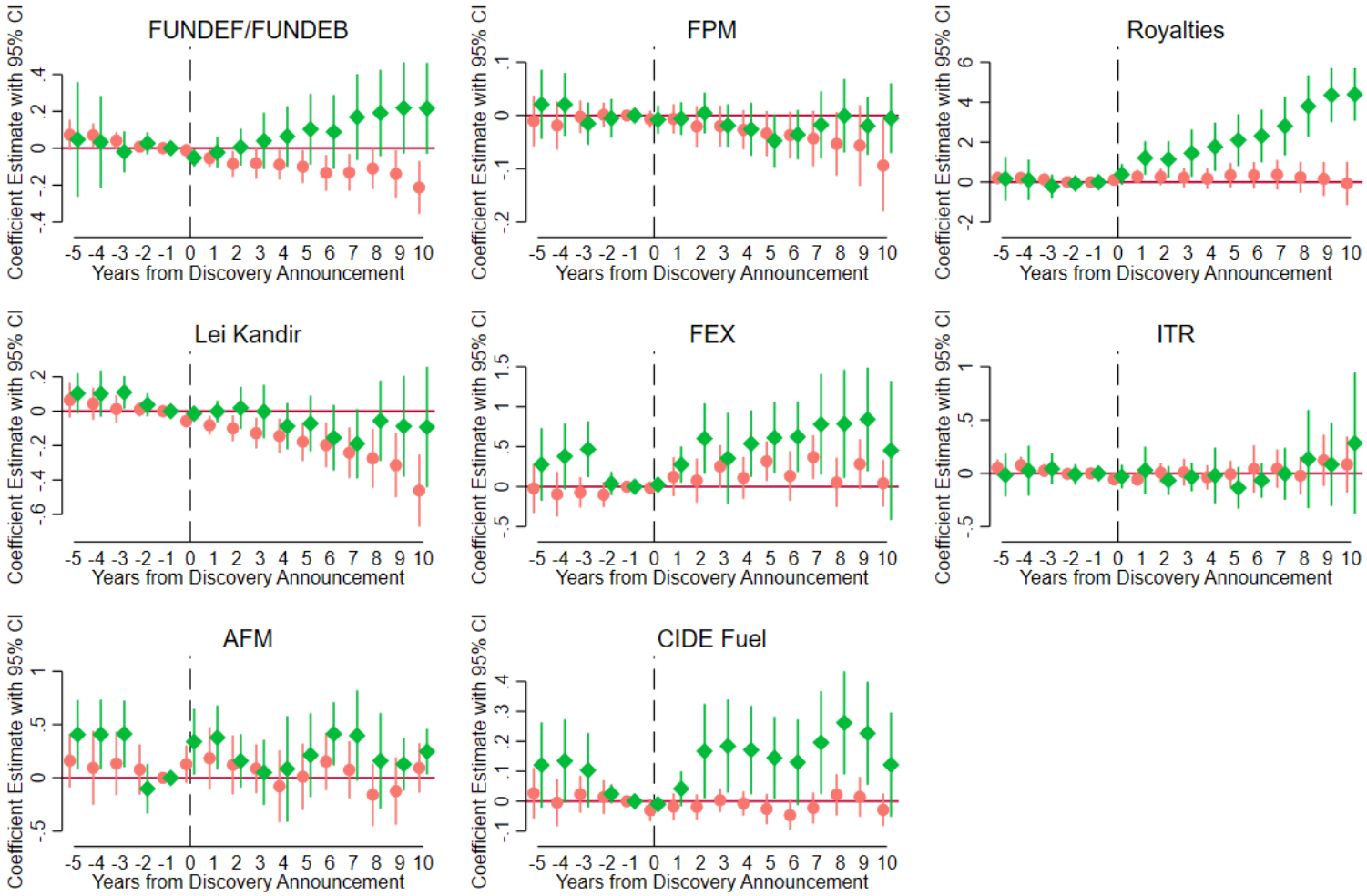
Discovery Effects on Formal Wages



▸ Return

Federal and State Transfer Revenues

State and Federal Transfers to Municipal Governments



Return

Electoral Competition: Robustness Across Samples and Estimators

	TWFE Wells	TWFE Pre-Match	CS Wells	CS Pre-Match
Council Candidates (Total)	0.131	0.046	0.172	0.070*
	(0.122)	(0.032)	(0.235)	(0.037)
Council Candidates (Compet.)	0.070	0.061*	0.098*	0.066
	(0.061)	(0.034)	(0.105)	(0.037)
Mayoral Candidates (Total)	0.041	0.035	0.065	0.054
	(0.052)	(0.048)	(0.068)	(0.050)
Mayoral Candidates (Compet.)	0.001	0.008	-0.129***	-0.087*
	(0.046)	(0.047)	(0.045)	(0.046)
Comp. Council Cand. Per Seat	0.047**	0.038**	0.068***	0.033
	(0.019)	(0.018)	(0.025)	(0.022)
Avg. Coalition Size	-0.081**	-0.078***	-0.118*	-0.077*
	(0.037)	(0.028)	(0.062)	(0.041)
Total Number of Donations	0.169*	0.149	0.157*	0.164**
	(0.087)	(0.091)	(0.092)	(0.069)
Total Value of Donations	0.131*	0.119	0.238**	0.114
	(0.078)	(0.083)	(0.120)	(0.113)
Number of Donations per Cand.	0.166**	0.124	0.106	0.040
	(0.080)	(0.081)	(0.095)	(0.086)
Value of Donations per Cand.	0.132	0.095	0.195	-0.006
	(0.082)	(0.085)	(0.137)	(0.128)
Share of Candidates Female	-0.008	-0.016***	-0.010	-0.006
	(0.007)	(0.005)	(0.010)	(0.120)
Avg. Candidate Age	0.001	-0.002	-0.031**	0.000
	(0.005)	(0.004)	(0.014)	(0.011)
Avg. Candidate Schooling	-0.030***	-0.024***	-0.031**	-0.009
	(0.009)	(0.006)	(0.014)	(0.010)
Municipality FEs	Y	Y	Y	Y
Election Period FEs	Y	Y	Y	Y
n (municipality-election periods)	404	3,745	404	3,745

▶ Return

Coefficients and Elasticities (Disappointed)

	Sample Properties			Coefficients			Small-n Bias Correct. Elast.		
Outcomes	$\overline{X}$	**n**	**Units**	**1 Year**	**5 Years**	**10 Years**	**1 Year**	**5 Years**	**10 Years**
Total Revenue (Millions)	162	1,392	83	0.00	-0.04	-0.20**	-0.64	-6.28	-20.79***
				(0.02)	(0.04)	(0.08)	(2.12)	(3.92)	(6.02)
Revenue p.c.	2,086	1,392	83	-0.01	-0.10	-0.26**	-2.13	-11.86**	-26.69***
				(0.02)	(0.06)	(0.11)	(2.14)	(5.44)	(8.02)
Tax Revenue p.c.	220	1,392	83	0.14*	-0.23	-0.35	10.93	-27.00**	-37.30***
				(0.08)	(0.17)	(0.23)	(8.75)	(12.09)	(14.28)
Oil Revenue p.c.	473	1,494	83	0.27	0.34	0.16	19.75	20.33	-5.57
				(0.17)	(0.31)	(0.43)	(20.87)	(37.60)	(40.41)
Non-Oil Transfer Rev. p.c.	652	1,440	80	-0.03**	-0.05**	-0.07*	-3.69***	-6.60***	-8.99**
				(0.01)	(0.03)	(0.04)	(1.41)	(2.53)	(3.94)
Spending p.c.	1,165	1,392	83	-0.02	-0.10*	-0.23***	-3.45	-12.43**	-23.95***
				(0.03)	(0.06)	(0.08)	(2.42)	(4.89)	(6.23)
Investment p.c.	226	1,423	83	-0.17	-0.46**	-0.70**	-21.69*	-43.14***	-56.92***
				(0.15)	(0.21)	(0.28)	(12.09)	(12.11)	(12.18)
Personnel Spending p.c.	933	1,392	83	-0.04*	-0.14**	-0.26***	-4.92**	-15.64***	-26.42***
				(0.02)	(0.06)	(0.09)	(2.08)	(4.73)	(6.30)
Education Spending p.c.	571	1,392	83	-0.01	-0.14**	-0.25**	-2.93	-15.78***	-25.64***
				(0.04)	(0.06)	(0.10)	(3.87)	(5.47)	(7.26)
Health Spending p.c.	449	1,392	83	-0.09	-0.17**	-0.24*	-12.76*	-18.62***	-26.23***
				(0.08)	(0.08)	(0.12)	(7.38)	(6.47)	(9.10)
GDP per capita	22,362	1,162	83	0.00	-0.04	-0.12	-1.86	-8.14	-18.27
				(0.04)	(0.08)	(0.17)	(4.30)	(7.71)	(13.66)
Population	80,980	1,494	83	0.01	0.04	0.05	-0.09	2.16	0.87
				(0.01)	(0.04)	(0.08)	(1.34)	(3.99)	(7.66)
No. Firms Extractive	9.1	1,494	83	-0.12*	-0.28**	-0.20	-14.73**	-29.30***	-26.79*
				(0.07)	(0.13)	(0.22)	(6.14)	(9.32)	(15.92)
No. Firms Mfg.	165.2	1,494	83	-0.01	0.01	-0.19*	-2.38	-2.85	-21.26***
				(0.03)	(0.07)	(0.10)	(3.26)	(7.02)	(7.69)
Avg. Formal Wage (Monthly)	1,034	1,494	83	-0.01	-0.08**	-0.11**	-2.13	-8.88***	-12.42***
				(0.02)	(0.03)	(0.05)	(1.767)	(3.036)	(4.21)

Sample includes disappointed municipalities (received less than 40% of revenues expected from discovery by 2017) and wells controls. Regressions include municipality and year FEs; standard errors are clustered at municipality level. Continuous outcome variables use inverse hyperbolic sine transformation. Monetary variables are inverse hyperbolic sine-transformed constant 2010 BRL. To interpret semi-elasticities, I use the small sample bias correction proposed by Kennedy (1981):

$$\hat{P} = (e^{(\beta - \frac{\widehat{Var(\beta)}}{2})} - 1) \times 100$$

Appendices

Return

Coefficients and Elasticities (Satisfied)

	Sample Properties			Coefficients			Small-n Bias Correct. Elast.		
Outcomes	$\overline{X}$	**n**	**Units**	**1 Year**	**5 Years**	**10 Years**	**1 Year**	**5 Years**	**10 Years**
Total Revenue (Millions)	345	1,211	71	0.05	0.16*	0.65***	3.01	11.74	74.53**
				(0.04)	(0.09)	(0.20)	(4.62)	(10.43)	(34.21)
Revenue p.c.	2,361	1,211	71	0.05	0.16	0.66***	2.74	11.69	75.12**
				(0.04)	(0.10)	(0.20)	(4.54)	(10.91)	(34.60)
Tax Revenue p.c.	279	1,211	71	0.01	-0.06	-0.21	-3.23	-15.98	-30.32
				(0.09)	(0.23)	(0.30)	(8.68)	(19.50)	(20.58)
Oil Revenue p.c.	606	1,278	71	1.21***	2.10***	4.35***	170.90	490.53	5441.63
				(0.42)	(0.65)	(0.68)	(114.05)	(383.00)	(3755.01)
Non-Oil Transfer Rev. p.c.	691	1,224	68	-0.03	-0.01	0.04	-3.63**	-2.59	1.26
				(0.02)	(0.04)	(0.05)	(1.72)	(4.10)	(5.12)
Spending p.c.	1,264	1,211	71	-0.07	0.01**	0.25**	-9.00	-2.15	20.79
				(0.05)	(0.07)	(0.12)	(4.12)	(6.55)	(14.07)
Investment p.c.	263	1,230	71	-0.06	0.34	0.82	-21.73	11.98	59.35
				(0.37)	(0.46)	(0.71)	(29.22)	(51.91)	(113.07)
Personnel Spending p.c.	997	1,211	71	-0.04	0.01*	0.19*	-5.86	-2.56	14.32
				(0.03)	(0.07)	(0.11)	(3.23)	(6.87)	(12.83)
Education Spending p.c.	627	1,208	71	-0.01	0.03*	0.35	-4.62	0.07	28.02
				(0.07)	(0.07)	(0.20)	(6.40)	(6.61)	(26.10)
Health Spending p.c.	461	1,208	71	0.20**	0.11	0.34	17.62*	6.88	25.42
				(0.08)	(0.09)	(0.23)	(9.90)	(9.61)	(29.05)
GDP per capita	27,043	994	71	0.06	0.57**	1.42***	2.56	55.00	253.10**
				(0.08)	(0.27)	(0.31)	(7.75)	(42.12)	(110.29)
Population	155,964	1,278	71	0.00	-0.01	-0.01	-0.40	-1.63	-3.11
				(0.01)	(0.02)	(0.05)	(0.89)	(2.17)	(4.49)
No. Firms Extractive	17.5	1,278	71	0.09	0.07	0.30	2.59	-1.89	18.90
				(0.12)	(0.17)	(0.26)	(12.29)	(16.78)	(31.23)
No. Firms Mfg.	273.8	1,278	71	-0.09*	-0.12**	-0.23**	-10.76**	-13.70***	-25.03***
				(0.05)	(0.06)	(0.11)	(4.29)	(4.76)	(8.05)
Avg. Formal Wage	1,073	1,278	71	-0.03	-0.01*	-0.09**	-4.17	-3.84	-11.06**
				(0.02)	(0.05)	(0.05)	(1.94)	(4.72)	(4.66)

Sample includes satisfied municipalities (received more than 40% of revenues expected from discovery by 2017) and wells controls. Regressions include municipality and year FEs; standard errors are clustered at municipality level. Continuous outcome variables use inverse hyperbolic sine transformation. Monetary variables are inverse hyperbolic sine-transformed constant 2010 BRL. To interpret semi-elasticities, I use the small sample bias correction proposed by Kennedy (1981):

$$\hat{P} = (e^{(\beta - \frac{\widehat{Var(\beta)}}{2})} - 1) \times 100$$

Appendices

▶ Return

Disappointed Municipalities: Robustness Across Samples and Estimators

	TWFE Wells	TWFE Pre-Matching	CS Wells	CS Pre-Matching
Total Revenue	-0.20**	-0.07	-0.38***	-0.14
	(0.08)	(0.07)	(0.10)	0.15
Revenue p.c.	-0.26**	-0.23**	-0.54***	-0.37**
	(0.11)	(0.10)	(0.17)	0.19
Tax Revenue p.c.	-0.35	-0.34*	-0.26	-0.30
	(0.23)	(0.18)	(0.29)	0.24
Oil Revenue p.c.	0.16	0.50	-0.03	0.16
	(0.43)	(0.39)	(0.72)	0.69
Transfer Revenue p.c.	-0.07*	-0.06*	-0.14**	-0.15***
	(0.04)	(0.04)	(0.07)	0.06
Spending p.c.	-0.23***	-0.14*	-0.46***	-0.25*
	(0.08)	(0.07)	(0.12)	0.14
Investment p.c.	-0.70**	-0.80***	-1.28***	-1.04***
	(0.28)	(0.26)	(0.33)	0.37
Personnel Spending p.c.	-0.26***	-0.16**	-0.52***	-0.29*
	(0.09)	(0.08)	(0.14)	0.15
Education Spending p.c.	-0.25**	-0.19**	-0.46***	-0.32**
	(0.10)	(0.09)	(0.16)	0.14
Health Spending p.c.	-0.24*	-0.33***	-0.43***	-0.33
	(0.12)	(0.11)	(0.15)	0.20
GDP p.c.	-0.12	-0.12	-0.34	0.01
	(0.17)	(0.15)	(0.30)	0.35
n (municipality-years)	1,494	15,570	1,494	15,570

Each column reports coefficient estimates and standard errors for the t + 10 period of event studies for a specific control group-estimator pair.

*** p<0.01, ** p<0.05, * p<0.1

▸ Interpreting Coefficients ▸ Return

Satisfied Municipalities: Robustness Across Samples and Estimators

	TWFE Wells	TWFE Pre-Matching	CS Wells	CS Pre-Matching
Total Revenue (Millions)	0.65***	0.83***	0.76***	0.89***
	(0.20)	(0.19)	(0.25)	(0.29)
Revenue p.c.	0.66***	0.77***	0.74***	0.87***
	(0.20)	(0.19)	(0.25)	(0.28)
Tax Revenue p.c.	-0.21	0.07	0.02	0.22
	(0.30)	(0.26)	(0.29)	(0.31)
Oil Revenue p.c.	4.35***	4.49***	4.69***	4.45***
	(0.68)	(0.69)	(0.95)	(1.01)
Transfer Revenue p.c.	0.04	0.08	0.05	0.04
	(0.05)	(0.05)	(0.06)	(0.06)
Spending p.c.	0.25**	0.38***	0.25**	0.43***
	(0.12)	(0.11)	(0.11)	(0.13)
Investment p.c.	0.82	0.92	1.44*	1.43
	(0.71)	(0.72)	(0.82)	(0.96)
Personnel Spending p.c.	0.19*	0.32***	0.26**	0.50***
	(0.11)	(0.10)	(0.12)	(0.13)
Education Spending p.c.	0.35*	0.41**	0.35***	0.45***
	(0.20)	(0.19)	(0.13)	(0.10)
Health Spending p.c.	0.34	0.31	0.42**	0.35*
	(0.23)	(0.19)	(0.19)	(0.19)
GDP p.c.	1.42***	1.51***	1.59***	1.82**
	(0.31)	(0.30)	(0.53)	(0.71)
n (municipality-years)	1,278	9,012	1,278	9,012

Each column reports coefficient estimates and standard errors for the t + 10 period of event studies for a specific control group-estimator pair.

*** p<0.01, ** p<0.05, * p<0.1

▸ Interpreting Coefficients ▸ Return

Small Sample Bias Corrected Semi-Elasticities (Disappointed)

	TWFE Wells	TWFE Pre-Matching	CS Wells	CS Pre-Matching
Total Revenue (Millions)	-20.79***	-10.22*	-35.17	-19.67
	(6.02)	(5.97)	(*In Progress*)	
Revenue p.c.	-26.69***	-24.41***	-46.43	-37.29
	(8.02)	(7.42)		
Tax Revenue p.c.	-37.30***	-35.04***	-33.29	-34.26
	(14.28)	(11.62)		
Oil Revenue p.c.	-5.57	35.46	-32.16	-16.70
	(40.41)	(52.28)		
Transfer Revenue p.c.	-8.99**	-7.82**	-15.95	-16.57
	(3.94)	(3.36)		
Spending p.c.	-23.95***	-16.44***	-40.48	-27.50
	(6.23)	(6.20)		
Investment p.c.	-56.92***	-60.59***	-76.50	-70.49
	(12.18)	(10.43)		
Personnel Spending p.c.	-26.42***	-18.33***	-44.28	-30.34
	(6.30)	(6.45)		
Education Spending p.c.	-25.64***	-20.87***	-42.05	-32.29
	(7.26)	(6.89)		
Health Spending p.c.	-26.23***	-31.61***	-39.41	-34.77
	(9.10)	(7.23)		
# Extractive Firms	-26.79*	-7.07	-22.94	9.49
	(15.92)	(19.42)		
# Mfg. Firms	-21.26***	2.54	-13.50	16.11
	(7.69)	(8.73)		
Avg. Formal Wage	-12.42***	-4.22	-19.86	-5.03
	(4.21)	(3.66)		
GDP p.c.	-18.27	-18.08	-39.00	-15.06
	(13.66)	(12.37)		
Population	0.87	10.49	-38.89	-4.86
	(7.66)	(7.95)		
n (municipality-years)	1494	15570	1494	15570

To interpret semi-elasticities, I use the small sample bias correction proposed by Kennedy (1981):

$$\hat{P} = (e^{(\beta - \frac{\widehat{Var(\beta)}}{2})} - 1) \times 100$$

Small Sample Bias Corrected Semi-Elasticities (Satisfied)

Return

	TWFE Wells	TWFE Pre-Matching	CS Wells	CS Pre-Matching
Total Revenue (Millions)	74.53**	107.96***	89.59	111.36
	(34.21)	(39.71)	(*In Progress*)	
Revenue p.c.	75.12**	95.43**	84.06	106.03
	(34.60)	(37.66)		
Tax Revenue p.c.	-30.32	-5.31	-11.39	6.54
	(20.58)	(24.45)		
Oil Revenue p.c.	5441.63	6205.26	6679.58	5057.57
	(3755.01)	(4330.57)		
Transfer Revenue p.c.	1.26	5.40	1.95	1.24
	(5.12)	(5.15)		
Spending p.c.	20.79	37.82**	21.93	43.86
	(14.07)	(15.18)		
Investment p.c.	59.35	75.04	180.02	158.75
	(113.07)	(125.85)		
Personnel Spending p.c.	14.32	30.86**	22.15	53.77
	(12.83)	(13.64)		
Education Spending p.c.	28.02	36.55	33.62	48.37
	(26.10)	(25.93)		
Health Spending p.c.	25.42	23.31	38.15	28.69
	(29.05)	(23.63)		
# Extractive Firms	18.90	75.28*	23.16	110.61
	(31.23)	(42.32)		
# Mfg. Firms	-25.03***	-7.53	-21.45	-1.79
	(8.05)	(8.92)		
Avg. Formal Wage	-11.06**	-1.80	-10.12	10.10
	(4.66)	(4.38)		
GDP p.c.	253.10**	290.35**	275.49	330.81
	(110.29)	(116.96)		
Population	-3.11	3.94	272.29	-1.46
	(4.49)	(4.23)		
n (municipality-years)	1278	9012	1278	9012

To interpret semi-elasticities, I use the small sample bias correction proposed by Kennedy (1981):

$$\hat{P} = (e^{(\beta - \frac{\widehat{Var(\beta)}}{2})} - 1) \times 100$$