

The Presource Curse

Anticipation, Disappointment, and Governance after Oil Discoveries

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Giant Oil or Gas Discoveries Have Affected 46 Countries Since 1988

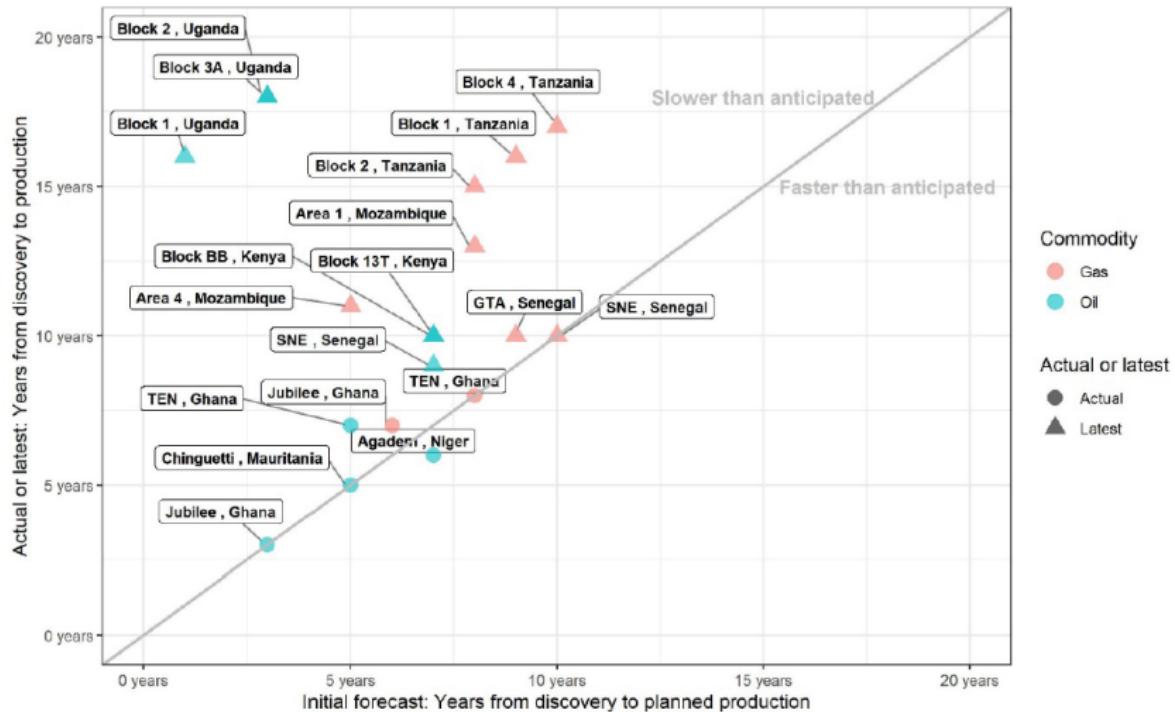
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Discoveries > 500 Million Barrels of Oil Equivalent, Cust and Mihalyi (2021)

Delay and Disappointment Are Common After Discoveries

| 2



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

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.

Mozambique fell prey to the promise of fabulous wealth - now it can't pay nurses

Nurses and teachers are among those bearing the brunt of a debt crisis rooted in the mistaken belief that major gas reserves would bring untold riches

Oil Bonanza Plunges Guyana Into Political Crisis

The discovery of a wealth of oil in the tiny country, one of the poorest in South America, has deepened ethnic divisions and exacerbated tensions during a crucial election.

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 - > **Corruption and rent-seeking** (Baragwanath, 2021; Brollo et al., 2013)
 - > **Conflict** (Berman et al., 2017; Nillesen & Bulte, 2014)
 - > **Dutch Disease** (Corden & Neary, 1982; Pelzl & Poelhekke, 2021)
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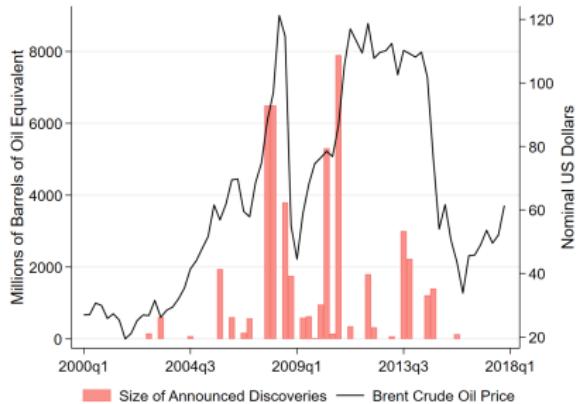
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"Satisfied" municipalities enjoy increased per capita revenues (+75%) and spending (+21%) after ten years, but do not invest in economic diversification or improve real public goods provision

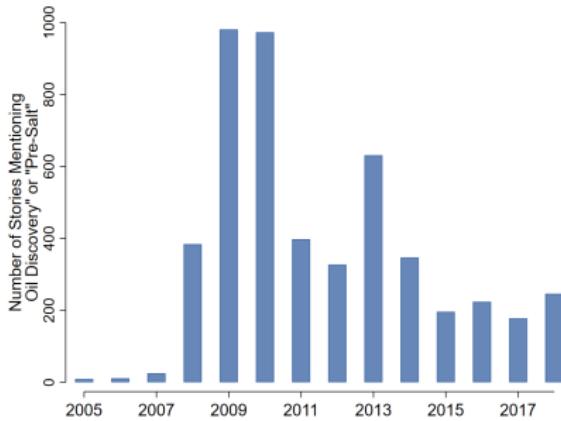
Brazil's Pre-Salt Discoveries: A Winning Lottery Ticket?

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Lula da Silva (2008): *"The Pre-Salt is a gift from God, a passport to the future, a winning lottery ticket, but could become a curse if we don't invest the money well."*



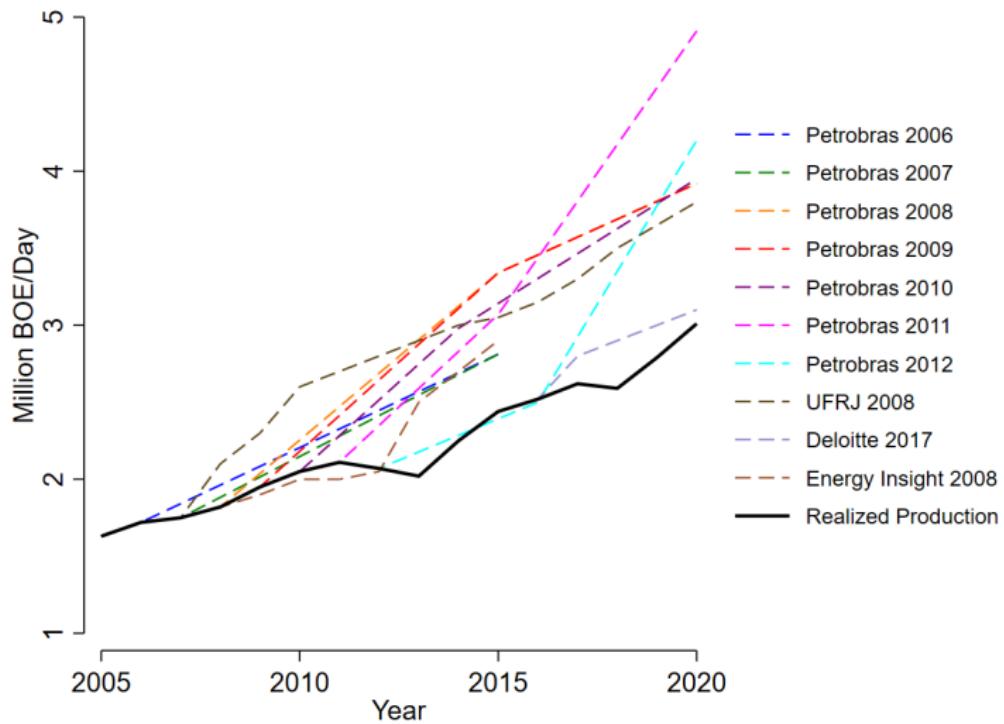
World Oil Prices and Oil Discoveries in Brazil



News Coverage of Oil Discoveries in *O Globo*

Brazil's Production Hasn't Met Expectations

| 8



Country-Level Production Forecasts vs Realized Production

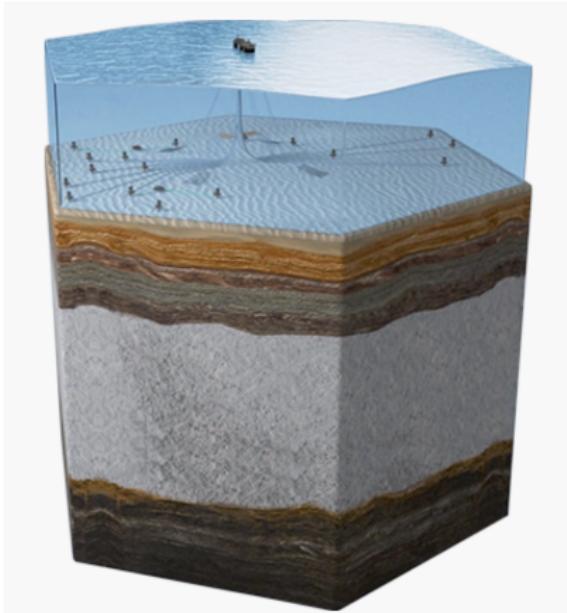
Public Finance:

- ▶ Brazil has a federal governing system with significant power devolved to the municipal level: municipal governments are responsible for a large proportion of health, education, public safety, and infrastructure provision
- ▶ Municipal budgets are composed of formulaic federal/state transfers (approx. 75-95% of total revenues) and local taxes
- ▶ Municipal fiscal policy is constrained by a "fiscal responsibility law," which imposes limits on allowable levels of spending and debt

Elections:

- ▶ Municipal elections occur every 4 years, offset by 2 years from state/federal elections. Municipal elections occurred in 2000, 2004, 2008, 2012, and 2016
- ▶ Municipal governments are run by mayors and councilors. Mayors are eligible to serve up to two consecutive terms

- ▶ **Geology:** Newly discovered reserves can turn out to be of lower quality or more difficult to extract than initially expected
- ▶ **Price Fluctuations:** A reserve that was commercially viable at \$80/barrel may no longer be viable at \$40/barrel, causing it to be abandoned
- ▶ **Producer Idiosyncrasies:** Firms may exaggerate discovery potential, or fail to develop reserves due to financial difficulties or shifts in strategy



Floating Production Storage and Offloading Vessel Over Ultra-Deepwater Pre-Salt Deposits (Petrobras, 2021)

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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/XPBR4, 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 reservas mais profundas.

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 30° 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.

"Communication to the Market" Filed by Petrobras with *Comissão de Valores Mobiliários*

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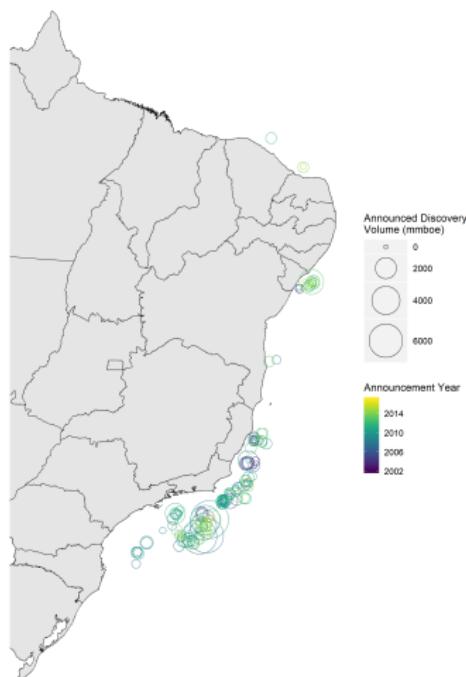
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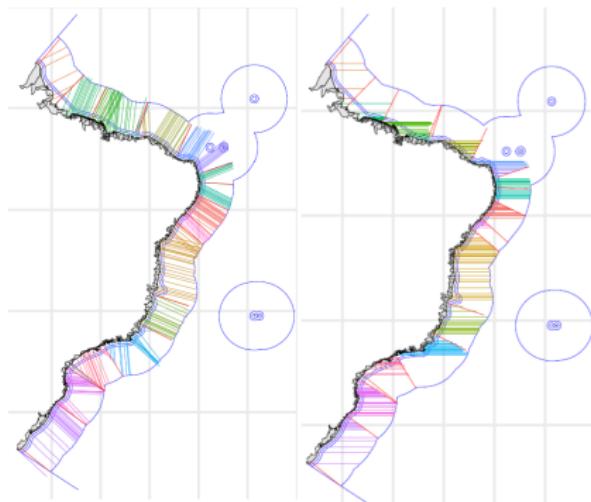
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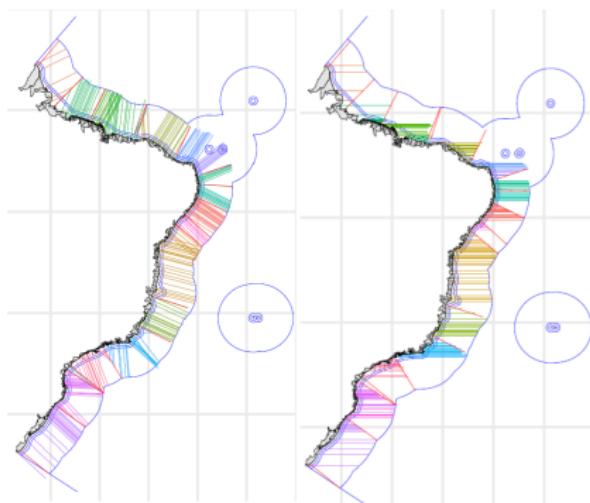


Next, I recreate geodesic projections of coastal boundaries used by Brazilian government to allocate offshore royalties to coastal municipalities

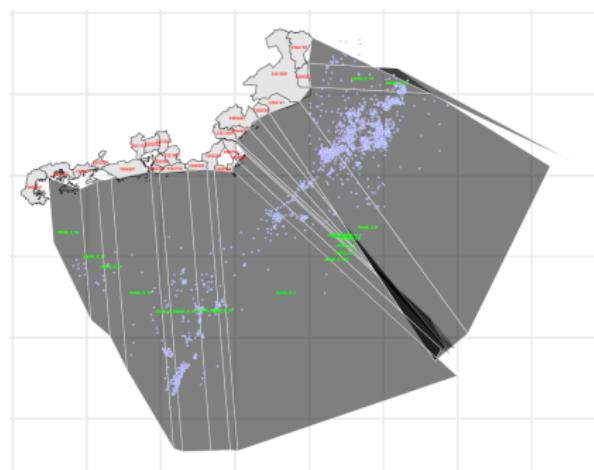


Orthogonal (Left) and Parallel (Right) Projections of Coastal Municipal Boundaries

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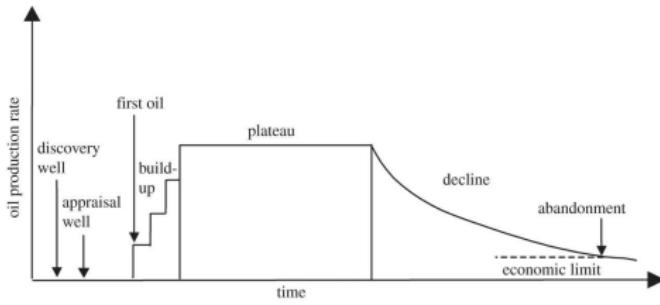
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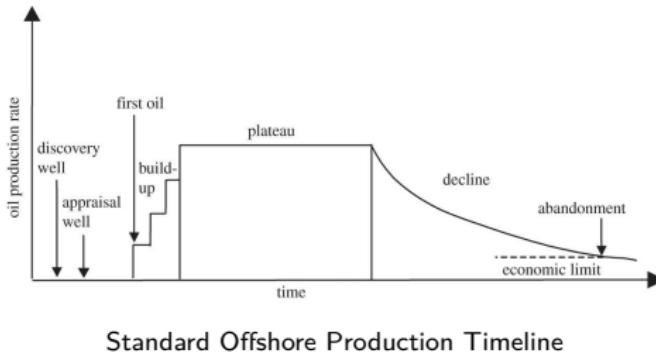
Offshore Wells Overlaid on Orthogonal
Projections (Example: Rio de Janeiro)

Exploiting a Quasi-Experiment III: Forecasting Revenue Expectations

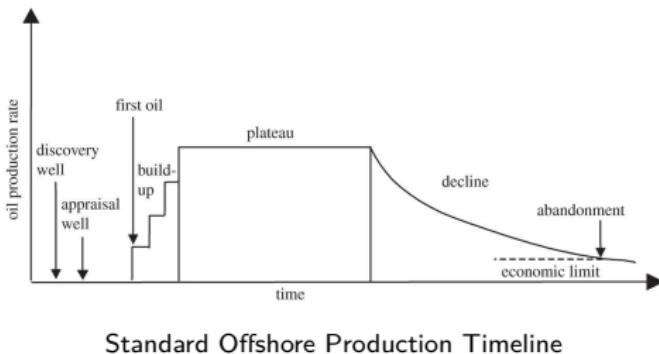
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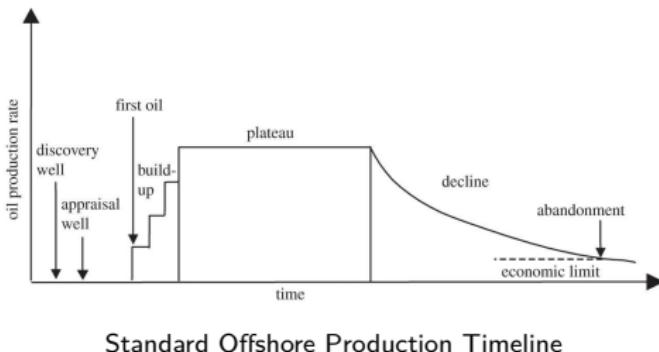
Standard Offshore Production Timeline



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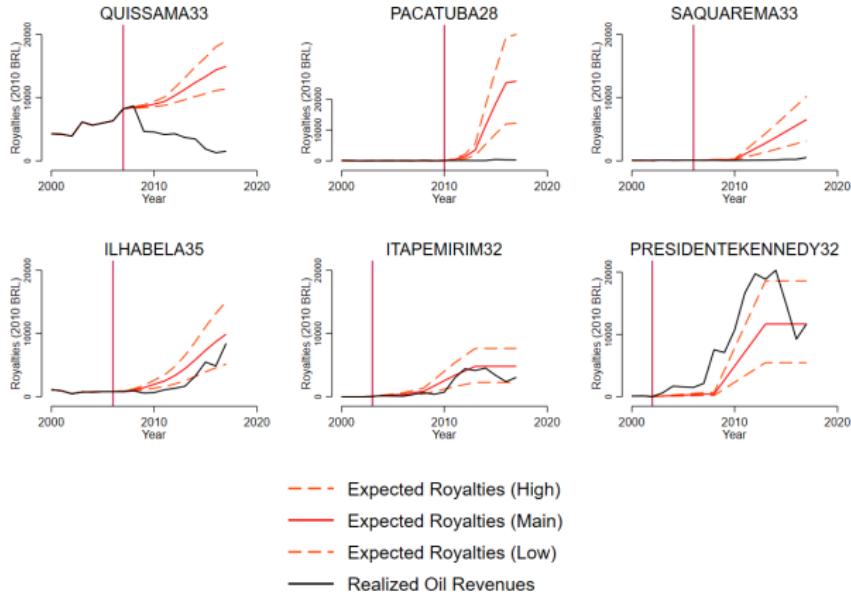
- 1 Forecast expected production stream after discovery announcement (function of volume discovered, average production delay, and standard offshore production assumptions)
 - 2 Apply royalty distribution rules to forecast revenue stream
 - 3 Compute forecast error for municipality m in year t :

$$Error_{mt} = \frac{\frac{Royalties_{mt}}{Royalties_{m,t0}} - E(Royalties_{mt})}{\frac{Royalties_{mt}}{Royalties_{m,t0}}} = \frac{\text{Realized Growth in Royalties since Discovery}}{\text{Expected Growth in Royalties since Discovery}}$$

► Forecasting Model

Comparing Forecast vs. Realized Revenues (Selected Examples)

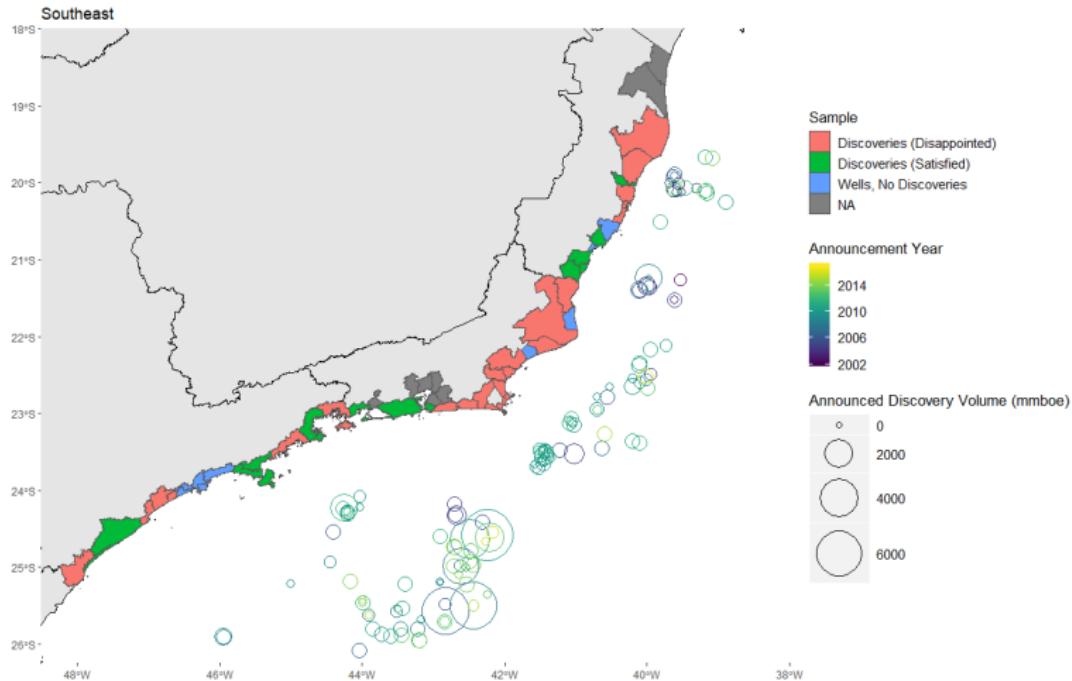
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- ▶ Of 48 municipalities affected by oil discoveries between 2000-2017, only 18 realize even 50% of the revenues they could have expected by 2017
- ▶ **For main analysis, group municipalities as "disappointed"/"satisfied" along median of distribution of $Error_{m,2017}$** ▶ *Distributions of Forecast Error*

Mapping Discovery Realizations (Example: Southeast Brazil)

| 15



► Full Brazilian Coastline

► Conditional Random Assignment Tests

Intro

Context

Setup

Empirical Strategy

Results

Conclusion

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

- ▶ Let E_m be period when municipality m is "treated" with event (i.e. first discovery announcement). Let $K_{mt} = t - E_m$
 - ▶ y_{mt} includes municipal governance outcomes (e.g., spending, revenue, debt, public goods provision)

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

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

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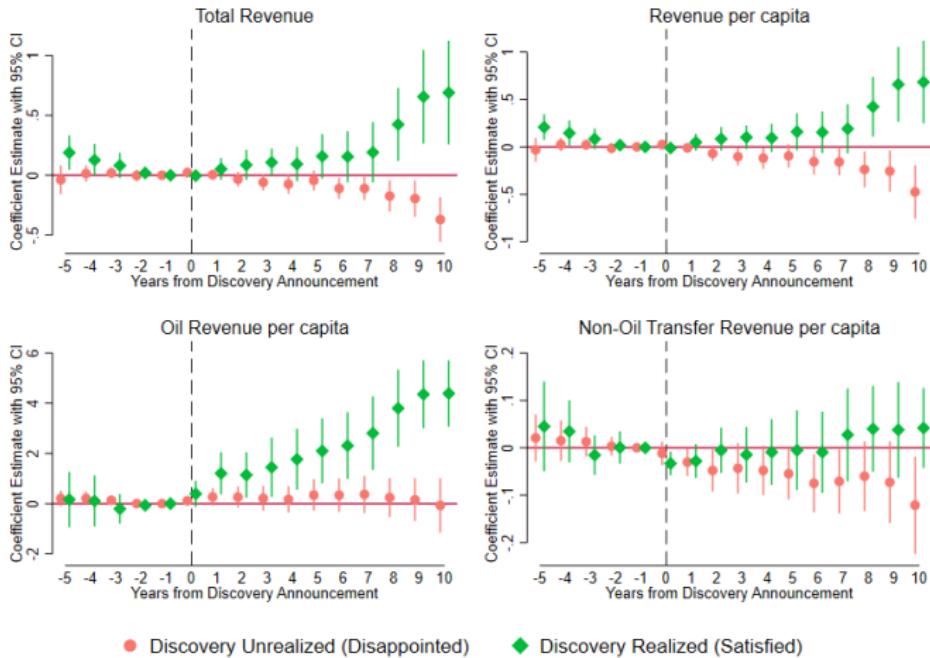
► Are pre-trends parallel between treated and control groups?

- > Verify pre-trends in event studies ($\beta_k = 0$ for $t < -1$?)
- > Examine pre-trends directly in sample means: ► Pre-Trends

► Panel Balance Across Relative Time Indicators

Results: Municipal Revenues after Oil Discoveries

| 19



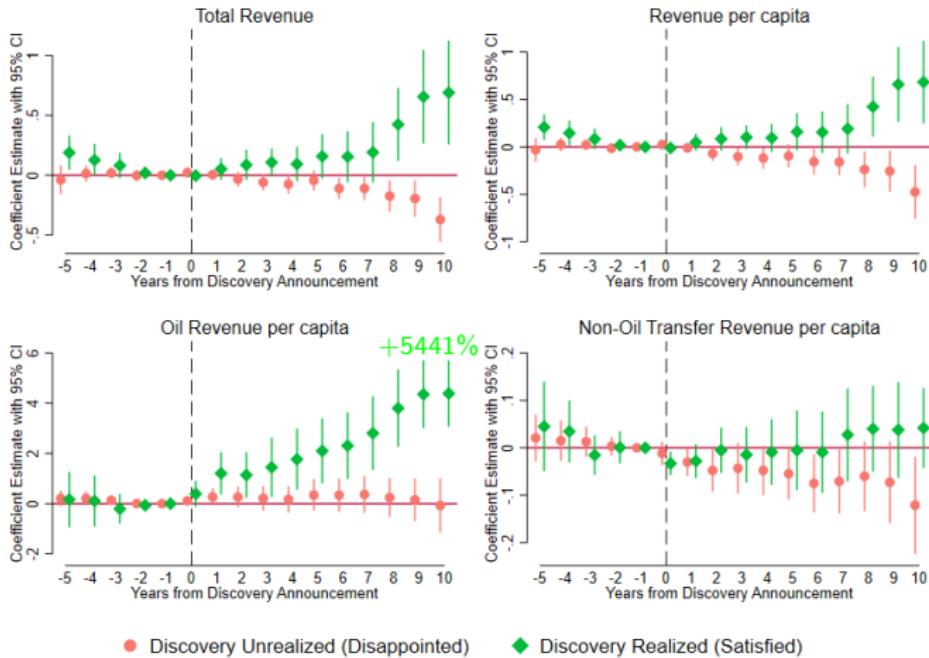
Effects on Disappointed and Satisfied treated groups are estimated separately but graphed together. Results are reported from **TWFE-Wells** specification. Continuous outcomes use inverse hyperbolic sine transformation. Standard errors are clustered at the municipality level. Monetary values are deflated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

► Breakdown of Transfers

► Interpreting Coefficients

Results: Municipal Revenues after Oil Discoveries

| 19



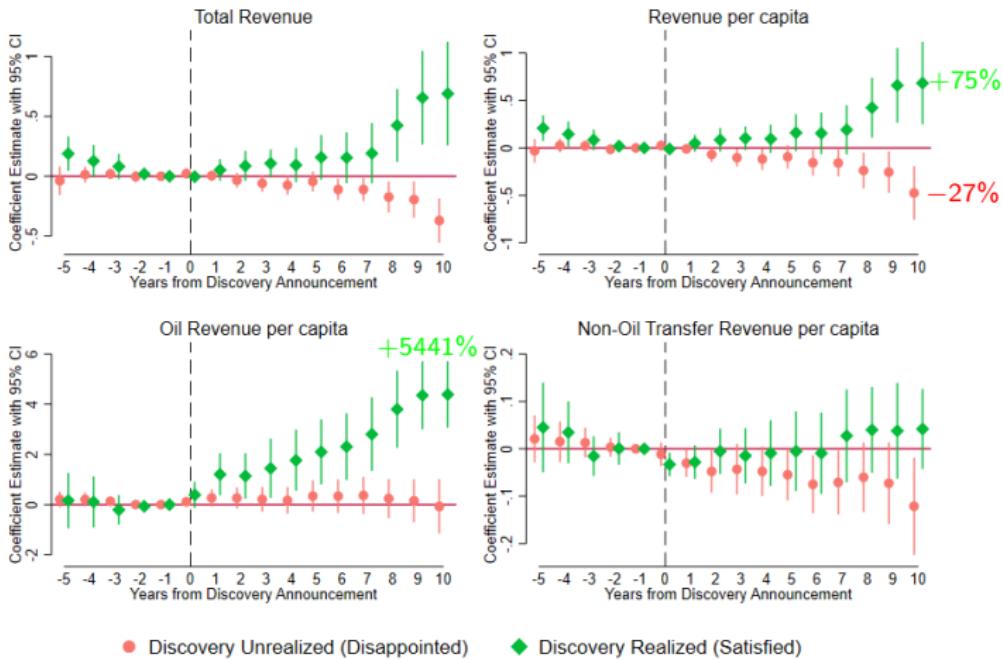
Effects on Disappointed and Satisfied treated groups are estimated separately but graphed together. Results are reported from **TWFE-Wells** specification. Continuous outcomes use inverse hyperbolic sine transformation. Standard errors are clustered at the municipality level. Monetary values are deflated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

► Breakdown of Transfers

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Results: Municipal Revenues after Oil Discoveries

| 19



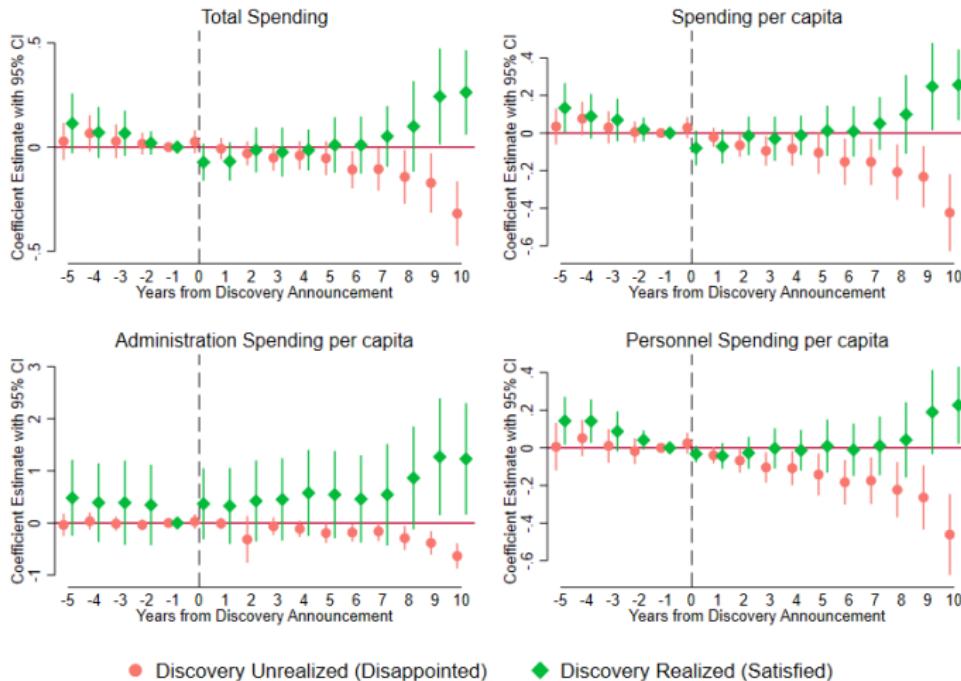
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► Breakdown of Transfers

► Interpreting Coefficients

Results: Municipal Spending

| 20

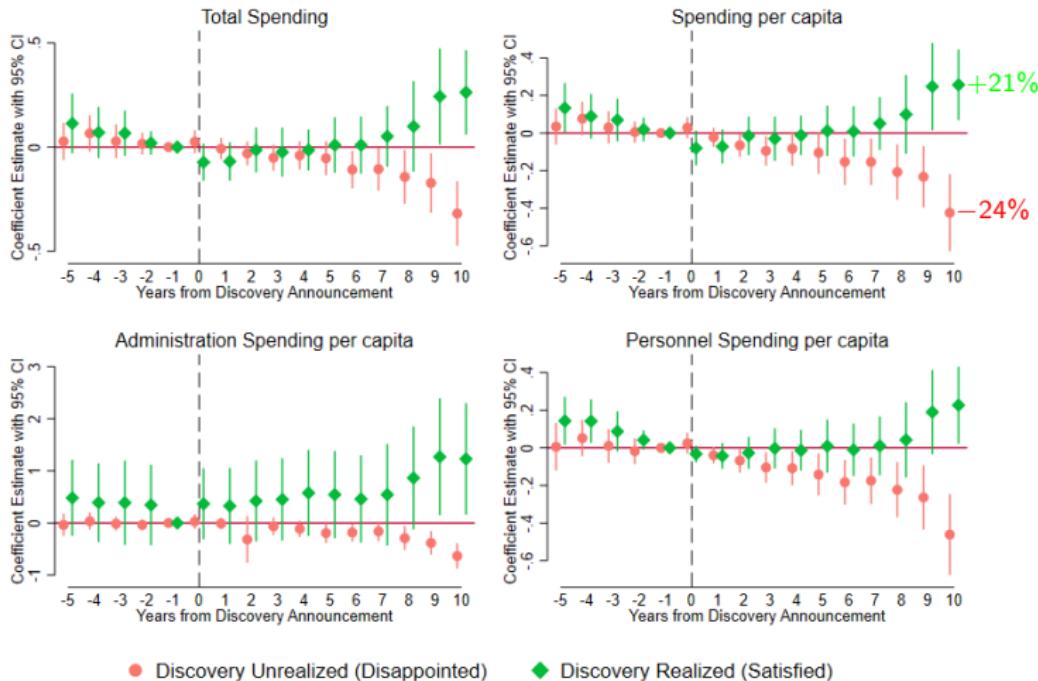


▶ Interpreting Coefficients

Intro
○○○○○○Context
○○○○○○Setup
○○○○○○Empirical Strategy
○○Results
○○○●○○○○○○○○○○Conclusion
○○

Results: Municipal Spending

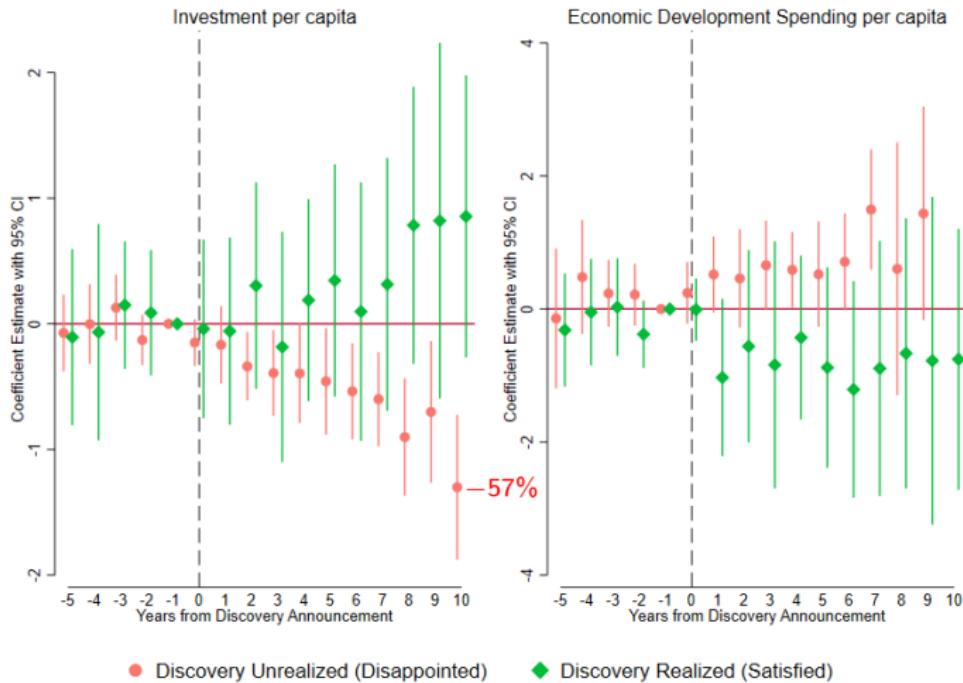
| 21



▶ Interpreting Coefficients

Results: Investment and Economic Diversification

| 22



▶ Interpreting Coefficients

Intro
○○○○○○

Context
○○○○○

Setup
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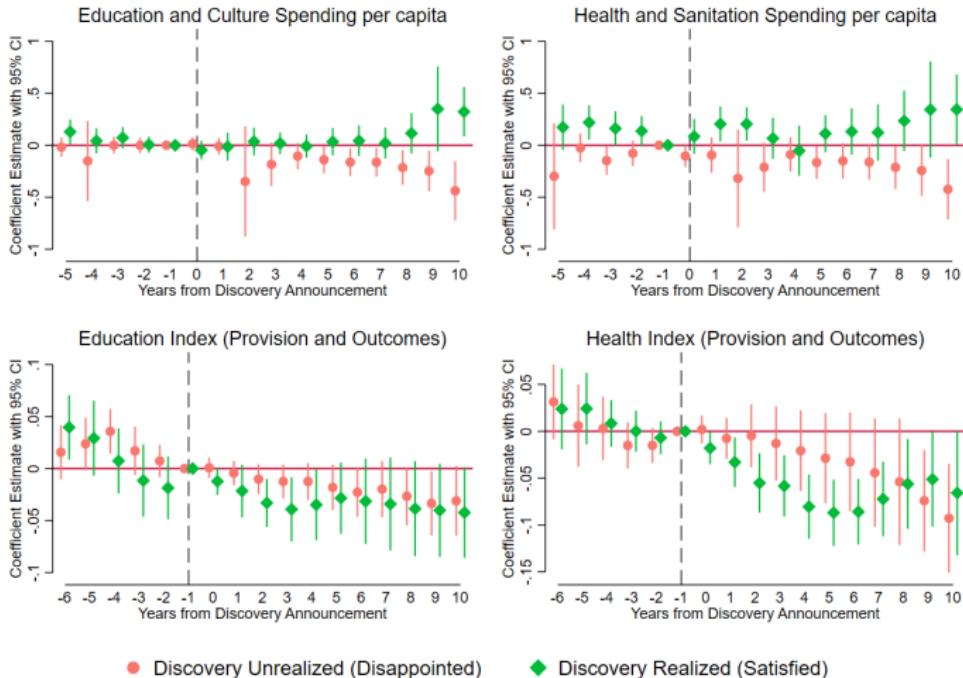
Empirical Strategy
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Results
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Conclusion
○○

Results: Public Goods Spending and Outcomes

| 23



► Public Goods Provision and Quality

Intro
○○○○○○

Context
○○○○

Setup
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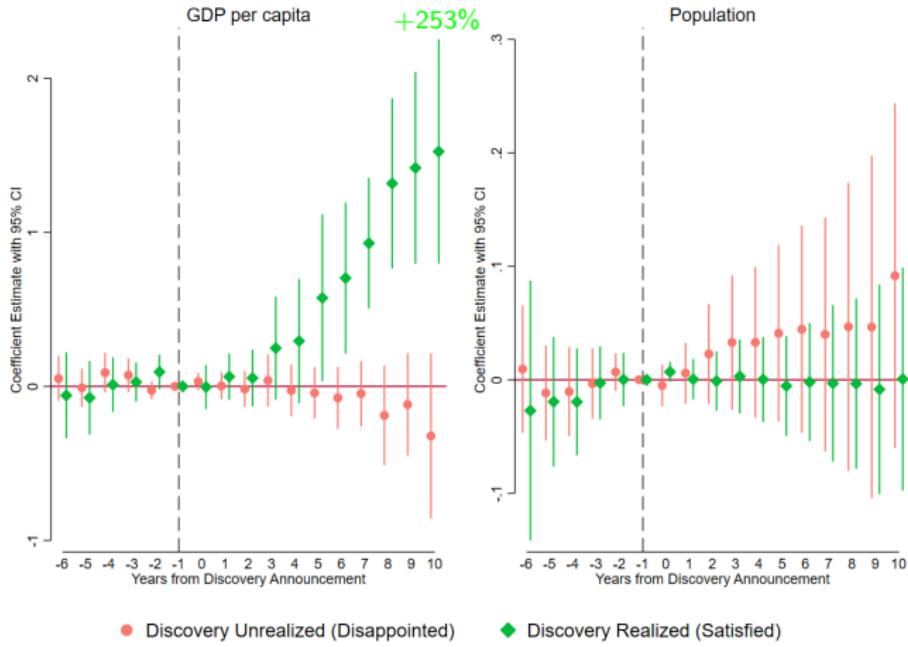
Empirical Strategy
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Results
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Conclusion
○○

Results: Municipal GDP and Population

| 24



► Results: In-Migration up to 2010

► Interpreting Coefficients

Robustness Across Samples and Estimators (Disappointed Municipalities) | 25

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

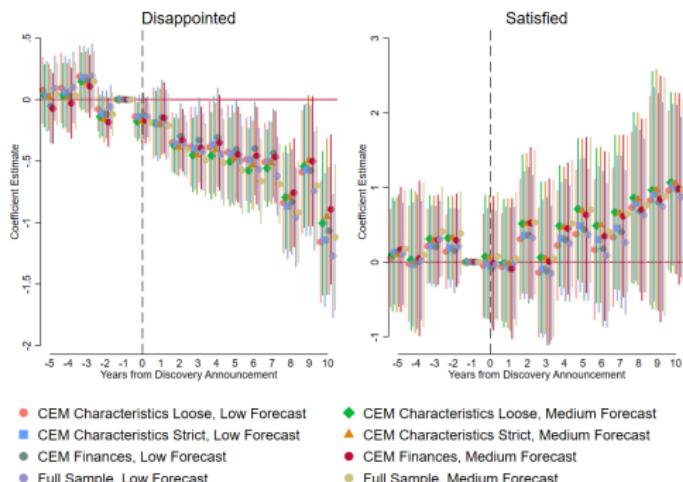
Each column reports coefficient estimates and standard errors for the $t + 10$ period of event studies for a specific control group-estimator pair.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ ▶ Interpreting Coefficients ▶ Satisfied Municipalities

► Alternative forecasting and matching parameters ► Sensitivity Analysis

► Sensitivity Analysis

Selected Example: Investment



► Event studies with multiple events ► Multiple Events

► Multiple Events

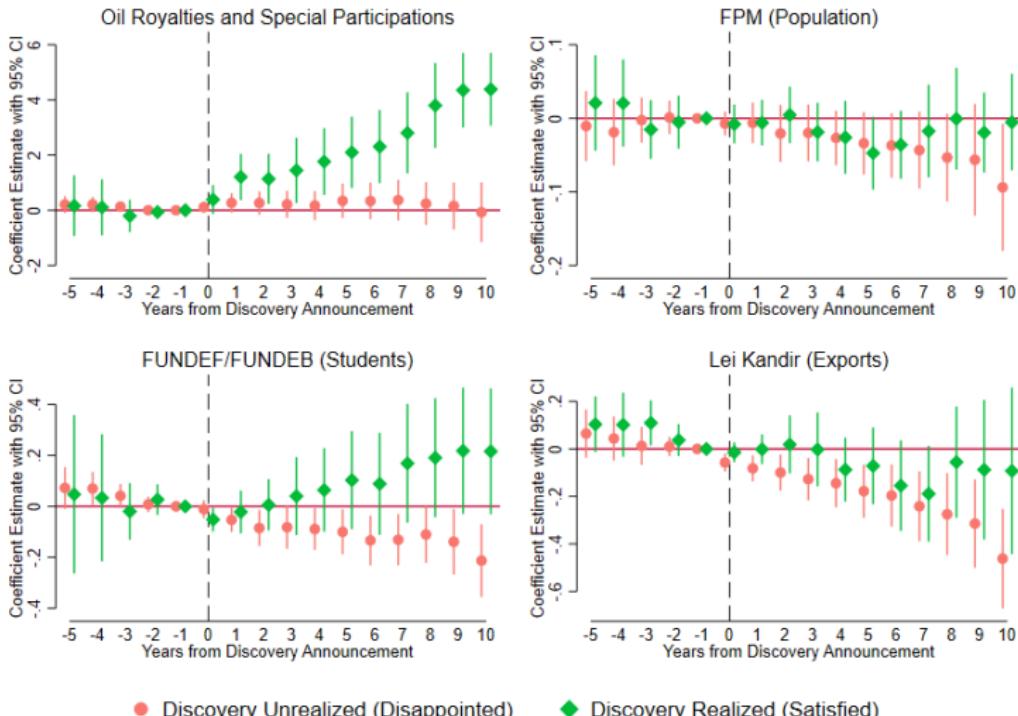
► Spatial spillovers onto neighboring municipalities ► Spatial Spillovers

► Spatial Spillovers

Why Are Disappointed Municipalities Worse Off?

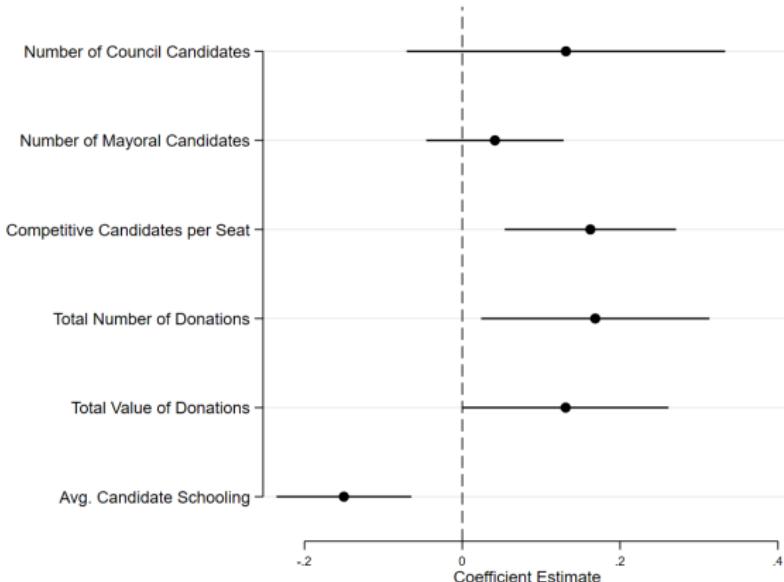
| 27

State and Federal Transfers to Municipal Governments



- 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

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



► Robustness

► Patronage and Elected Politician Characteristics

- ▶ Discoveries are often delayed and disappointed – this is an important part of the "resource curse"



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 - ▶ Brazilian municipalities did not react immediately to discovery announcements, possibly because of a fiscal responsibility law

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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)
- ▶ Local political competition increases after discovery announcements; lower educated candidates run for and win office

Policy Takeaway:

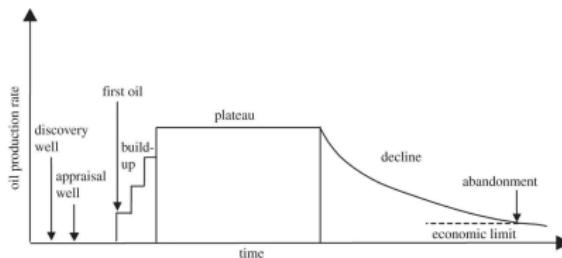
- ▶ Revenue sharing rules that concentrate resource impacts in specific places:
 - 1 Concentrate disappointment—better to spread impacts over exploration portfolio
 - 2 Strain capacity to spend windfalls efficiently and encourage resource dependence

Policy Takeaway:

- ▶ Revenue sharing rules that concentrate resource impacts in specific places:
 - 1 Concentrate disappointment—better to spread impacts over exploration portfolio
 - 2 Strain capacity to spend windfalls efficiently and encourage resource dependence

My contributions:

- ▶ **Account for heterogeneity in discovery realizations:** our understanding of places affected by resources should include those experiencing disappointment
- ▶ **Take timing seriously:** resource impacts evolve; I build a subnational panel dataset to estimate dynamic outcomes



Standard Offshore Production Timeline

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

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

- ▶ 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

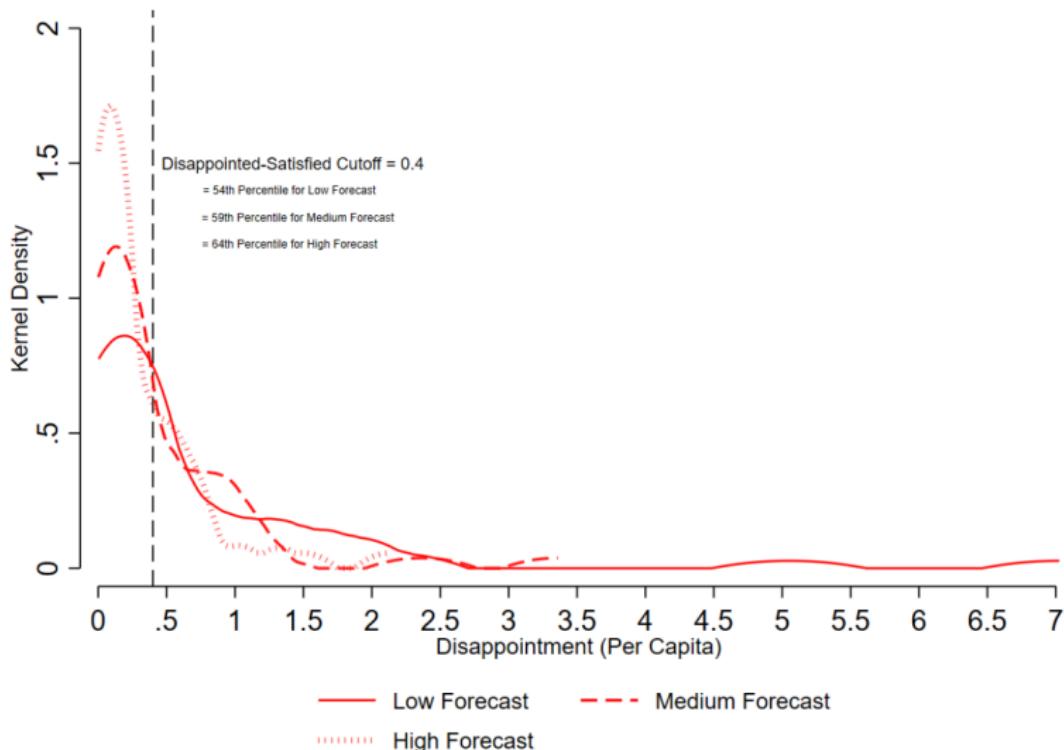
In each period, compute **error** in municipality m in year t :

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

This is the ratio of realized royalty growth between discovery announcement in t_0 and current period t , and expected royalty growth over the same period. [► Return](#)

Distributions of Forecast Error Across Treated Municipalities

| 33



Pre-Treatment (Year 2000) Balance Between Samples

| 34

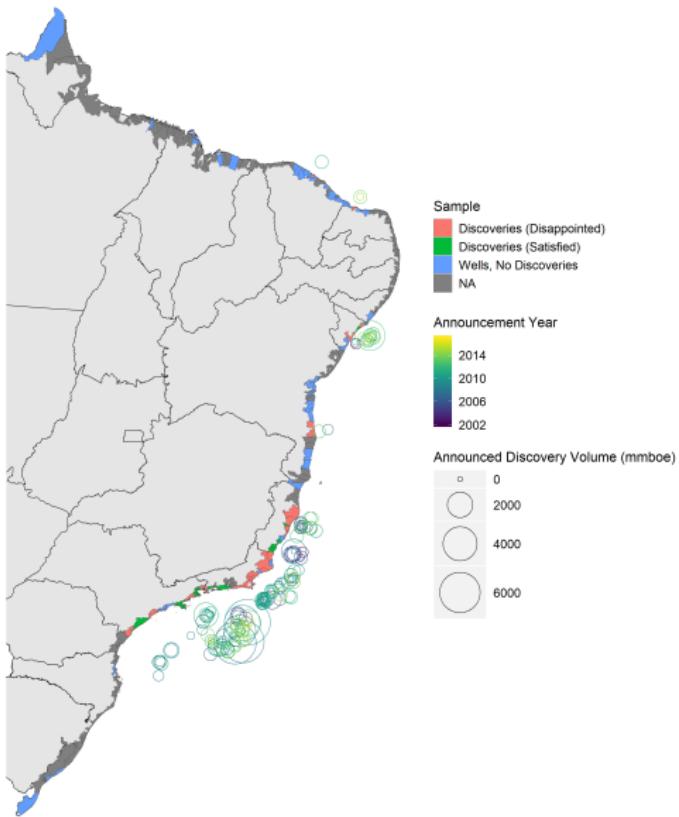
	Treated Samples		Control Samples			
	Disappoint.	Satisfied	Wells	Match (D)	Match (S)	Coastal
<i>Latitude</i>	-19.50 (6.25)	-21.82 (3.13)	-13.04 (9.59)	-20.21 (7.91)	-20.00 (8.13)	-16.40 (9.24)
<i>Dist. from State Capital</i>	116.62 (85.35)	88.59 (57.12)	150.15 (120.02)	192.14 (143.64)	92.79 (38.81)	248.87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

| 35



► Return

Appendices



Régress 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

$$Y_m^{2000} = \alpha + \beta_1 Treatment_m + X'_m \lambda + \delta_s + \epsilon_m$$

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

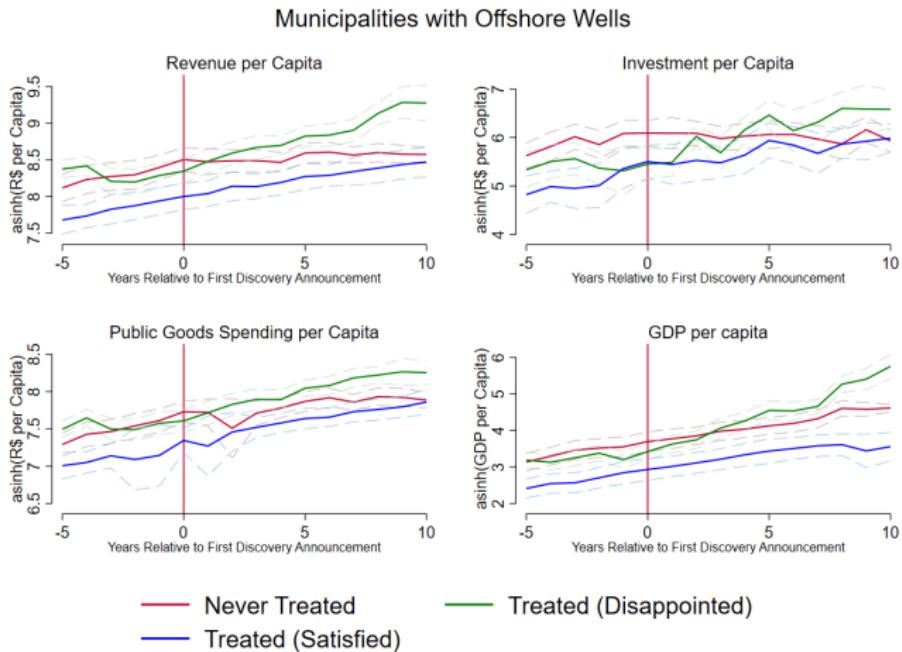
Outcome	$1(\text{Wells} = 1)$	$1(\text{Discovery} = 1)$	$1(\text{Satisfied} = 1)$
	p-value (FWER-adj.)	p-value (FWER-adj.)	p-value (FWER-adj.)
<i>Cumulative Party Align. w. Governor</i>	0.417 (0.668)	0.604 (0.879)	0.926 (0.937)
<i>Cumulative Party Align. w. President</i>	0.953 (0.963)	0.680 (0.879)	0.160 (0.521)
<i>State Capital Dummy</i>	0.091 (0.283)	0.745 (0.879)	0.198 (0.521)
<i>Contemp. Party Align. w. Governor</i>	0.745	0.387	NA
<i>Contemp. Party Align. w. President</i>	0.558	0.550	NA
<i>State Capital Dummy</i>	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

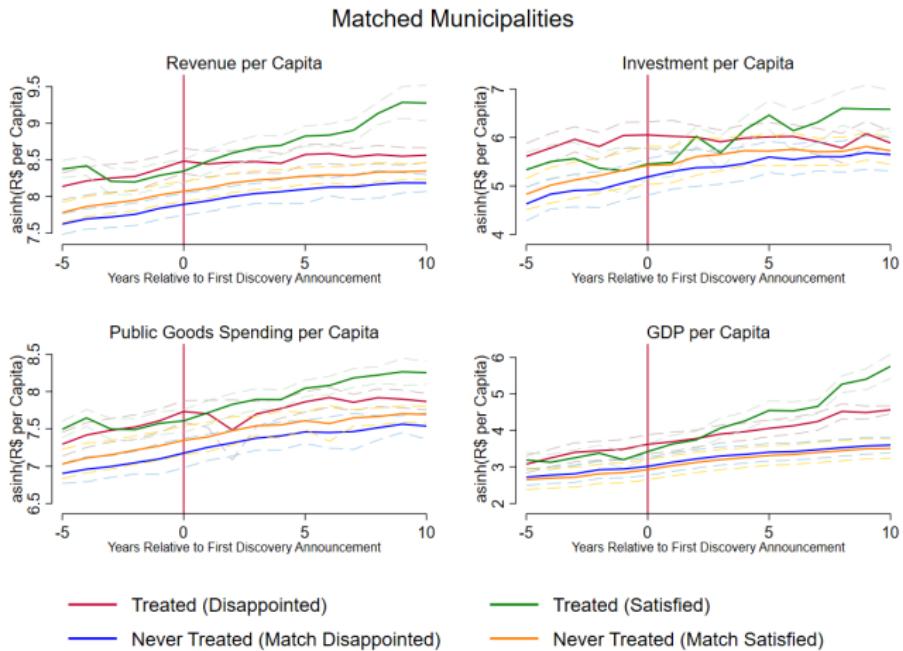
| 39



[Return](#)

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

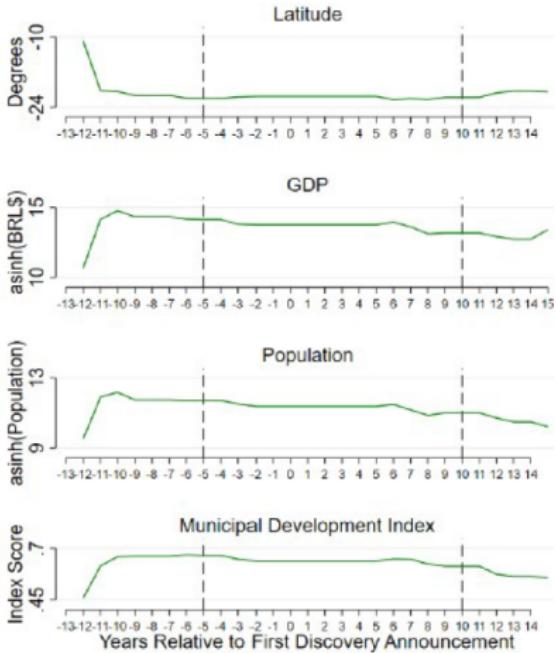
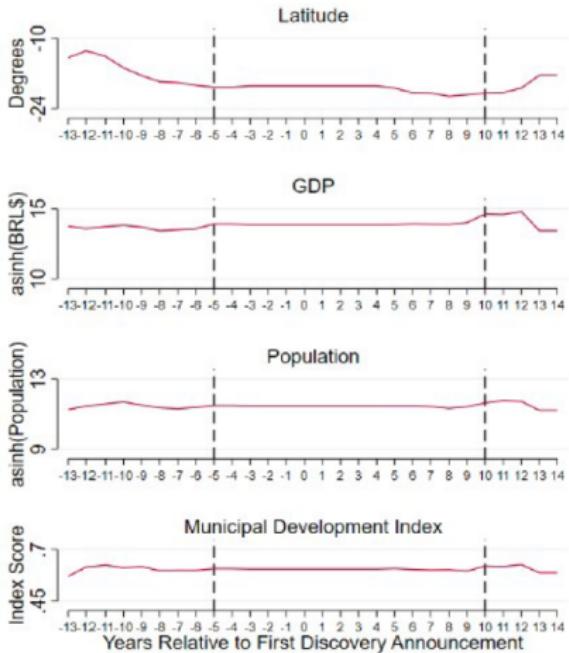
| 40



[Return](#)

Sample Means Across Unbalanced Panel

| 41

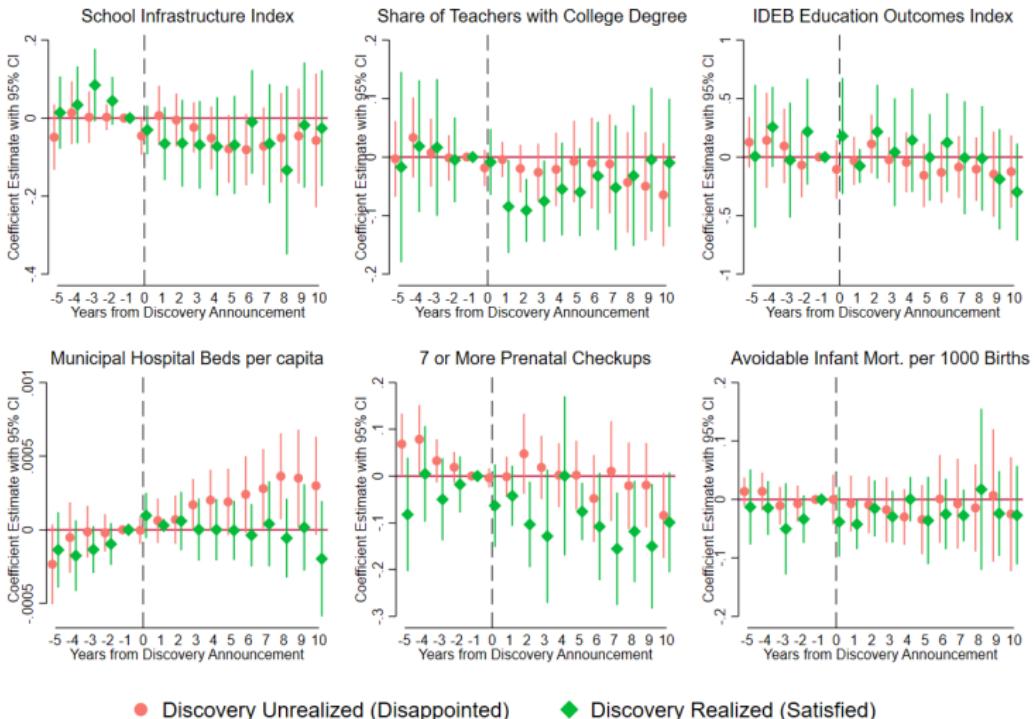


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Appendices



Results: Public Goods Provision and Quality



- Discovery Unrealized (Disappointed)

◆ Discovery Realized (Satisfied)

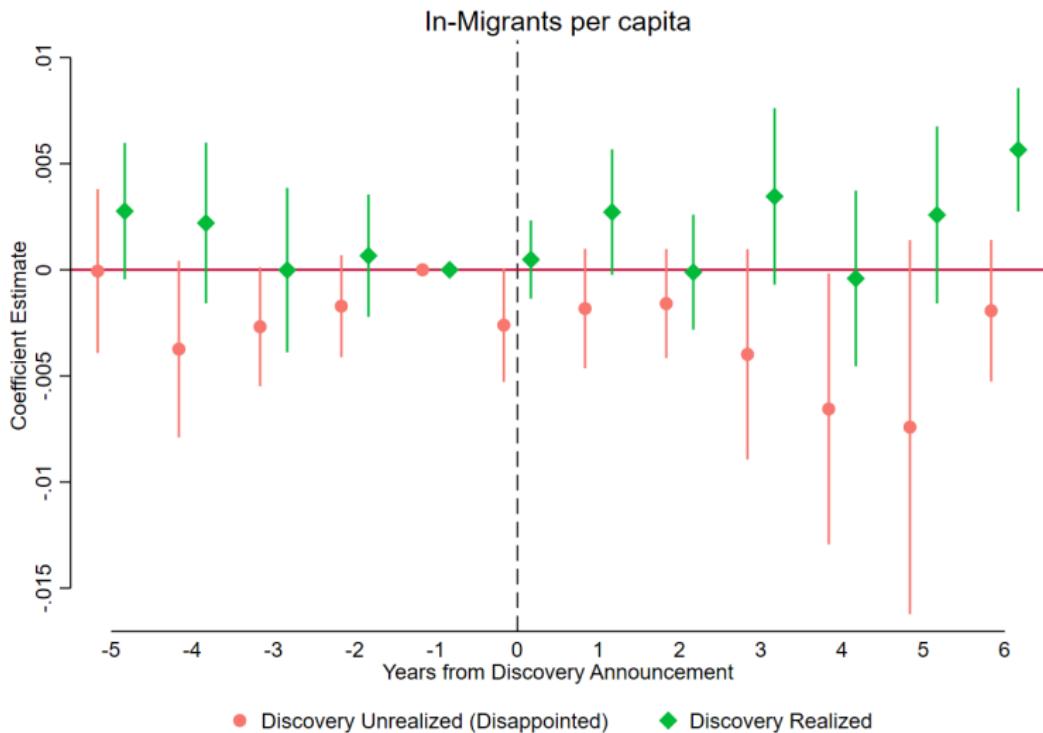
▶ Return

Appendices



Results: In-Migration (up to 2010)

| 43



▶ Return

Appendices



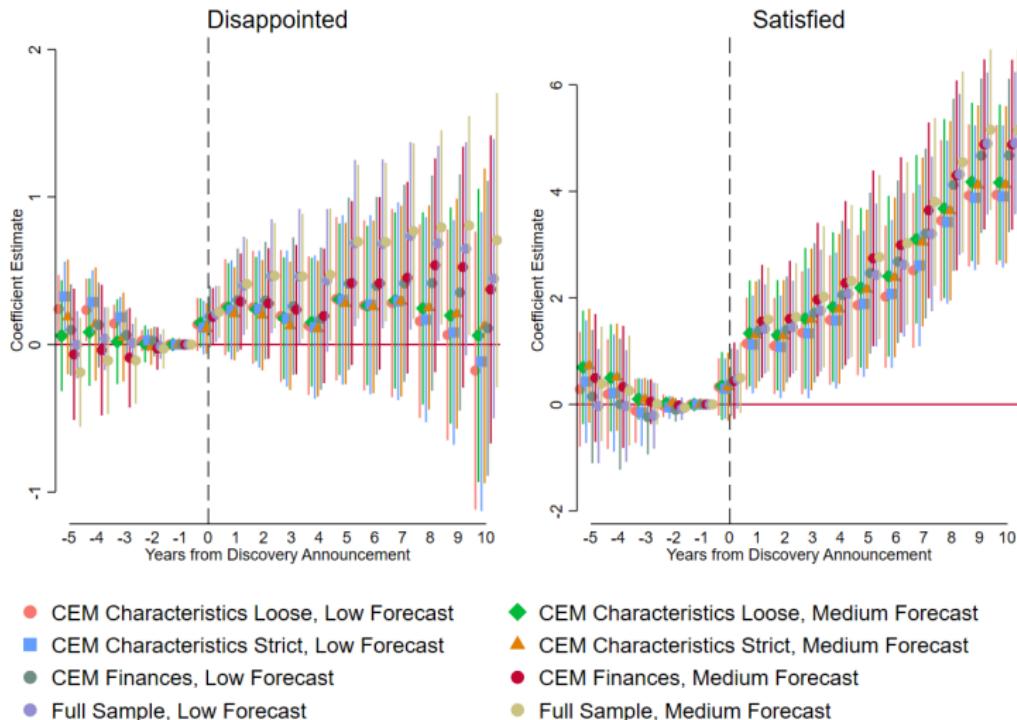
	TWFE Wells	TWFE Pre-Matching	CS Wells	CS Pre-Matching
<i>Total Revenue (Millions)</i>	0.65*** (0.20)	0.83*** (0.19)	0.76*** (0.25)	0.89*** (0.29)
<i>Revenue p.c.</i>	0.66*** (0.20)	0.77*** (0.19)	0.74*** (0.25)	0.87*** (0.28)
<i>Tax Revenue p.c.</i>	-0.21 (0.30)	0.07 (0.26)	0.02 (0.29)	0.22 (0.31)
<i>Oil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

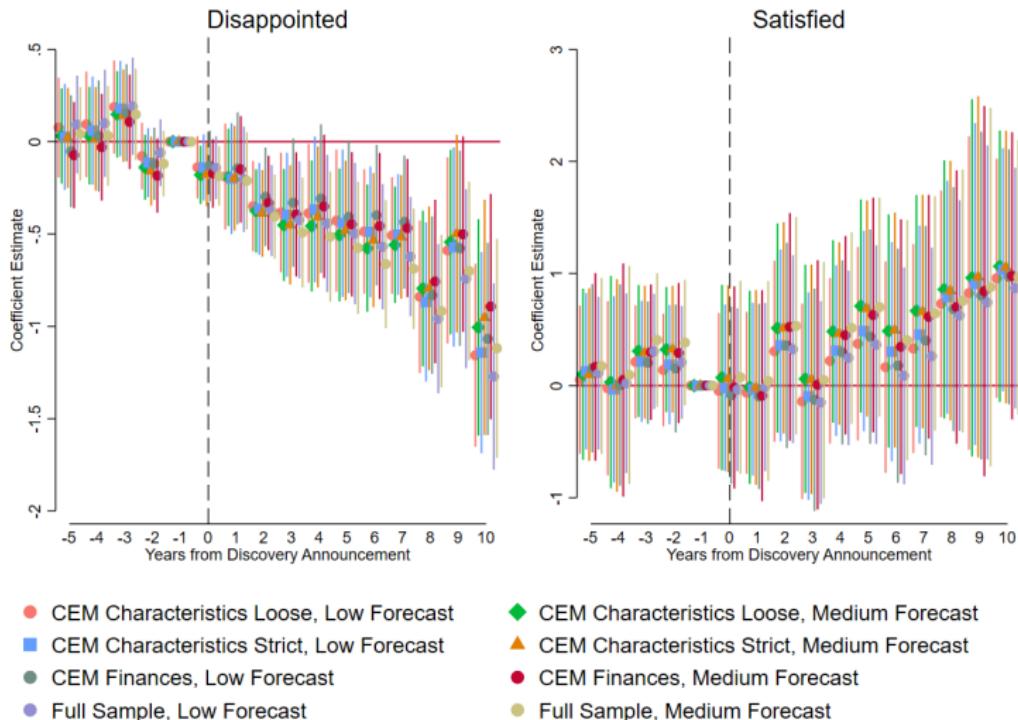
Robustness to Alternative Forecasting and Matching Parameters: Oil Revenues

| 45



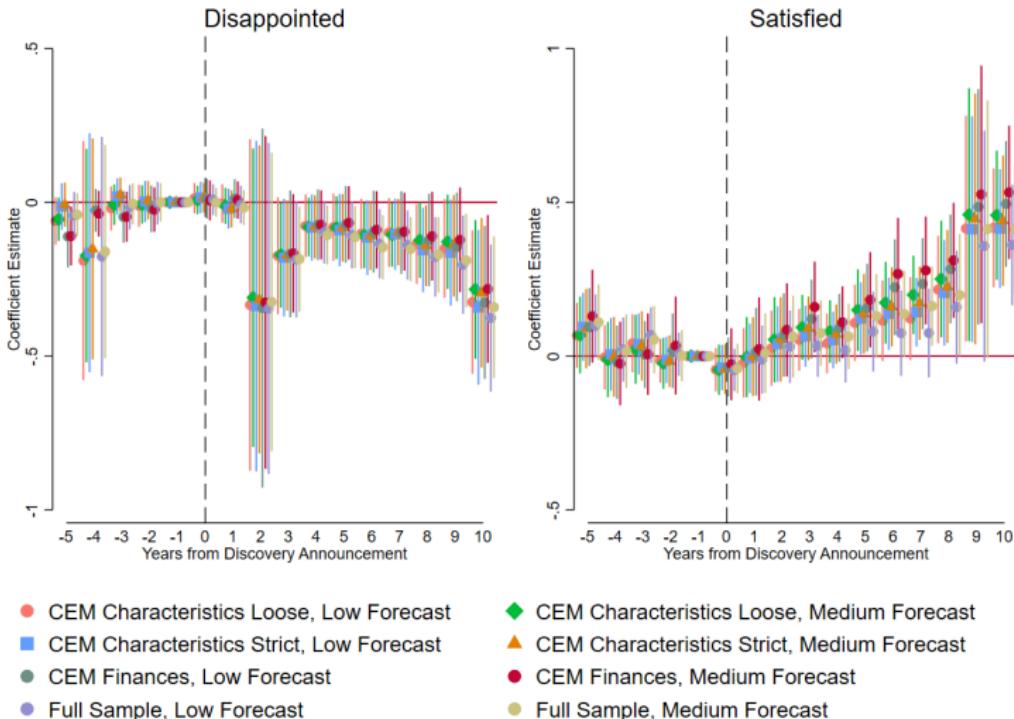
Robustness to Alternative Forecasting and Matching Parameters: Investment

| 46



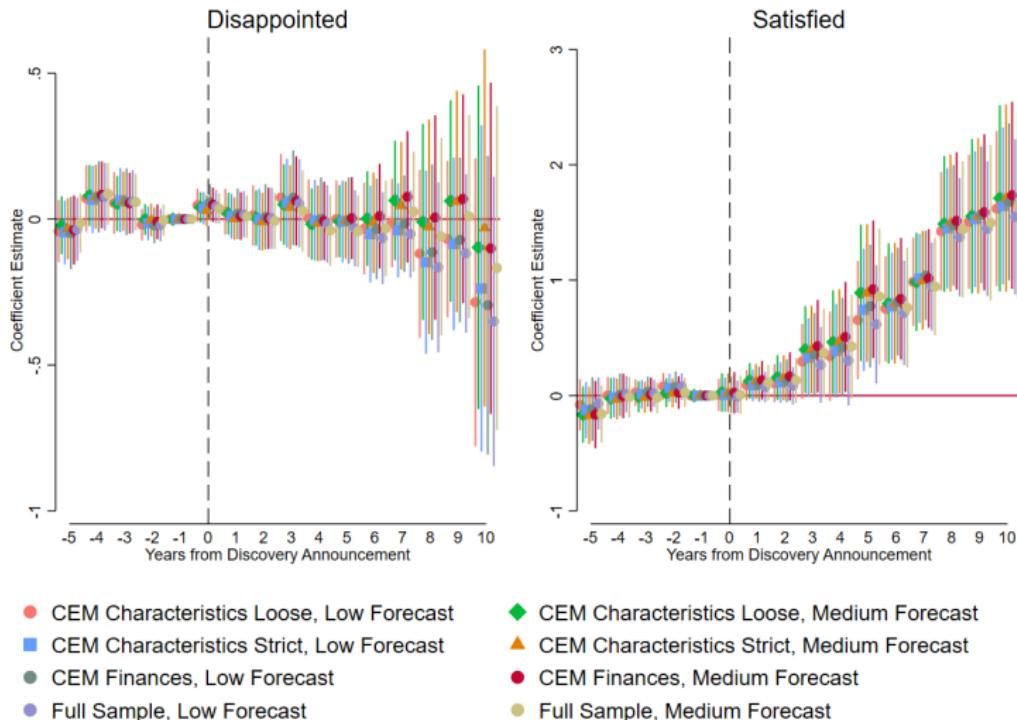
Robustness to Alternative Forecasting and Matching Parameters: Education Spending

| 47



Robustness to Alternative Forecasting and Matching Parameters: GDP

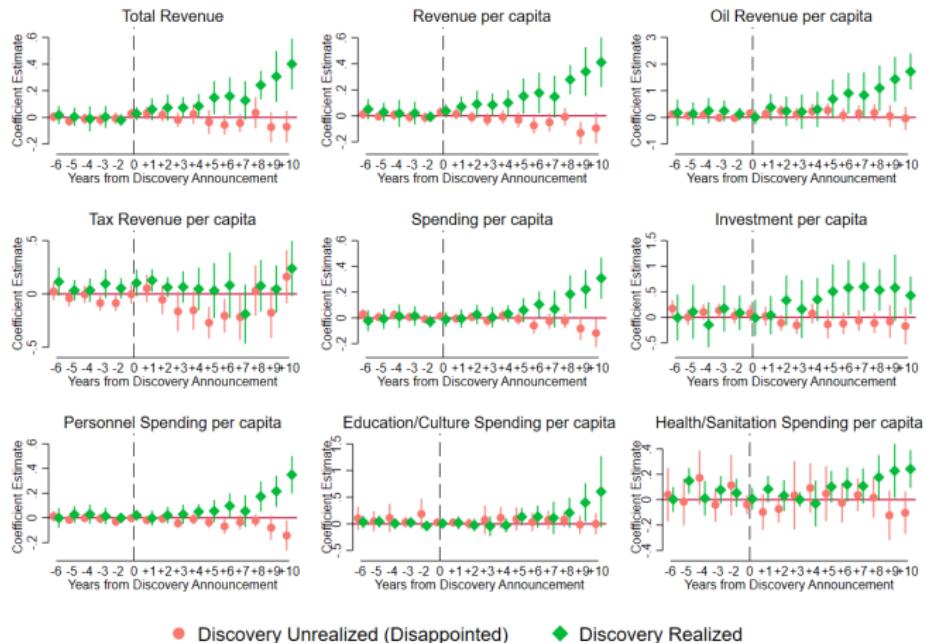
| 48



Event Studies With Multiple Events

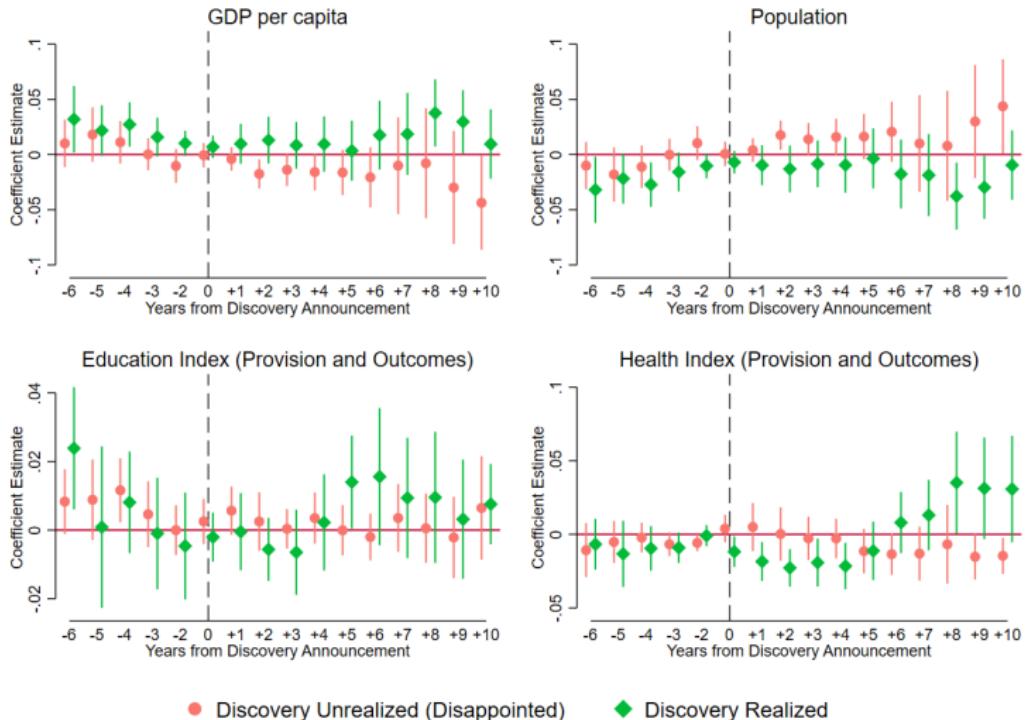
| 49

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

| 50



▶ Return

Appendices

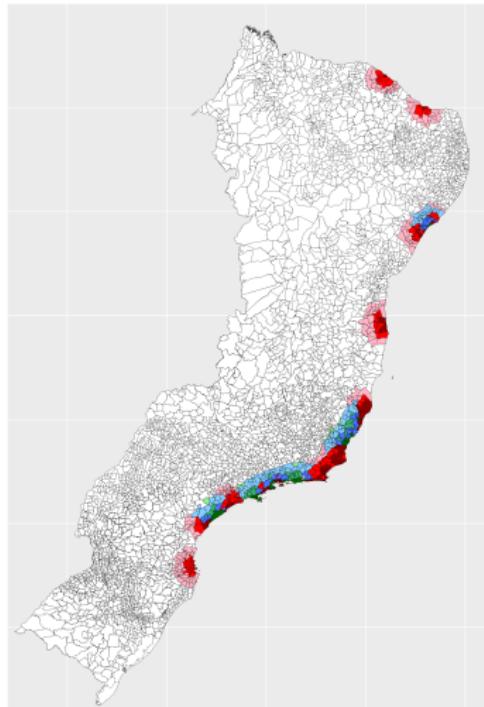


Spatial Spillovers Onto Neighboring Municipalities

| 51

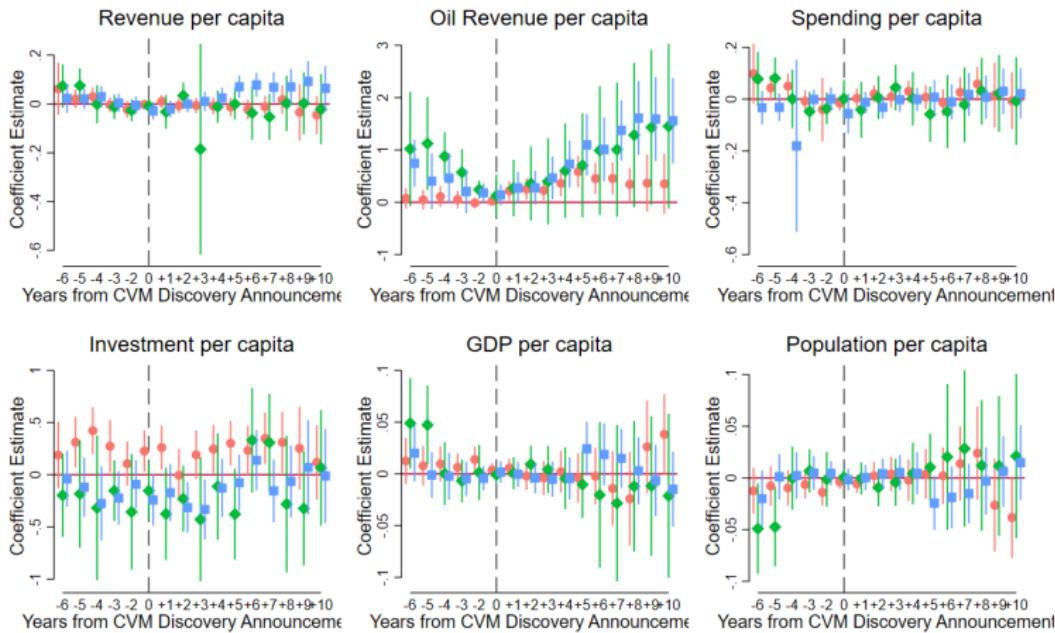
- ▶ Identify municipalities that are (i) near/far (0-50 and 50-100km) from disappointed municipalities; (ii) near/far from satisfied municipalities; (iii) near/far both

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



Spatial Spillovers: Effects on Public Finances

| 52

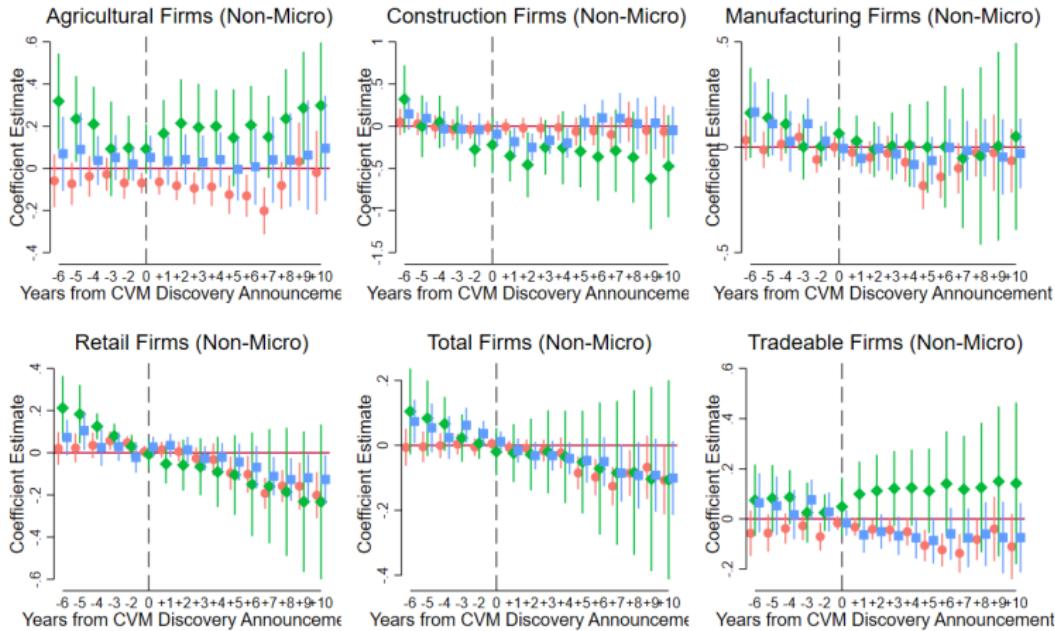


- Near Disappointed Municipality (< 50km.)
 - ◆ Near Satisfied Municipality (<50km.)
 - Near Both Types (<50km.)



Spatial Spillovers: Effects on Firm Entry

| 53



- Near Disappointed Municipality (< 50km.)
- ◆ Near Satisfied Municipality (<50km.)
- Near Both Types (<50km.)

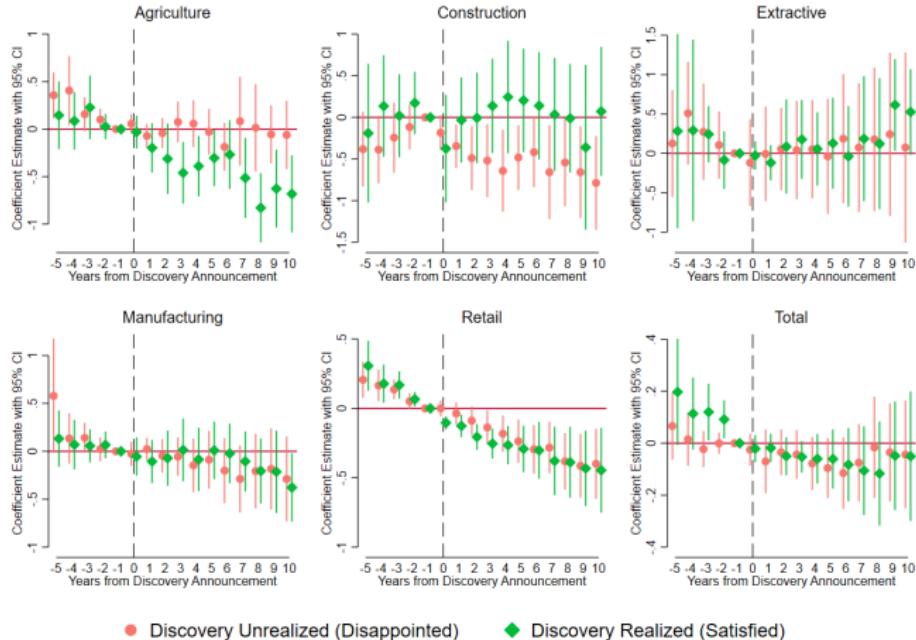
▶ Return

Appendices



Discovery Effects on Formal Employment

| 54

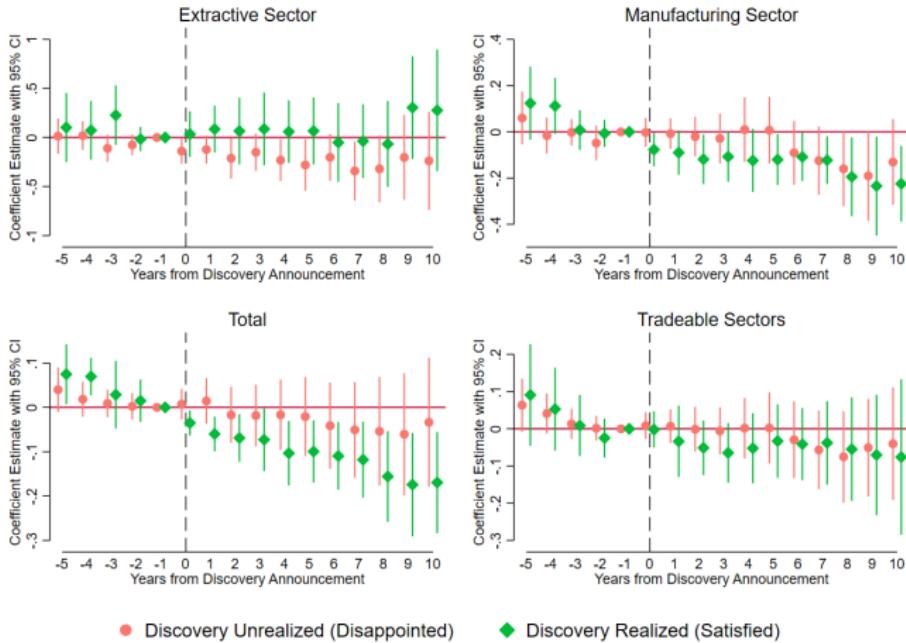


Appendices



Discovery Effects on Firm Entry

| 55



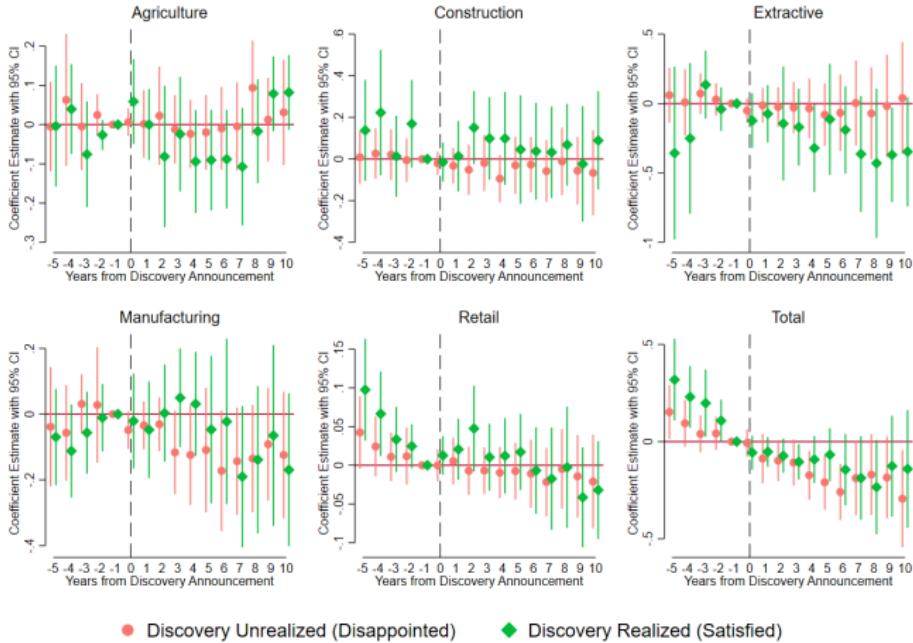
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Appendices



Discovery Effects on Formal Wages

| 56



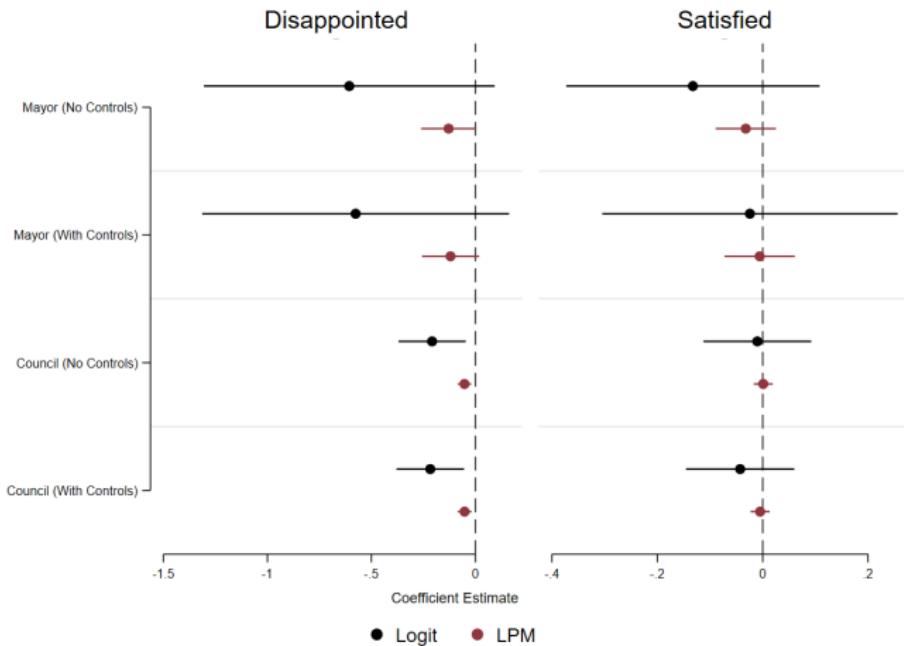
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Do Voters Punish Incumbents for Discovery Disappointment?

| 57

Estimate likelihood of reelection for incumbent i in municipality m and election period e :

$$P(\text{Reelection}_{ime} = 1) = \delta_m + \lambda_e + \beta \text{Disappointed}_{me} + X_i' \mu + \epsilon_{ime}$$



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

Coefficients and Elasticities (Disappointed)

| 59

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

Appendices

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

► Return

Coefficients and Elasticities (Satisfied)

| 60

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

Appendices

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

Small Sample Bias Corrected Semi-Elasticities (Disappointed)

| 61

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

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

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

Small Sample Bias Corrected Semi-Elasticities (Satisfied)

[► Return](#)

| 62

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

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

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

Patronage and Elected Politician Characteristics

| 63

Winner Characteristics	TWFE Wells	TWFE Pre-Match
<i>Winners' Age</i>	0.118 (0.691)	0.045 (0.629)
<i>Winner Share Female</i>	0.011 (0.018)	0.008 (0.018)
<i>Winners' Avg. Schooling</i>	-0.150* (0.089)	-0.142* (0.076)
<hr/>		
Patronage (Mayors Only)		
<i>No. Donors Hired to Commissioned Posts</i>	-0.013 (0.045)	-0.197 (0.222)
<i>Share of Donors Among Commissioned Hires</i>	0.000 (0.000)	0.000 (0.003)
<i>Share of Commissioned Hires Among Donors</i>	0.000 (0.001)	-0.007 (0.005)
<hr/>		
Patronage (All Politicians)		
<i>No. Donors Hired to Commissioned Posts</i>	-0.039 (0.186)	0.137 (0.169)
<i>Share of Donors Among Commissioned Hires</i>	-0.002 (0.003)	-0.001 (0.003)
<i>Share of Commissioned Hires Among Donors</i>	-0.011 (0.007)	-0.008 (0.006)
<i>Municipality FEs</i>	Y	Y
<i>Election Period FEs</i>	Y	Y
<i>n</i> (municipality-election periods)	404	3,745