

The Presource Curse

Anticipation, Disappointment, and Governance after Oil Discoveries

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What is the "Resource Curse?"

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Resource Curse: Natural resources can create development challenges including rent-seeking, corruption, and Dutch Disease

What is the "Presource Curse?"

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Resource Curse: Natural resources can create development challenges including rent-seeking, corruption, and Dutch Disease

"Presource Curse": Anticipation, delays, and disappointment after large discoveries are common → can cause resource curse problems independently of the resources themselves.

(Mihalyi & Scurfield, 2020; Vezina, 2020; Cust & Mihalyi, 2017; Arezki et al., 2017; Vicente, 2010)

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What we know:

- ▶ Long delays, disappointed expectations, fiscal problems, and corruption after major offshore oil and gas discoveries in African countries
- ▶ Reliance on country case-studies and cross-country analyses makes it difficult to explore detailed governance outcomes or establish causality

Focus on Brazil: major offshore oil/gas discoveries in 2000-2010s

- 1 Do announcements of major offshore oil discoveries in Brazil cause anticipatory changes in:
 - > Local governance (e.g. municipal public finances, elections)
 - > Local firm behavior (e.g. firm entry/exit and employment)

Focus on Brazil: major offshore oil/gas discoveries in 2000-2010s

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 - > Local firm behavior (e.g. firm entry/exit and employment)
- 2 How often are municipalities' discovery expectations disappointed/satisfied?
 - > Do disappointed expectations result in negative long-term outcomes, such as reduced revenues, investment, or public goods provision?

Focus on Brazil: major offshore oil/gas discoveries in 2000-2010s

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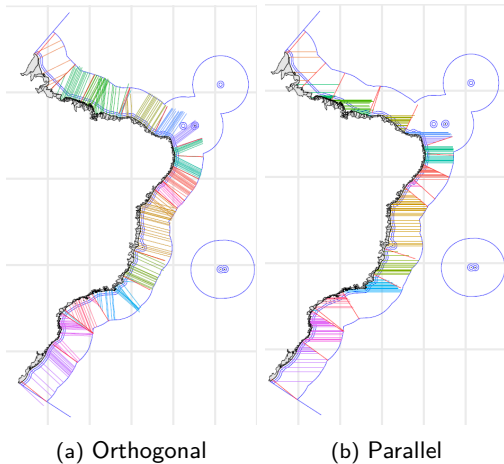
Contributions:

- ▶ 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)

Exploiting a Quasi-Experiment I: Distribution Maps

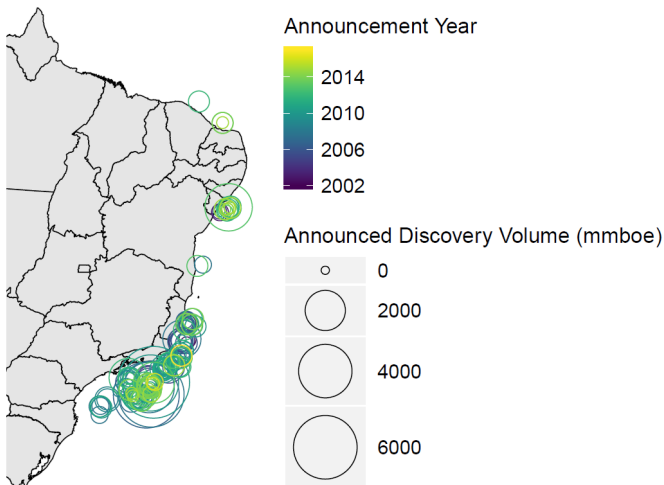
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Recreate projection maps used by government to allocate offshore royalties to coastal municipalities



Exploiting a Quasi-Experiment II: Discovery Announcements | 4

Compile geolocated dataset of 179 offshore discovery announcements filed by oil companies with Brazil's SEC (CVM) between 2000-2017



Exploiting a Quasi-Experiment III: Forecasting Revenue Expectations after Discoveries

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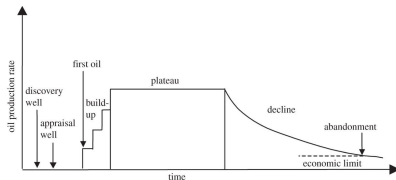


Figure: Standard Offshore Production Timeline

Exploiting a Quasi-Experiment III: Forecasting Revenue Expectations after Discoveries

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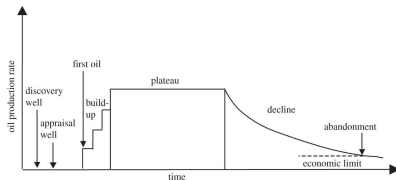


Figure: Standard Offshore Production Timeline

- 1 Forecast each municipality's expected production stream after discovery announcement (function of volume discovered, avg. production delay, and standard offshore production assumptions)

Exploiting a Quasi-Experiment III: Forecasting Revenue Expectations after Discoveries

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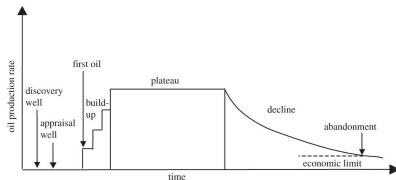


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- 2 Apply royalty distribution rules to forecast revenue stream

Exploiting a Quasi-Experiment III: Forecasting Revenue Expectations after Discoveries

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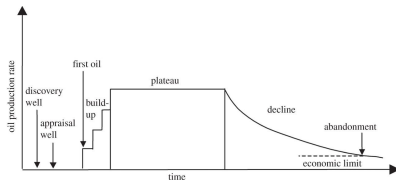


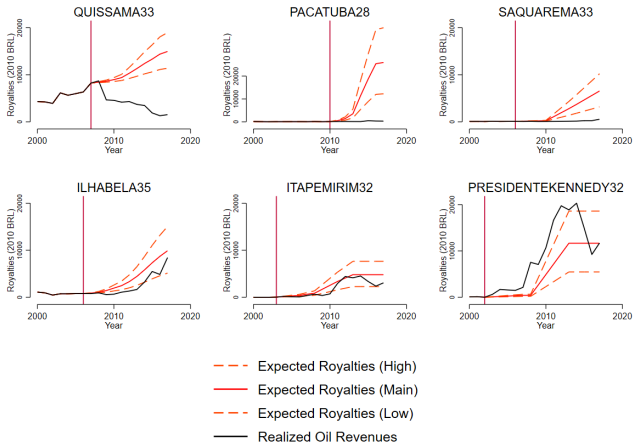
Figure: Standard Offshore Production Timeline

- 1 Forecast each municipality's expected production stream after discovery announcement (function of volume discovered, avg. production delay, and standard offshore production assumptions)
- 2 Apply royalty distribution rules to forecast revenue stream
- 3 Compute "disappointment" for municipality m in year t :

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

Comparing Forecast vs. Realized Revenues (Examples)

| 6



Of 48 municipalities affected by oil discoveries between 2000 and 2017, 30 end up receiving less than 40% of the revenues they could have expected

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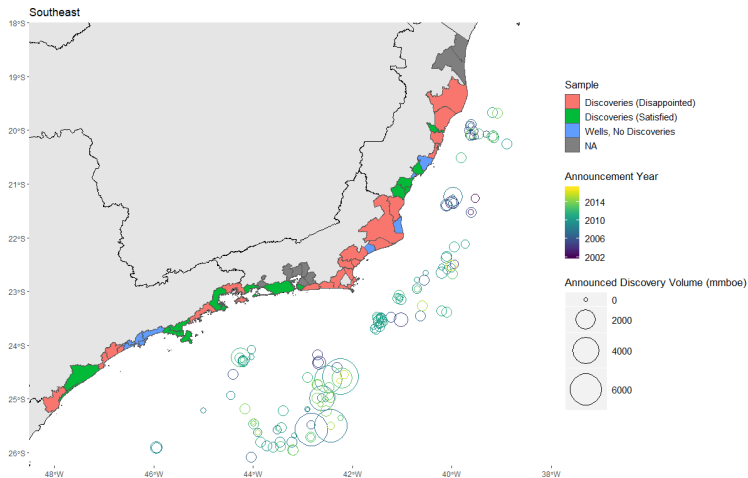
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Mapping Discovery Realizations (Example: Southeast Brazil) | 7



| 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 |

- ▶ 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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- ▶ Estimate separately for disappointed and satisfied municipalities, each relative to **never-treated control municipalities**

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- ▶ Controls:
 - 1 municipalities that got wells but no discoveries (as-if-random)
 - 2 matched municipalities (coarsened exact matching)

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- ▶ Estimate separately for disappointed and satisfied municipalities, each relative to **never-treated control municipalities**
- ▶ Controls:
 - 1 municipalities that got wells but no discoveries (as-if-random)
 - 2 matched municipalities (coarsened exact matching)
- ▶ Implement Callaway and Sant'Anna (2020) staggered event study estimator as robustness check

- ▶ **Discoveries and disappointment were exogenous to municipal conditions**
 - > Offshore discoveries and outcomes are determined by geology, technology, and international prices
 - > Conditional on geographic covariates, discoveries and disappointment cannot be predicted by baseline characteristics or political alignment:
 - ▶ Results of Conditional Random Assignment Tests

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- > Offshore discoveries and outcomes are determined by geology, technology, and international prices
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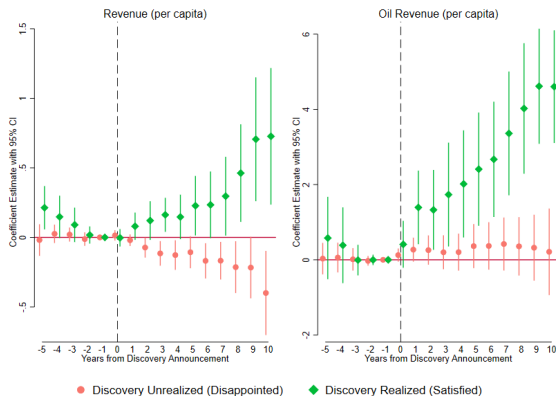
► Results of Conditional Random Assignment Tests

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

- > Verify pre-trends in event studies
- > Examine pre-trends directly: ► Pre-Trends

Results: Municipal Revenues after Oil Discoveries

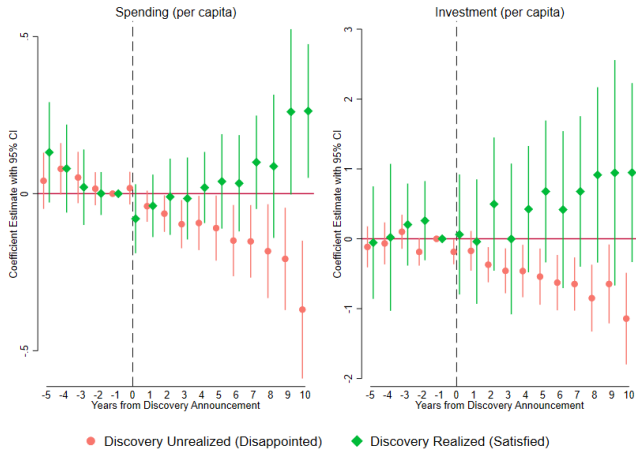
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Outcomes use inverse hyperbolic sine transformation. Standard errors are clustered at the municipality level. [▶ Breakdown of Transfers](#) [▶ Interpreting Coefficients](#)

Results: Municipal Spending

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► Interpreting Coefficients

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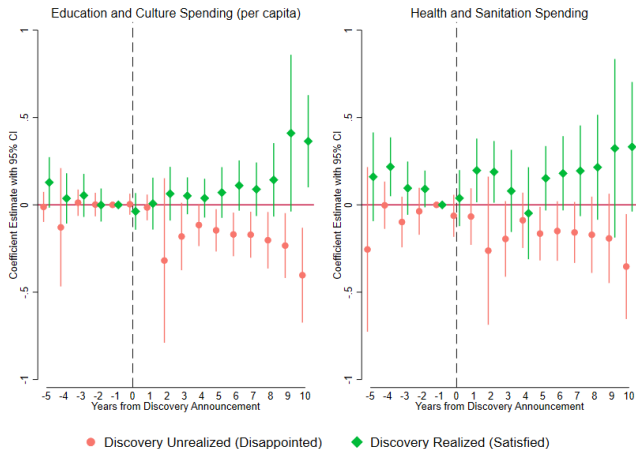
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Results: Public Goods Spending

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► Interpreting Coefficients

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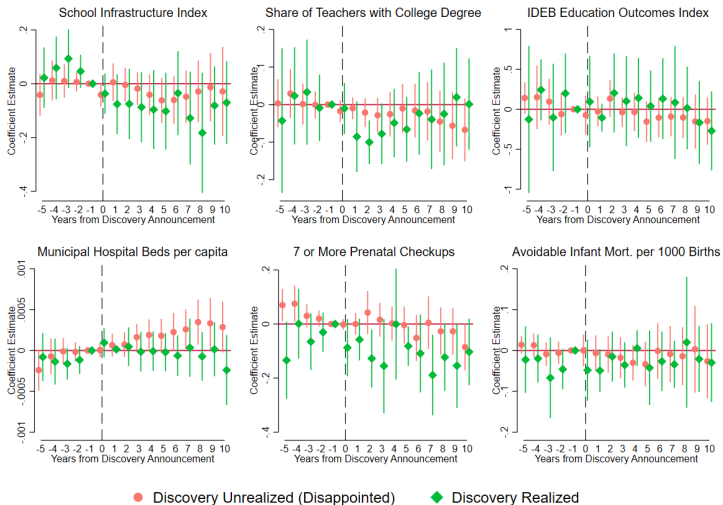
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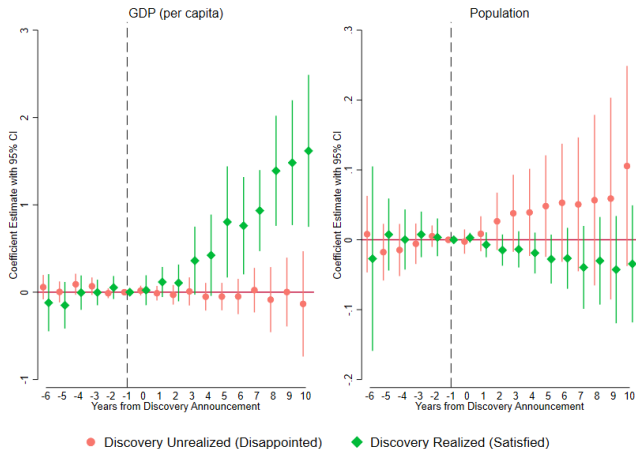
Results: Public Goods Provision and Quality

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Results: Municipal GDP and Population

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► Results: In-Migration up to 2010

► Results: Firm Entry

► Interpreting Coefficients

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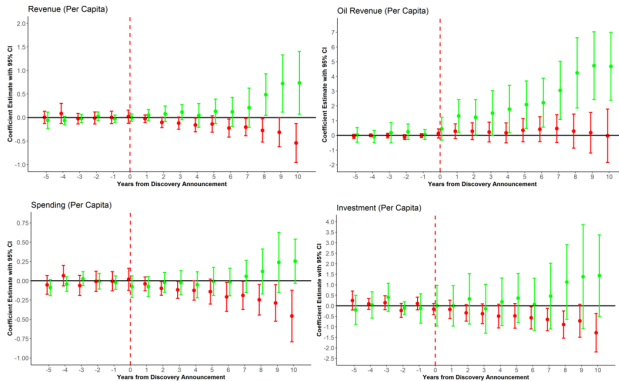
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Results are Robust to Callaway and Sant'Anna did Estimator | 16



Robustness checks:

- ▶ Alternative forecasting parameters and pre-matching on baseline characteristics
- ▶ Event study specifications with multiple events

- ▶ Municipalities did not react immediately to discovery announcements, possibly because of a balanced budget law and limited capacity to borrow
- ▶ Disappointment was widespread (30/48 discovery-treated municipalities)
- ▶ Satisfied municipalities: revenue \uparrow 128%, public goods spending p.c. \uparrow 48% 10 yrs. after discovery announcement; public goods provision unchanged
- ▶ Disappointed municipalities: revenue \downarrow 15%, investment p.c. \downarrow 68%, public goods spending p.c. \downarrow 27% 10 yrs. after discovery announcement
- ▶ Negative effects on disappointed places may be result of in-migration (reducing per capita outcomes) and reductions in state and federal transfers

▶ Breakdown of Transfers

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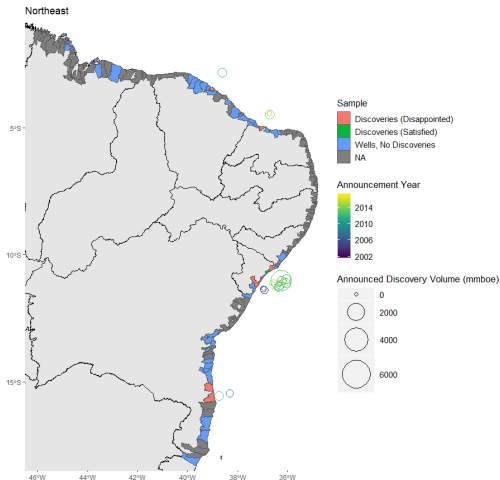
▶ Breakdown of Transfers

Contribution of approach:

- ▶ Quantifying "disappointment" (negative forecast error) reveals a source of heterogeneity in discovery effects that is highly relevant, given how commonly major resource discoveries fail to pan out

Mapping Discovery Realizations (Northeast Brazil)

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Regress characteristic Y_m 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

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

| | 1(<i>Wells</i> = 1) | 1(<i>Discovery</i> = 1) | 1(<i>Satisfied</i> = 1) |
|-------------------------------------|-------------------------------------|------------------------------|------------------------------------|
| Outcome | p-value | p-value | p-value |
| <i>Population</i> | 0.000 (0.011) | 0.661 (0.994) | 0.206 (0.804) |
| <i>GDP</i> | 0.000 (0.001) | 0.902 (0.995) | 0.235 (0.804) |
| <i>Municipal Develop. Index</i> | 0.005 (0.132) | 0.163 (0.684) | 0.183 (0.804) |
| <i>Urban Share of Population</i> | 0.000 (0.011) | 0.600 (0.993) | 0.123 (0.725) |
| <i>Income per capita</i> | 0.000 (0.008) | 0.673 (0.994) | 0.404 (0.804) |
| <i>Income Gini Coefficient</i> | 0.008 (0.132) | 0.017 (0.119) | 0.192 (0.804) |
| <i>% Employed in Extractive</i> | 0.003 (0.132) | 0.802 (0.995) | 0.226 (0.804) |
| <i>% Formally Employed</i> | 0.922 (0.945) | 0.496 (0.988) | 0.450 (0.804) |
| <i>% Homes w. Water & Sewer</i> | 0.752 (0.945) | 0.823 (0.995) | 0.958 (0.961) |
| Sample | Municipalities in Coastal States | Municipalities with Wells | Municipalities with Discoveries |
| Observations | 3961 | 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.

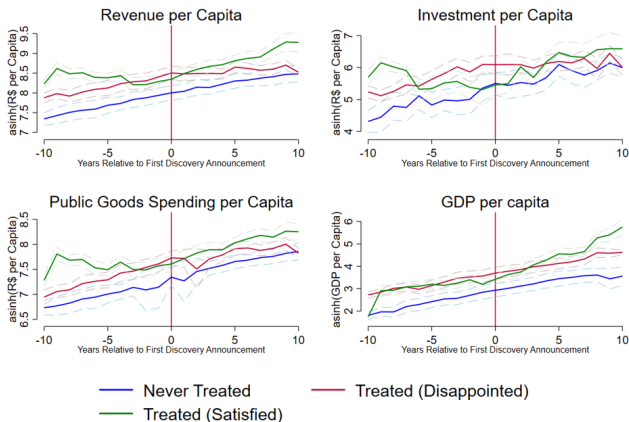
| | 1(<i>Wells</i> = 1) | 1(<i>Discovery</i> = 1) | 1(<i>Satisfied</i> = 1) |
|--|----------------------------------|---------------------------|---------------------------------|
| Outcome | p-value | p-value | p-value |
| <i>Cumulative Party Alignment w. Governor</i> | 0.426 (0.688) | 0.604 (0.879) | 0.926 (0.937) |
| <i>Cumulative Party Alignment w. President</i> | 0.545 (0.688) | 0.680 (0.879) | 0.160 (0.521) |
| <i>State Capital Dummy</i> | 0.019 (0.327) | 0.745 (0.879) | 0.198 (0.521) |
| <i>Contemp. Party Alignment w. Governor</i> | 0.822 | 0.387 | NA |
| <i>Contemp. Party Alignment w. President</i> | 0.052 | 0.550 | NA |
| <i>State Capital Dummy</i> | 0.000 | 0.973 | NA |
| Sample | Municipalities in Coastal States | Municipalities with Wells | Municipalities with Discoveries |
| Observations | 3961 | 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

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Municipalities with Offshore Wells



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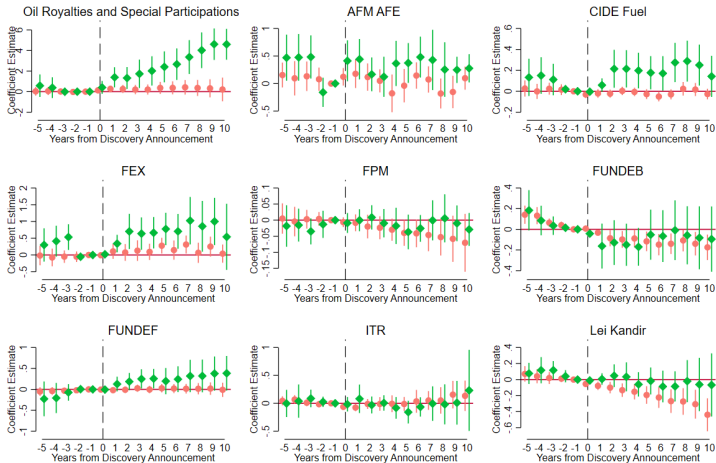
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Results: State and Federal Transfers

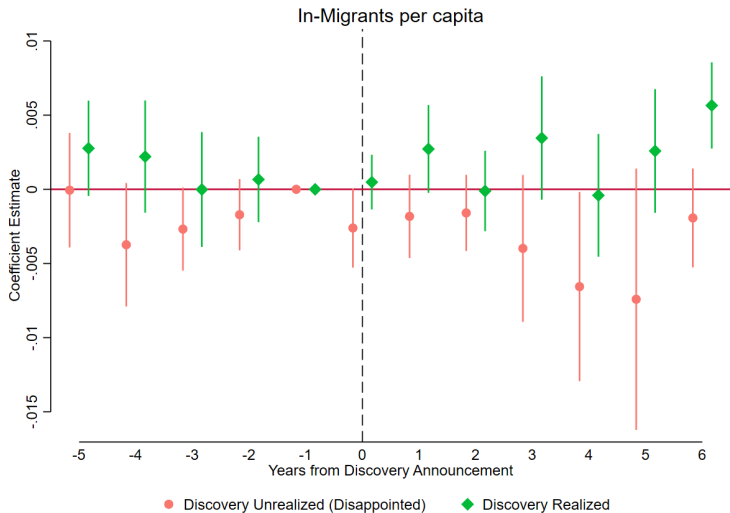
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● Discovery Unrealized (Disappointed) ◆ Discovery Realized

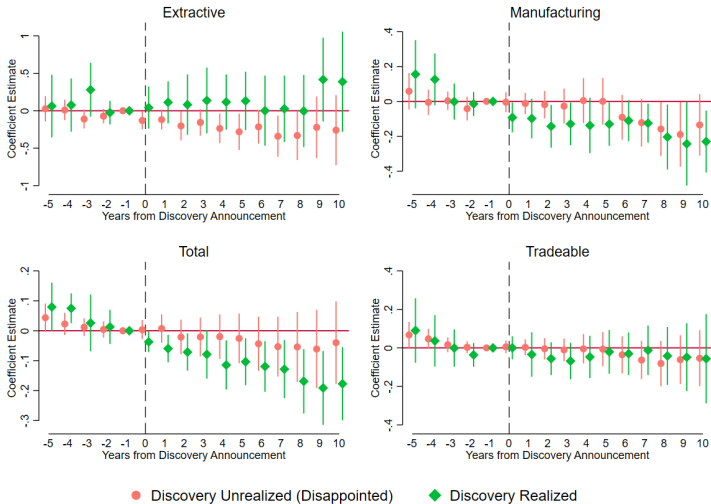
Results: In-Migration (up to 2010)

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Results: Number of Firms

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Oil revenues are controlled by mayors and council members. **Do discovery announcements increase competition for local office?**

- ▶ Municipality m was treated ($T_{me} = 1$) in prior 4-year period e if it experienced a discovery during that period
- ▶ y_{mpe} includes measures of electoral competition: competitive candidates, win margins, donations, candidate quality

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

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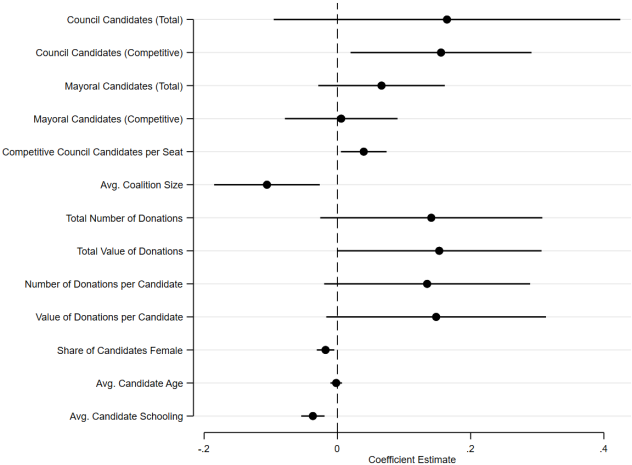
$$y_{me} = \delta_m + \lambda_p e + \beta_1 T_{me} + \epsilon_{me}$$

Do voters punish candidates for exogenous discovery disappointment? Estimate likelihood of reelection for incumbent i :

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

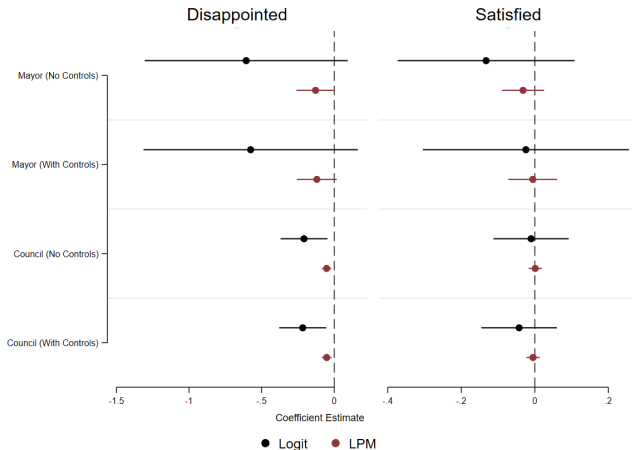
Results: Discovery Effects on Electoral Competition

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



Results: Effects of Disappointment on Incumbent Reelection | 28

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



Coefficients and Elasticities (Disappointed)

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| Outcomes | Sample Properties | | | Coefficients | | | Small-n Bias Correct. Elast. | | |
|--------------------------------|-------------------|--------|-------|-----------------|-----------------|-----------------|------------------------------|-------------------|------------------|
| | Sample Mean | n= | Units | 1 Yr | 5 Yrs | 10 Yrs | 1 Yr | 5 Yrs | 10 Yrs |
| <i>Total Rev. (Millions)</i> | 62 | 14,248 | 863 | 0.05 (0.03) | 0.05 (0.05) | -0.15 (0.08) | 3.12 (3.14) | 3.11 (5.30) | -14.99 (6.89) |
| <i>Oil Revenue p.c.</i> | 49 | 14,666 | 863 | 0.26 (0.18) | 0.47 (0.31) | 0.08 (0.54) | 19.33 (20.97) | 47.23 (46.09) | -0.56 (54.05) |
| <i>Total Non-Oil Rev.</i> | 1,439 | 14,228 | 863 | 0.05 (0.05) | 0.07 (0.06) | -0.01 (0.05) | 2.33 (4.86) | 4.95 (6.62) | -3.76 (5.18) |
| <i>Non-Oil Revenue p.c.</i> | 1,440 | 14,228 | 863 | 0.00 (0.02) | -0.06 (0.05) | -0.23 (0.07) | -1.59 (2.31) | -7.04 (4.45) | -21.25 (5.78) |
| <i>Investment p.c.</i> | 143 | 14,378 | 862 | -0.22 (0.16) | -0.52 (0.21) | -1.06 (0.29) | -26.19 (11.64) | -45.17 (11.69) | -68.12 (9.09) |
| <i>Education Spending p.c.</i> | 424 | 14,188 | 863 | -0.02 (0.03) | -0.12 (0.06) | -0.29 (0.12) | -3.24 (3.34) | -12.71 (5.53) | -26.56 (9.10) |
| <i>Health Spending p.c.</i> | 320 | 14,188 | 863 | -0.13 (0.08) | -0.20 (0.07) | -0.39 (0.11) | -15.36 (7.03) | -21.82 (5.80) | -35.05 (7.18) |
| <i>Population</i> | 43,759 | 14,666 | 863 | 0.02 (0.01) | 0.09 (0.04) | 0.19 (0.08) | 2.01 (0.82) | 9.31 (4.34) | 20.12 (9.38) |
| <i>No. Mfg. Firms</i> | 63 | 14,688 | 864 | 0.04 (0.04) | 0.17 (0.06) | 0.22 (0.09) | 2.19 (3.99) | 15.89 (6.78) | 22.16 (10.67) |

Sample includes disappointed municipalities (received less than 40% of revenues expected from discovery by 2017) and matched controls. Regressions include municipality and year FEs; standard errors are clustered at municipality level. Continuous outcome variables use inverse hyperbolic sine transformation. Control municipalities are constructed through coarsened exact matching on year 2000 levels of municipal GDP, population, distance from state capital, latitude, and Municipal Development Index (FIRJAN). 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):

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

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Coefficients and Elasticities (Satisfied)

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| Outcomes | Sample Properties | | | Coefficients | | | Small-n Bias Correct. Elast. | | |
|-------------------------|-------------------|-------|-----------|-----------------|----------------|----------------|------------------------------|--------------------|----------------------|
| | Sample Mean | n= | No. Units | 1 Yr | 5 Yrs | 10 Yrs | 1 Yr | 5 Yrs | 10 Yrs |
| Total Rev. (Millions) | 151 | 8535 | 517 | 0.09 (0.04) | 0.25 (0.08) | 0.85 (0.21) | 6.71 (4.76) | 25.48 (10.59) | 128.82 (48.61) |
| Oil Revenue p.c. | 69 | 8,773 | 517 | 1.03 (0.45) | 1.77 (0.70) | 3.86 (0.67) | 123.14 (100.27) | 367.14 (328.40) | 3698.26 (2537.78) |
| Total Non-Oil Rev. | 1,754 | 8,503 | 517 | 0.03 (0.03) | 0.13 (0.05) | 0.34 (0.14) | 2.10 (2.87) | 11.86 (6.01) | 38.56 (18.84) |
| Non-Oil Revenue p.c. | 1,754 | 8,503 | 517 | 0.02 (0.02) | 0.08 (0.06) | 0.27 (0.13) | 0.49 (2.42) | 6.85 (6.21) | 29.84 (17.36) |
| Investment p.c. | 203 | 8,568 | 517 | -0.01 (0.37) | 0.44 (0.43) | 1.05 (0.54) | -17.92 (30.42) | 28.83 (55.51) | 138.30 (129.57) |
| Education Spending p.c. | 507 | 8,483 | 517 | -0.01 (0.05) | 0.11 (0.06) | 0.42 (0.10) | -3.95 (5.18) | 8.12 (5.95) | 48.39 (14.72) |
| Health Spending p.c. | 384 | 8,483 | 517 | 0.12 (0.08) | 0.14 (0.09) | 0.32 (0.14) | 8.38 (8.88) | 10.55 (9.82) | 32.78 (18.03) |
| Population | 75,022 | 8,773 | 517 | 0.02 (0.01) | 0.04 (0.02) | 0.07 (0.04) | 1.16 (1.17) | 3.78 (2.40) | 6.15 (4.73) |
| No. Mfg. Firms | 136 | 8,805 | 518 | 0.04 (0.06) | 0.13 (0.07) | 0.26 (0.10) | 0.82 (6.44) | 10.47 (7.62) | 25.08 (12.46) |

Sample includes satisfied municipalities (received more than 40% of revenues expected from discovery by 2017) and matched controls. Regressions include municipality and year FEs; standard errors are clustered at municipality level. Continuous outcome variables use inverse hyperbolic sine transformation. Control municipalities are constructed through coarsened exact matching on year 2000 levels of municipal GDP, population, distance from state capital, latitude, and Municipal Development Index (FIRJAN). 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):

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

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