Winning and Losing the Resource Lottery: Governance after Uncertain Oil Discoveries*

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Abstract

Natural resource discoveries are often followed by delays and uncertain production outcomes, creating challenges for governments that anticipate resource revenues. I leverage exogenous subnational variation in offshore oil discoveries in Brazil to identify dynamic effects of discovery news and revenue shocks on local public finances, public goods provision, and politics. Municipalities where discoveries are realized enjoy significant growth in revenues and spending, but fail to improve public goods provision or stimulate economic activity. Municipalities that experience discovery announcements but never receive windfalls suffer long-term declines in revenues, investment, and public goods provision relative to never-treated controls. I show that electoral responses underlie these dynamics: discovery announcements draw less-educated candidates into local politics, and shortfalls between anticipated and realized oil revenues increase political turnover. Findings highlight discovery uncertainty as a fundamental resource governance challenge, and reveal mismanagement of windfalls and adjustment costs after disappointment as two faces of the Resource Curse.

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1 Introduction

Forty-six countries have experienced oil or gas discoveries of more than 500 million barrels of oil equivalent since 1988 (Cust and Mihalyi, 2017). Resource discoveries create shocks to expected wealth and can alter macroeconomic outcomes including savings, investment, and employment (Arezki et al., 2017). Nevertheless, discoveries are notoriously noisy signals. They are often followed by delays and unpredictable production outcomes, and are likely to become increasingly uncertain in coming decades.[1]

Heterogeneity in discovery realizations can cause some affected countries or regions to receive vast revenue windfalls, while others receive nothing. In places with successful discoveries, natural resource extraction and revenues create opportunities for economic development (Berry et al., 2022; Toews and Vézina, 2020), but also bring challenges associated with the Resource Curse (Venables, 2016). Independent of extraction or revenues, anticipation after discovery announcements can provoke rent-seeking and corruption (Vicente, 2010). Places where discoveries fail to produce must grapple with disappointed expectations leading to revenue shortfalls and public finance dysfunction (Mihalyi and Scurfield, 2020).

Development consequences of discovery shocks are mediated by the responses of leaders and citizens (Armand et al., 2020). While governance is a fundamental determinant of economic development, isolating its impact is difficult as it is typically endogenous to the development process (Baland et al., 2010). In this paper, I leverage major offshore oil and natural gas discoveries in Brazil – which affect local economies *indirectly* through a municipal governance channel – to measure the effects of news and revenue shocks on local public finances and public goods provision, political competition, selection, and patronage, and formal economic activity.

[1]Since 1950, oil discoveries have taken an average of seven years to begin production, with a standard deviation of nine years (Mihalyi, 2020). As exploration moves into deeper waters and more remote locations, production delays are likely to grow, increasing the scope for anticipation and uncertainty (Geiger, 2019). Pressures to leave fossil fuels in the ground to combat climate change increase the likelihood that discoveries remain undeveloped in the future (McGlade and Ekins, 2015; Welsby et al., 2021).

Methodologically, I exploit quasi-experimental variation created by the interaction of (i) exogenous offshore oil and natural gas discoveries and subsequent revenue realizations, with (ii) Brazil's formulaic oil and gas revenue sharing rules.[2] Based on geographical alignment between coastal municipalities and offshore fields, these rules allow municipal governments to predict whether they will be future beneficiaries of announced discoveries – thus introducing subnational variation amongst comparable local governments.

I identify dynamic causal effects of discovery announcements and subsequent revenue realizations by comparing municipalities affected by discovery announcements with never-treated municipalities where exploratory offshore wells were drilled after 1999 but no discoveries occurred, under the assumption that, conditional on drilling, the success of a well is as-if-random (Cavalcanti et al., 2019; Cust et al., 2019). To quantify heterogeneity in discovery realizations, I develop a forecasting model based on standard offshore production assumptions, announced reserve volumes, and Brazil's royalty distribution rules. Comparing forecast and realized revenues in each discovery-treated municipality reveals that some places eventually enjoy revenue windfalls in line with expectations, while others are disappointed. I leverage this exogenous variation in forecast error to categorize municipalities into two treatment arms: "satisfied" and "disappointed". Using a rich panel dataset, I estimate event study specifications around the first major discovery announcement separately for each of these groups relative to never-treated controls. I implement Callaway and Sant'Anna (2021)'s group-time average treatment effect estimator to address biases introduced by staggered treatment timing and heterogeneous treatment effects.

Forty-eight Brazilian municipalities were affected by offshore discovery announce-

[2]Offshore discoveries are exogenous to municipalities, as they are made by multinational corporations operating hundreds of kilometers offshore, servicing installations from distant ports, and responding to international prices and technologies. Post-discovery production outcomes are also driven by extra-municipal factors: a fall in global prices can make a promising field commercially unviable; reserves can turn out smaller or more difficult to extract than initially estimated. Companies may also leave discoveries undeveloped due to internal policy changes, financial difficulties, or shifts in strategy.

ments between 2000-2017. Of these, only 18 receive 50% or more of the revenues they could have expected by 2017 based on the forecasting model, suggesting disappointment was widespread, but not universal. Municipalities do not exhibit anticipatory fiscal responses to discovery announcements, possibly due to constraints imposed by a fiscal responsibility law that limits their ability to engage in deficit spending.

As production ramps up five to ten years after a discovery announcement, municipalities' type emerges (i.e., "disappointed" or "satisfied") and outcomes for the two groups diverge sharply. In places where discovery expectations are realized, per capita total revenues increase by 88% ten years after the first discovery relative to counterfactual municipalities that had exploratory wells but no major discoveries during this period. Per capita oil revenues increase by a striking 6,872% (from a pre-treatment mean of R$30 to R$2,061 ten years on, or from 1% to 42% of pre-treatment average annual income), highlighting the radical effects discoveries can exert on public finances. Per capita spending in satisfied municipalities increases by 25%; per capita spending on education and health increase by 37% and 42%, respectively.

Despite dramatic changes in revenues and spending in satisfied municipalities, measures of real public goods provision decline significantly relative to controls in the decade following a major announcement – corroborating Caselli and Michaels (2013), who find that oil revenues increase public goods spending, but not real public goods provision, in Brazilian municipalities. This may be the result of limited capacity to spend oil windfalls effectively, leakage of oil rents into corruption, or lags in improving difficult-to-change education and health outcomes. Further highlighting the disconnect between resource windfalls and real development outcomes in satisfied places, municipal GDP per capita (which includes royalties mechanically) increases by 289% ten years on from a discovery, yet formal employment, firm registrations, and average formal earnings remain unaffected or decline.

In "disappointed" municipalities (i.e., those that experience discovery announcements but never receive expected windfalls), oil revenues remain unchanged ten years after a major discovery, yet per capita total revenues decline by 45% relative to never-treated controls, largely as a result of falling tax revenues (-34%) and other transfers from federal and state governments (-16%). Per capita spending declines 39%, per capita investment by 76%, and per capita education and health spending by 40% and 30%, respectively. Indicators of real public goods provision decline significantly.

To explore mechanisms underlying negative outcomes in discovery-affected places, I measure effects of discovery announcements on the behavior of politicians and voters. Using difference-in-differences specifications, I show that discovery announcements prior to a municipal election have varied effects on political competition (increasing the number of council candidates while decreasing the number of mayoral candidates) and increase the value and number of campaign donations. Discoveries decrease schooling levels of both candidates and winners, which may erode governing capacity and is indicative of rent-seeking (Melo and Tigre, 2022; Brollo et al., 2013). Furthermore, I find incumbent politicians are significantly less likely to be reelected when a municipality's oil revenues are below anticipated levels at the time of an election. Increased political turnover in disappointed places may disrupt public service delivery and capacity to adapt to shortfalls (Akhtari et al., 2022; Toral, 2021).

I contribute causal, subnational evidence of short and long-term impacts of resource discoveries and subsequent revenue realizations on governance. A growing literature on the "Presource Curse" has documented long delays, fiscal problems, arms purchases, and corruption after major oil and natural gas discoveries in Africa (Mihalyi and Scurfield, 2020; Vezina, 2020; Cust and Mihalyi, 2017; Wright et al., 2016; Vicente, 2010). I explore these dynamics in a novel context that presents institutional contrasts to earlier research. I extend previous findings, which have faced cross-country data limitations, by constructing uniquely detailed municipality-level panel datasets measuring a wide range of governance outcomes. More broadly, I contribute to literature on the Resource Curse, which has increasingly moved from studies at the cross-country level (Alexeev and Conrad, 2009; Mehlum et al., 2006) to the subnational level (Cust and Poelhekke, 2015). By taking the timing and heterogeneity of discoveries and production into account, I add nuance to existing evidence on the effects of resource revenues on local public finances (Ardanaz and Tolsa Caballero, 2016; James, 2015).

My findings add to research on the economic and political effects of Brazil's royalty transfers (Postali, 2015; Monteiro and Ferraz, 2014), and more broadly to the rich literature on local electoral accountability and candidate selection (Brollo et al., 2013; Ferraz and Finan, 2011). Baragwanath (2020) finds that oil royalties increase corruption and entry of more corrupt candidates, lending supporting evidence that discovery announcements attract rent-seekers to office. Cavalcanti et al. (2019) compare economic outcomes in Brazilian municipalities where successful versus unsuccessful wells were drilled between 1940-2000. They find *onshore* discoveries had positive economic effects due to direct linkages, but no detectable effects from *offshore* discoveries. I complement this study by exploring a key determinant of economic development – local governance – and by focusing on effects of major offshore discoveries announced *since* 2000, which were much larger than pre-2000 discoveries. A key contribution I make is identification of dynamic governance effects and political responses to different types of revenue realization after discovery shocks.

Finally, I make a methodological contribution to the analysis of discoveries and the Resource Curse by quantifying heterogeneity in discovery realizations using a forecasting model. Average effects on discovery-affected places may hide sharp divergence between places where revenues are realized and places where discoveries never produce. Failure to account for this heterogeneity could lead studies of resource revenues to mistakenly identify disappointed places as controls, despite news shocks felt by this group. Studies of discovery impacts may arrive at biased estimates if they do not account for divergence between disappointed and satisfied places. My documentation of discovery uncertainty as a central resource governance challenge yields policy insights for the design of resource revenue sharing rules, regulation of discovery announcements, and post-discovery governance.

2 Context: Oil and Local Governance in Brazil

Brazil experienced major offshore oil and gas discoveries during the 2000s and 2010s. The largest occurred in the ultra-deepwater Pre-Salt layer of the Santos and Campos sedimentary basins off the coast of São Paulo, Rio de Janeiro, and Espírito Santo, though large discoveries were made off the coasts of Sergipe, Rio Grande do Norte, and Ceará as well. Pre-Salt discoveries included the announcement in 2007 of the 5-8 billion barrel Tupi field (production name Lula) and the announcement in 2010 of the 4.5 billion barrel Franco field (production name Búzios) and 7.9 billion barrel Mero field (production name Libra). In total, 179 major discoveries averaging 429 million barrels each were announced between 2000 and 2017.

Contemporaneously with the Pre-Salt discoveries, a period of high world oil prices increased the expected value of the finds and provoked a wave of optimism.[3] In 2009, Brazil's president at the time, Luiz Inácio Lula da Silva, said that "the Pre-Salt is a gift from God, a passport to the future; it's a winning lottery ticket, but could become a curse if we don't invest the money well (Batista, 2008)." Lula's then chief of staff and later president Dilma Rouseff remarked that "there will be money left over [from the Pre-Salt] for pensions, for improving the living conditions of the population, for investment, for everything (Batista, 2008)." Despite this optimism, the crash in world oil prices and the outbreak of a corruption scandal centered on Petrobras (Brazil's national oil company) in 2014 combined to slow Pre-Salt developments.

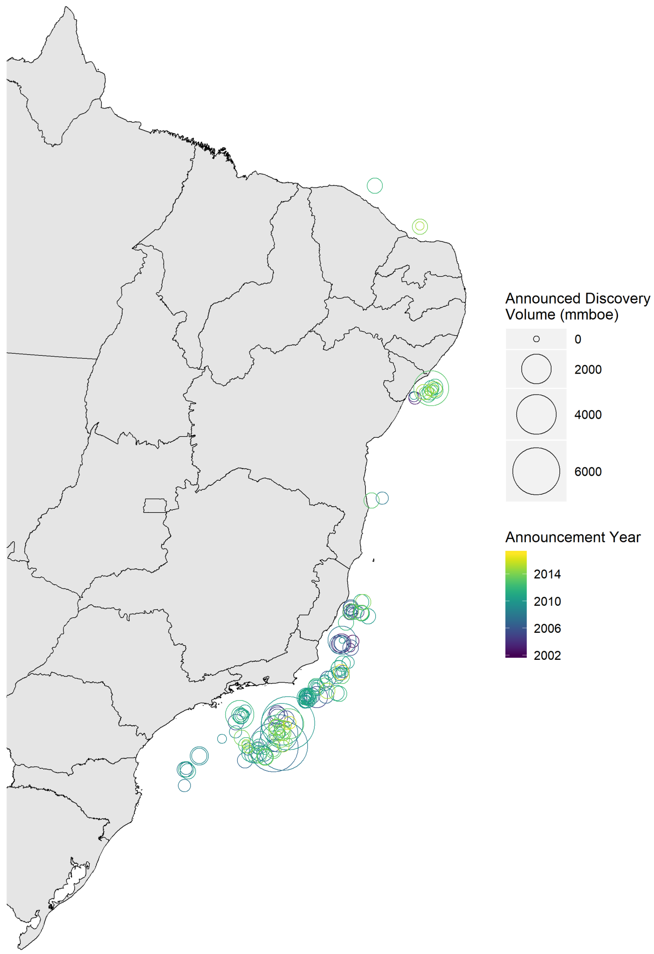
[3] Pre-Salt discoveries became a major topic in Brazilian news media, with stories on the topic in Rio de Janeiro's *O Globo* newspaper increasing from just 9 in 2005 to 981 in 2009, before declining to 178 by 2017 (see Appendix A1).

2.1 Discovery Announcements

Oil companies announced major discoveries in "communications to the market" filed with the *Comissão de Valores Mobiliários* (CVM), Brazil's Securities and Exchange Commission. I compile all communications pertaining to new and confirmatory oil discoveries in Brazil between 2000 and 2017 (see Appendix B1 for additional information on companies and discovery announcements). Declarations typically specify the well, block, and field where the discovery occurred, and often include the estimated volume of discovery reserves. CVM discovery announcements appear promptly in news coverage, transmitting discovery information to the broader population.[4] Figure 1 maps all major offshore discoveries announced between 2000 and 2017.

[4] In Appendix A2, I present a CVM discovery announcement and an associated news report published the same day. I identify contemporaneous news coverage of nearly every CVM announcement during this period (available upon request).

Figure 1: Major Offshore Oil or Gas Discovery Announcements (2000-2017)



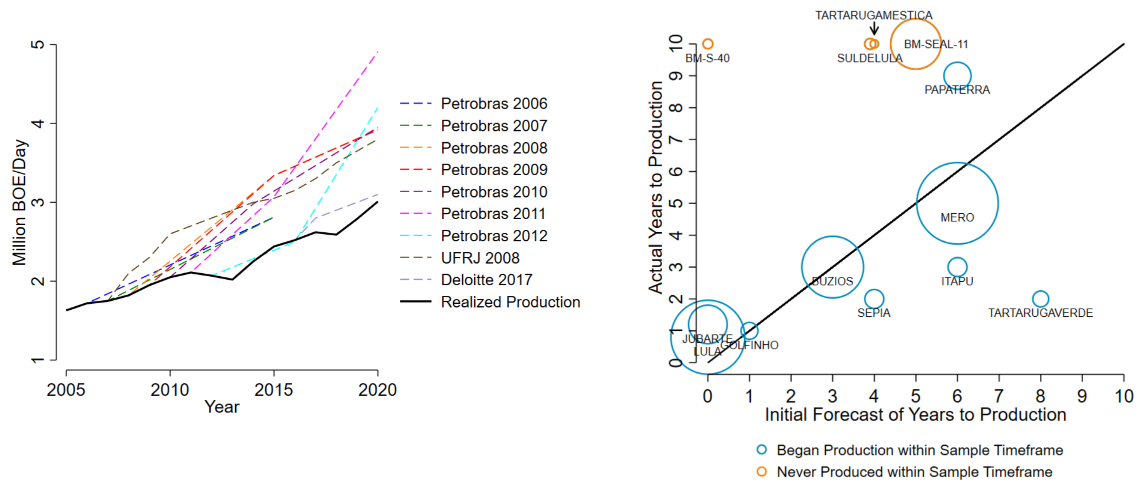
Note: Announced discoveries are compiled from declarations made by oil companies to Brazil's *Comissão de Valores Mobiliários* between 2000 and 2017.

The initial optimism provoked by Brazil's Pre-Salt oil and gas discoveries is reflected in contemporaneous production forecasts. Figure 2a plots country-level forecasts from a variety of sources against realized production between 2005 and 2020. Evidently, projections were systematically over-optimistic during this period, suggesting forecasters did not account for factors that subsequently slowed production. Figure 2b plots the relationship between forecast and realized years-to-production for each instance in which a CVM discovery announcement offered a prediction of field-level start dates. As shown in the figure, field-level production delays were heterogeneous:

while many fields (including major fields such as Tupi/Lula and Mero/Libra) began production on or ahead of schedule, others never produced.[5]

Figure 2: Production Forecasts and Realized Production Outcomes

(a) Country-Level Production (b) Field-Level Years-to-Production



Note: Country-level forecasts are drawn from Petrobras Annual Reports, de Oliveira (2008), and England (2017). Field-level years-to-production forecasts are drawn from CVM announcements. Years-to-production forecasts are only available for a sub-sample of major discovery fields. The 45-degree lines represents perfect alignment between forecast and realized years to first commercial production. Fields lying above this line took longer than forecast to produce, while fields lying below it produced more quickly. Size of each field's circle corresponds with announced discovery volume.

2.2 Royalty Distribution

In 1985-1986, Laws 7.453/85 and 7.525/86 established royalty requirements for Brazilian offshore oil production and created a system of orthogonal and parallel geodesic projections of coastal municipal boundaries to determine royalty distribution to coastal municipalities (Piquet and Serra, 2007). Distribution is determined by a formula that takes into account geographical alignment with offshore oil and natural gas fields, population, the presence of oil and gas infrastructure within municipal boundaries, spe-

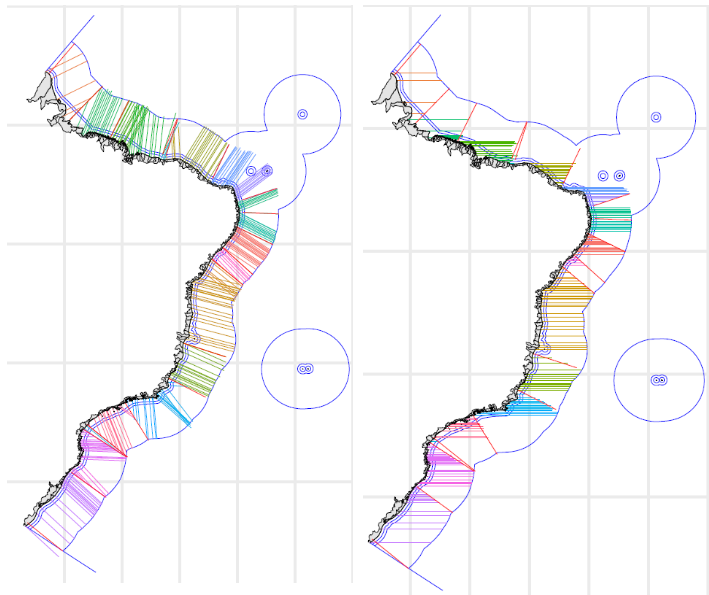
[5]In line with Brazil's experience, Mihalyi and Scurfield (2020) document near-universal negative forecast errors (over-optimism) for country-level production after the announcement of major oil and gas discoveries in 12 African countries. Differently from Brazil, the authors document substantial field-level production delays for all but one major African discoveries.

cific tax rates applied to each field, and the current volume and value of production. Municipalities directly aligned with offshore fields are called "producer municipalities," and receive large shares of royalty revenues, as well as additional revenues from especially productive fields, called "special participations" (Gutman, 2007). I describe royalty distribution rules in more detail in Appendix D.2.

Brazil's use of geodesic boundary projections to determine offshore royalty allocation creates a quasi-experiment in which exogenous offshore discoveries and production outcomes are transparently tied to specific coastal municipalities for reasons outside of municipalities' control. Coastal municipalities are likely to have at least a basic understanding of the extent of their individual catchment zones, since these determine royalty receipts and thus significant fractions of their budget. To tie each major discovery announcement back to geographically aligned municipalities, I merge wells cited in discovery announcements with the ANP's comprehensive well database. I next reconstruct orthogonal and parallel projections of municipal coastal boundaries used by the ANP to determine municipal royalty distributions (Figure 3). Finally, I overlay wells in the ANP registry onto catchment zones created by the geodesic projections and link discovery wells back to their aligned municipality. I describe mapping procedures in greater detail in Appendix D1.

Figure 3: Geodesic Projections to Maritime Boundaries

(a) Orthogonal Projections (b) Parallel Projections



Note: Orthogonal and parallel projections of coastal municipal boundaries are drawn separately for each state, and cut off at state boundary-projections. Projections extend 200 nautical miles (370km.) to Brazil's maritime limit, designated by the solid blue line. Reconstruction of projections follows documentation provided in IBGE (2009).

2.3 Municipal Public Finances and Elections

Brazil has a federal governing system with significant authority devolved to the municipal level. Municipal governments receive the majority of their budgets from formulaic federal and state transfers. Municipalities also collect taxes that typically account for 5-25% of municipal budgets (Abrucio and Franzese, 2010). Using these funds, municipal governments are responsible for a large proportion of health, education, public safety, and infrastructure provision. For instance, the vast majority of schools and hospitals in Brazil are run by municipalities. Municipal governments therefore have significant responsibility and autonomy in administration and public goods provision.

There are, however, limitations on municipal fiscal autonomy. The primary constraint is a fiscal responsibility law introduced in 2000, which limits spending and debt for municipal governments. While limits do not bind for most municipalities, they restrain extreme fiscal behaviors and may temper municipal reactions to discoveries (Fioravante et al., 2006).

Municipal elections occur every four years in Brazil. Municipal elections elect mayors and council members (i.e., legislators), whose number is proportional to the population of the municipality. Voting is obligatory and mayors are eligible to serve two consecutive terms (Lavareda and Telles, 2016).

3 Discovery Uncertainty and Forecasting

Offshore oil and gas production is a fundamentally uncertain endeavor – especially in ultra-deep waters. Uncertainty is driven by geology, price fluctuations, and producers' private information.[6] Confirmatory wells drilled after a discovery can reveal that reserves are smaller, of lower quality, or more difficult to extract than initially expected. A reserve that was commercially viable at a world price of $80/barrel may no longer be viable at $40/barrel. Firms may exaggerate discovery potential or fail to develop reserves due to financial difficulties or shifts in strategy.[7]

3.1 Modeling Discovery Expectations

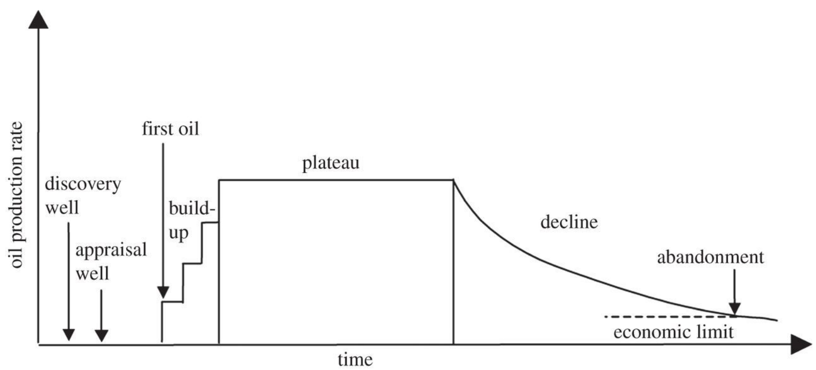
After a discovery well is drilled there is a buildup period of several years before peak production is reached. Figure 4 depicts a standard production trajectory for an

[6]Based on systematic review of all news stories in *O Globo* reporting on "oil discovery" or "Pre-Salt" between 2005-2018, contemporaneous Brazilian news coverage of discovery announcements *did* highlight risks associated with resource revenues (i.e., the "Resource Curse") (Buarque, 2013; Rodrigues, 2010; Paul, 2009), but did not emphasize discovery uncertainty prior to 2016, at which point unanticipated offshore production challenges, price volatility, and producer-specific shocks had become glaringly apparent. In this year, an advisor to the National Oil Agency noted that "after the euphoria of the Pre-Salt discoveries... Brazil is experiencing an oil curse without the oil (Ordoñez, 2016)." Absence of contemporaneous news coverage of discovery risk supports the forecasting model assumption that municipalities did not account for risk factors that ultimately led to disappointment.

[7]OGX, the second-largest Brazilian oil company during the Pre-Salt period, made many large and dramatic discovery announcements during the late 2000s and early 2010s, but later encountered financial difficulties and went bankrupt, leaving its fields undeveloped (Moreno, 2013). OGX's financial problems were unknown to municipalities at the time of discovery announcements, and they had no reason to suspect that the company's discoveries would have different revenue realizations than discoveries made by Petrobras.

offshore oil and gas field (Höök et al., 2014). I estimate this production curve for each discovery-affected municipality and feed values into the ANP's royalty distribution formula to calculate the municipality's expected revenue stream from a discovery.

Figure 4: Standard Offshore Oil Production Curve



Source: Höök et al. (2014)

For each discovery announcement d, let t_0 be discovery year, θ_{st} be average discovery-to-production delay in sedimentary basin s up to year t, and V_d be the announced volume of new reserves associated with discovery d. Let δV_d be the peak rate of production in oil equivalent units, where δ is a proportion of the total reserve volume extracted each year. In my preferred specification I use $\delta = 0.02$, which would result in approximately 46% of recoverable reserves extracted over 30 years, a conservative but plausible expectation (US Energy Administration, 2015). I calculate the expected production stream of d in year t for each municipality m that is aligned with d as:

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

I do not forecast production out to the exponential decline period since the longest post-discovery period observed in the data is 15 years. $E(Production_{mdt})$ varies according to the prevailing basin-level delay period up to the discovery year, allowing for geological variation in delays as well as municipal learning, wherein expectations of delays are updated based on neighbors' experiences. Appendix Figure A3 plots moving averages of basin-level production delays between discovery announcements and commercial production. Delays range from 1-2 years in the Espírito Santo basin, to 5 years in the Campos basin, to 7-9 years in the ultra-deep water Santos basin.

To compute expected royalty revenues from discovery d, I apply the ANP royalty formula (see ANP (2001) for a more detailed description), where P_{t0} is the Brent Crude oil price in the year of discovery announcement, X_{t0} is the BRL/USD exchange rate in this year, R_f is the tax rate applied to field f, and A_{mf} is the alignment share between municipality m and field f:

$$
\begin{aligned}
Royalties_{mdt} = & \underbrace{\left(\mathbb{1}(alignment_{md} = 1) \times E(Prod_{mdt}) \times (P_{t0} \times X_{t0}) \times 0.30 \times 0.05\right)}_{\text{First 5\% of Royalty Tax to Municipalities Aligned with Well}} + \\
& \underbrace{\left(E(Prod_{mdt}) \times (P_{t0} \times X_{t0}) \times 0.225 \times (R_f - 0.05) \times A_{mf}\right)}_{\text{Tax in Excess of 5\% to Municipalities Aligned with Field}}
\end{aligned}
\tag{2}
$$

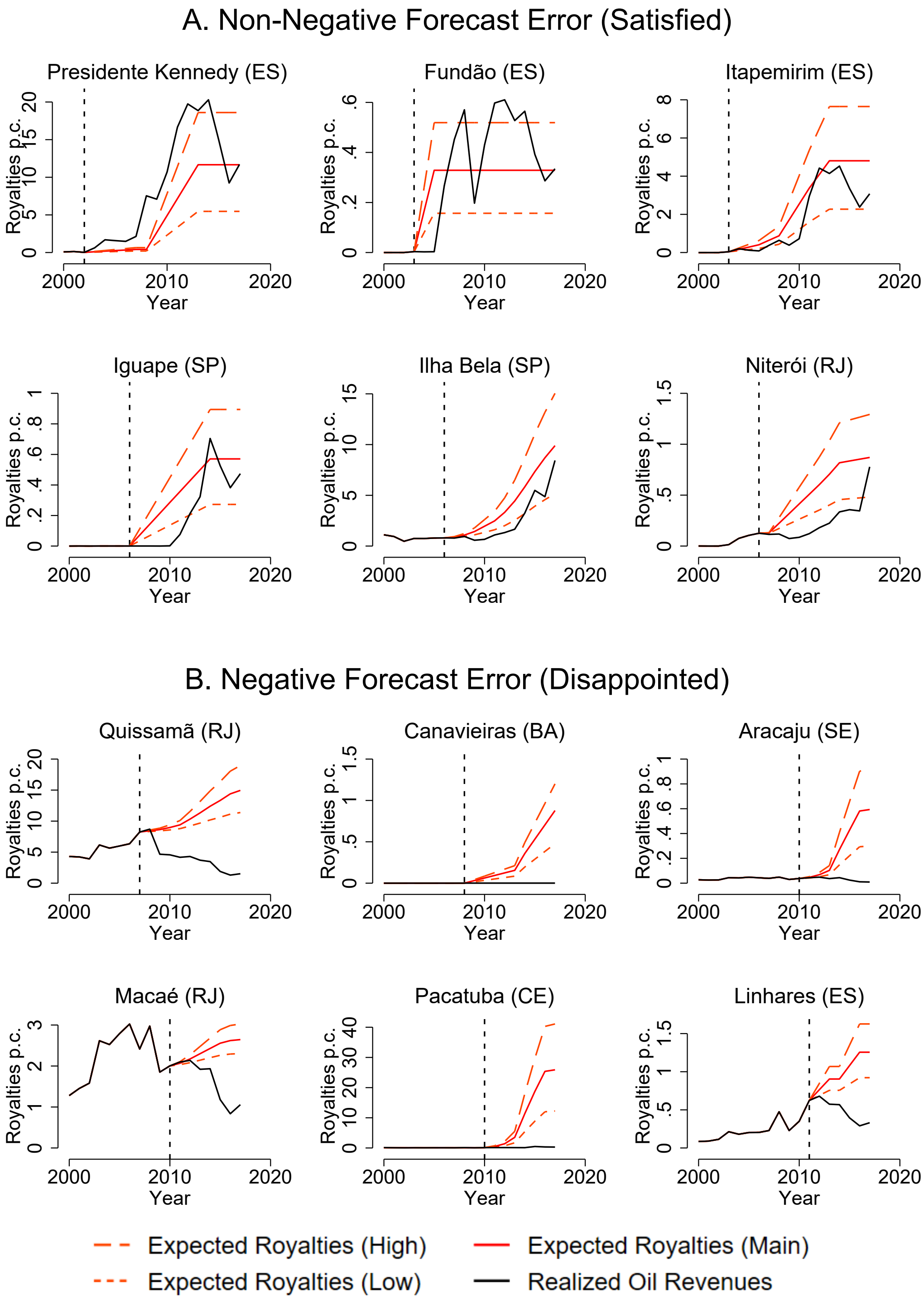
Finally, I compute a normalized measure of forecast error, which I refer to as $Disappointment_{mt}$, by taking the ratio of *realized* growth in per capita revenue between the year of the event and year t and *expected* revenue growth between the year of the event and year t. I explore heterogeneity across forecast error by classifying municipalities into two groups: (i) "Disappointed" municipalities are those where $Disappointment_{m,2017} \leq 0.4$, indicating that post-discovery realized oil revenues grew by less than 40% of what these places could have expected by 2017; (ii) "Satisfied" municipalities are those where $Disappointment_{m,2017} > 0.4$.[8]

Figure 5 shows examples of municipalities affected by discovery announcements.

[8] The 0.4 cutoff approximates the 50th percentile of the distribution of $Disappointment_{m,2017}$. In Appendix A4, I report kernel density plots of $Disappointment_{m,2017}$ for alternative forecasting specifications. In Section 5.1, I show that results are robust to variations in forecasting parameters.

Sub-figure 5a shows oil revenue forecasts and realizations for six municipalities that are classified as "satisfied." Sub-figure 5b shows selected municipalities that are classified as "disappointed" (i.e., they experience large negative forecast errors between expected and realized oil revenues). In Appendix B2, I report disappointed/satisfied classifications for all discovery-affected municipalities. Sub-figures illustrate the clear effects of both global oil price changes (e.g., the 2014 price crash) and discovery-driven production changes on municipal oil revenues.

Figure 5: Municipal Revenue Forecasts vs Realized Revenues (Examples)



Note: Dashed vertical lines indicate the year of the first discovery announcement affecting a municipality. Red lines represent forecasts of municipal oil revenues. Black lines represent realized oil revenues, drawn from Brazil's National Oil Agency (ANP). Y-axis plots municipal oil revenues per capita in thousands of constant 2010 BRL. Municipalities are organized in ascending order by discovery date.

4 Data

I draw on a wide array of administrative data sources to build an exceptionally rich municipality-year panel of governance outcomes between 2000-2017. Municipality-level outcomes include disaggregated public finances, federal and state transfers, public hiring and public goods provision, GDP and population, and formal employment, firm registrations, and earnings. I also construct an election-level panel spanning five municipal elections between 2000-2016 that includes demographic, vote, and donations data for candidates during this period. I detail data sources in Appendix Table D1. In Appendix Table B3, I present baseline descriptive statistics for treated subsamples ("Disappointed" and "Satisfied") and alternative control groups.

5 Empirical Strategy and Identification

I estimate dynamic effects of a discovery announcement on municipal public finances and other outcomes of interest using an event study framework (Sun and Abraham, 2021). This approach allows me to detect both rapid reactions to discovery announcements that occur in anticipation of future royalties, and longer-term trends driven by the gradual realization of discovery type. To accommodate staggered treatment timing and heterogeneous treatment effects, I implement Callaway and Sant'Anna (2021)'s (CS) group-time average treatment effect estimator.

For municipality m in year t, let E_m be the period when m is first treated by a discovery announcement.[9] Then let $K_{mt} = t - E_m$ be the number of years before or after the event. I regress municipality-level outcome Y_{mt} on $\mathbb{1}(K_{mt} = k)$ relative year indicators for the fully-saturated set of indicators going from the beginning to end of the sample. I control for municipality and year fixed effects, δ_m and λ_t, and cluster standard errors at the level of treatment (municipality):

[9] An assumption here is that municipalities are treated only once by a discovery announcement. In reality, some municipalities are treated multiple times. I estimate an event study specification with multiple events per unit as a robustness check in Appendix C12.

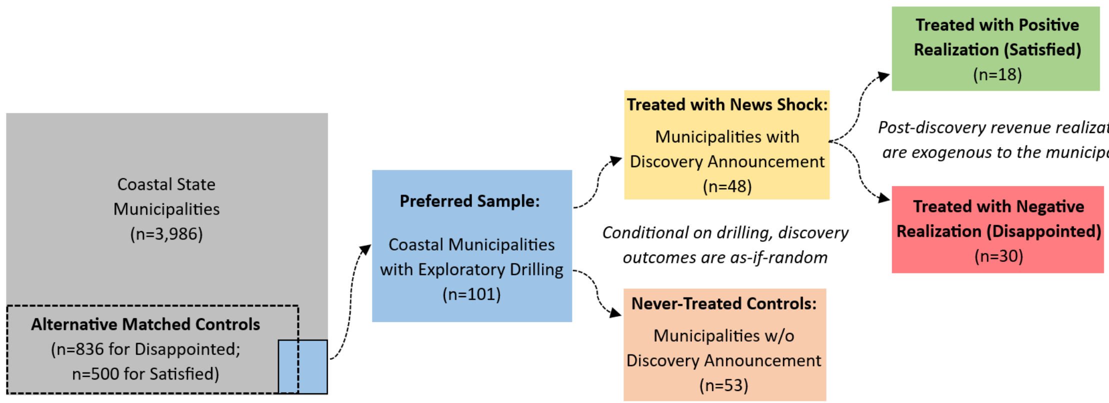
$$Y_{mt} = \delta_m + \lambda_t + \sum_{k \neq -1} [\mathbb{1}(K_{mt} = k)]\beta_k + \epsilon_{mt} \tag{3}$$

In this expression, β_k is the average treatment effect on the treated at length of exposure k from the first discovery announcement. In my preferred specification, I use municipalities that had exploratory offshore wells between 2000-2017 but never received a major discovery announcement as controls. The intuition underlying this choice of control group is that all municipalities that received exploratory offshore wells were comparably attractive in terms of oil prospects and exploratory conditions. Previous studies have argued that, conditional on drilling, discovery outcomes are as-if-random (Cavalcanti et al., 2019; Cust et al., 2019).

Since – conditional on the presence of exploratory offshore wells – discoveries and subsequent revenue realizations are as-if-random (see Section 5.2 below for further discussion of these points), I conceptualize Disappointed and Satisfied groups as two independent treatment arms whose type is known to the econometrician but only gradually revealed to municipalities as discovery outcomes are realized. I estimate Equation 3 separately for Disappointed and Satisfied municipalities relative to never-treated-controls.

Appendix Table B3 documents minor imbalances in select baseline covariates between sub-samples treated with discoveries and never-treated municipalities that experienced exploratory drilling. I thus construct pre-matched control groups as a robustness check. Specifically, I use coarsened exact matching (Iacus et al., 2012) to construct never-treated control groups that are balanced with treated groups along the dimensions of (pre-treatment) quintiles of GDP, population, distance from state capital, latitude, and municipal development index. Figure 6 summarizes the main empirical strategy and assignment of municipalities to treatment and control groups.

Figure 6: Assignment of Treatment and Control Status to Coastal Municipalities



5.1 Political Agent Mechanisms

Political agents' and voters' responses to discovery announcements may underlie observed governance outcomes. I thus implement a difference-in-differences specification to study discovery effects on political competition, selection, and patronage. To measure political competition, I compute the number of candidates and competitive candidates (Niemi and Hsieh, 2002). I compute the number and value of campaign donations to measure intensity of fundraising and influence-buying. As a measure of political selection (and winner characteristics), I use candidates' and winners' sex, age, and education-level. To measure the intensity of public employment patronage, I follow Colonnelli et al. (2020) in computing the number and share of campaign donors who are hired to discretionary municipal public jobs (*cargos comissionados*) after the candidate they donated to wins an election.

Let Y_{me} be an outcome in municipality m in election period e. I regress this outcome on unit and time fixed effects (δ_m and λ_e) and T_{me}, a time-varying indicator of whether a discovery occurred in the municipality's offshore catchment zone in the four years prior to an election (Equation 4). For continuous outcome variables, I apply the inverse hyperbolic sine transformation, and in all cases I cluster standard errors at the municipality level.

$$Y_{me} = \delta_m + \lambda_e + \beta T_{me} + \epsilon_{me} \tag{4}$$

Finally, I test whether disappointment in offshore revenue expectations at the time of an election leads to lower reelection rates for incumbent politicians. I estimate logit and linear probability models of reelection likelihood for candidate c in municipality m in election period e, where $Disappointed_{me}$ is a time varying indicator of disappointment and X is a vector of controls (candidates' age, sex, and schooling level). Standard errors are clustered at the municipality level and δ_s and λ_e are state and election-period fixed effects:

$$P(Reelection_{cme} = 1) = \delta_s + \lambda_e + \beta Disappointed_{me} + X'\mu + \epsilon_{cme} \tag{5}$$

5.2 Identification

First, are discoveries and subsequent revenue realizations as-if-randomly allocated to municipalities? The location of offshore exploratory drilling is determined by geological features of the seabed, technologies internal to multinational oil companies, and global prices. Since exploratory drilling is extremely expensive – and drilling in the right versus wrong place can mean huge differences in production outcomes – oil companies' profit motives to drill in accurate geologies make it very unlikely they could be influenced by municipal lobbying of any kind. Furthermore, since offshore fields are serviced by ship and helicopter from major ports, local infrastructure or economic or governance conditions are unlikely to shape an oil company's decision of where to drill. Once exploratory drilling is undertaken, finding oil or natural gas is as-good-as-random. If it were non-random, the oil company would have used this information to avoid costly drilling in unsuccessful places (Speight, 2014).

Among discovery-treated municipalities, are subsequent revenue realizations as-if-random? Development of an offshore field depends on a succession of operations that gradually reveal information about that field, including geological features of the reserve that could make it more difficult than expected to exploit. Further variation in development of fields is caused by idiosyncratic events affecting specific oil companies. Finally, discovery timing relative to global oil price fluctuations introduces additional variation into revenue realizations: a discovery in 2004 may have begun production in 2009 at the peak of world oil prices, while an identical discovery in 2010 may have begun production after the price crash of 2014, leading to lower royalties.

To test these arguments empirically, I estimate conditional random assignment tests, where Y_m^{2000} are municipality characteristics in 2000 (pre-discovery), $Treatment_m$ is an indicator of (i) whether wells are drilled in coastal municipalities; (ii) whether a major discovery is announced in municipalities where wells are drilled; and (iii) whether expectations are satisfied in municipalities that received discovery announcements. I include a vector of time-invariant geographical controls (latitude, distance to state and federal capitals), $\boldsymbol{X}_m$, and state fixed effects, δ_s:

$$Y_m^{2000} = \alpha + \beta_1 Treatment_m + \boldsymbol{X}'_m \lambda + \delta_s + \epsilon_m \tag{6}$$

In Appendix Table B4, I report results of conditional assignment tests. I estimate Equation 6 separately for each outcome reported in the table. For each test, I report the p-value for the outcome in question, which, if significant, suggests the value of that variable in 2000 was significantly predictive of future wells being drilled (column 1), discoveries being made (column 2), or discovery expectations being satisfied (column 3). Initial municipality characteristics are in some cases predictive of where wells are drilled, but not of where discoveries are made or whether expectations are satisfied. This supports the claim that offshore discoveries and realizations were exogenous to municipality characteristics, especially after conditioning on exploratory activity.

I test whether political favoritism influences discovery outcomes by estimating conditional random assignment tests equivalent to Appendix Table B4, but with outcomes registering alignment between the political party of municipal mayors and state governors or the president. I include a state capital dummy and standard geographical controls. As illustrated in Appendix Table B5, political alignment is not significantly predictive of future wells being drilled (column 1), discoveries being made (column 2), or discovery expectations being satisfied (column 3). The state capital dummy is predictive of where wells are drilled, but not discoveries or realizations.

Identification of causal effects also requires parallel pre-trends between treated and control units, limited spillovers onto neighboring municipalities, and limited anticipation of discovery announcements (Callaway and Sant'Anna, 2021). While pre-trends may be verified visually in event studies ($\hat{\beta}_k = 0$ for $t < -1$), I also plot sample means of key outcomes for treated subsamples and control groups in Appendix C14, allowing evaluation of differences in levels and co-movements (McKenzie, 2021).

Scope for spillovers between treated and control municipalities is limited in this context: municipal revenues are spent within municipal boundaries, public services are mostly restricted to municipal residents, and participation in local elections also requires municipal residency. Since offshore oil fields are serviced remotely from a few major hubs, most treated municipalities only feel effects of offshore production through the public spending channel, limiting likely firm-level effects to sectors that contract with municipal governments (e.g., construction).[10]

My preferred control group ("Wells") reduces concerns over anticipation since both treated and control municipalities experience offshore oil exploration activity and the timing of discovery announcements is unpredictable. Finally, dynamic learning may lead treatment effects to differ for late-treated units if they can observe outcomes in early-treated units. The Brazilian context limits these concerns, as most discoveries were clustered within a narrow window (76% occurred between 2007-2014) and treatment effects take 5-10 years to emerge, making it difficult to learn contemporaneously from neighbors.

[10]In Appendix C17, I analyze spatial spillovers from discoveries. Discoveries did not exert spillovers onto public finances, GDP, population, or employment in neighboring places.

6 Results

I focus first on municipal public finance outcomes. Figure 7 displays event study results for discovery effects on total and disaggregated municipal revenues. I plot estimates for Satisfied and Disappointed treated groups in the same graph, but each is estimated separately relative to the never-treated Wells control group.[11] In Appendices B6-B10, I present coefficient estimates and standard errors, sample sizes, and sample characteristics for event studies.[12]

As evidenced in Figure 7, oil revenues increase within one year of a discovery announcement in municipalities that will ultimately be classified as "Satisfied" (e.g., see their discovery realized). After ten years, discoveries in satisfied municipalities increase per capita oil revenues by 6,872% relative to never-treated controls.[13] "Disappointed" municipalities never experience an increase in oil revenues, suggesting that indications of a place's ultimate discovery realization begin to emerge relatively soon after a discovery announcement. Disappointing discoveries lead to 45% lower per capita total revenues in affected communities after 10 years. Non-oil transfer revenues from state and federal governments decline by 16% in disappointed municipalities and remain unchanged in satisfied municipalities.[14] Tax revenues are noisily estimated, but trend downward in disappointed places after discoveries.

Changes in revenue translate closely into changes in spending (Figure 8). In sat-

[11] Appendix Figure A6 reports results from an event study analogous to those reported in Figure 7, but with Disappointed and Satisfied treatment arms combined into a single "Discovery-Treated" group. As is clear from this figure, the average effect of discoveries on revenue per capita is indistinguishable from zero, despite significant and divergent effects on Disappointed and Satisfied groups. This key source of heterogeneity is missed when discovery uncertainty is not taken into account.

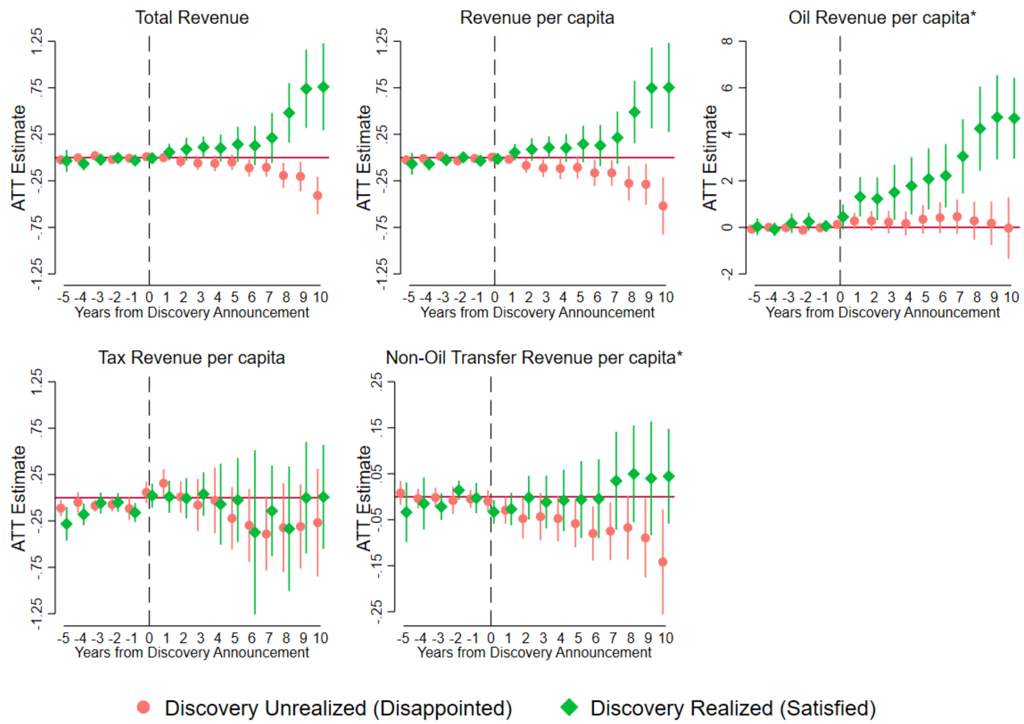
[12] To preserve reasonable sample sizes, I do not impose a balance requirement on treated units across relative time periods. As a result, panel composition changes slightly, with all treated municipalities present in the panel at t=0 and some dropping out in more extreme years. In Appendix C16, I plot treated sample means for baseline characteristics over relative years to show that the composition of treated groups does not change substantively across the panel.

[13] I interpret semi-elasticities using a small sample bias correction (Bellemare and Wichman, 2020): $\hat{P} = (e^{(\beta - \frac{\widehat{Var(\beta)}}{2})} - 1) \times 100$

[14] I disaggregate effects by type of transfer in Appendix A7. In disappointed municipalities, transfers pegged to population, students, and exports decline significantly after discovery announcements.

isfied municipalities, per capita spending increases significantly beginning nine years after a discovery announcement (+25% ten years on), aligning with the typical delay between discovery and peak offshore oil production.

Figure 7: Revenues

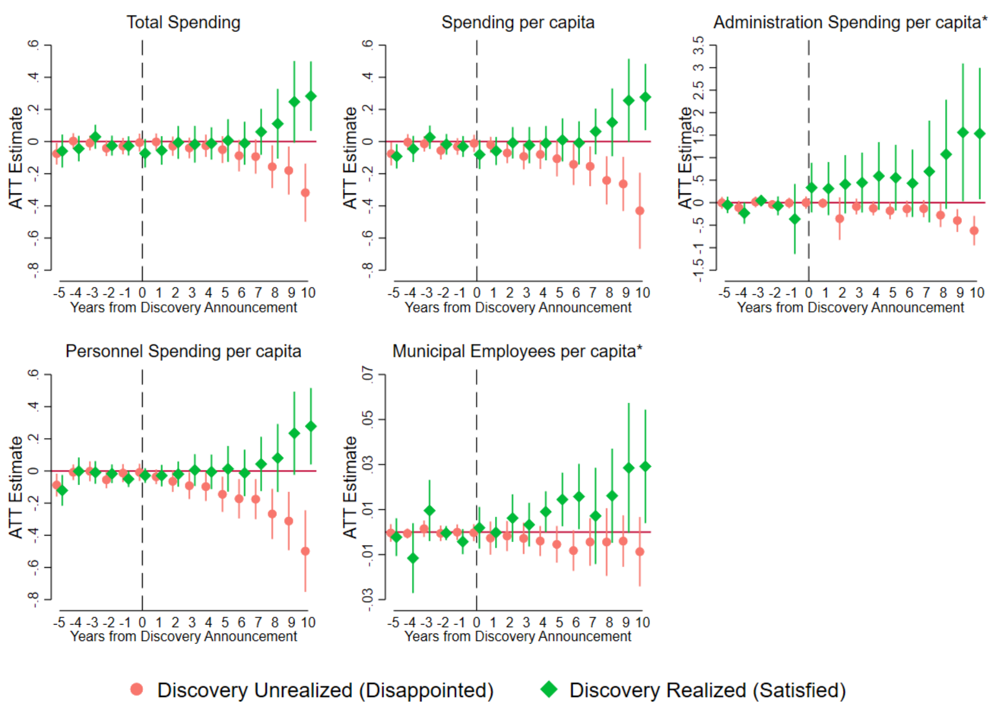


Note: Event studies are estimated separately for Disappointed and Satisfied municipalities relative to never-treated controls (municipalities with exploratory offshore wells between 2000-2017 but no discovery announcements). Event study specifications include municipal and year fixed effects and are estimated using the Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. Revenue variables refer to current (realized) values. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures to accommodate large differences in scale of effects.

Per capita spending declines significantly in disappointed municipalities beginning three years after a discovery (-39% ten years on). Spending on administration and personnel falls by 51% and 43% respectively in disappointed places after ten years, and increases by 220% and 24% respectively in satisfied places. Finally, the number of municipal public employees per capita remains unchanged in disappointed places, and increases significantly in satisfied places beginning five years after a discovery (+2.3% ten years on).

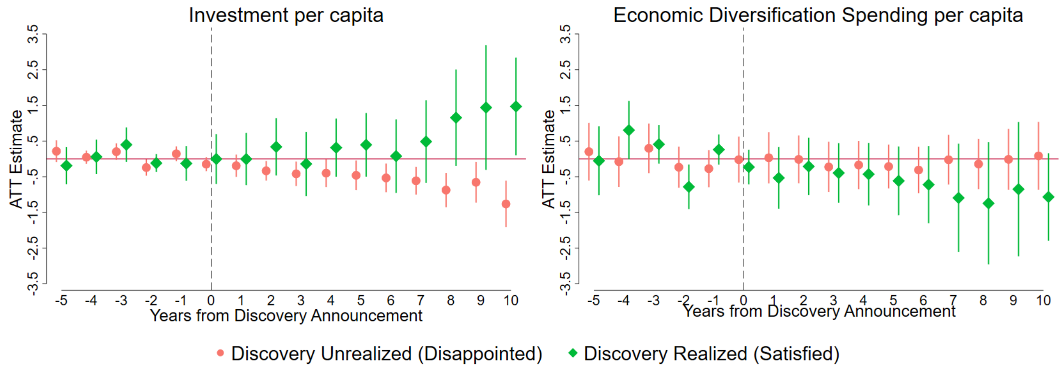
Public investment (e.g., infrastructure) trends upwards in satisfied municipalities after discoveries (Figure 9). Investment in disappointed municipalities falls by 43% relative to controls after 5 years, and by 76% after 10 years. Spending to promote non-extractive sectors (agriculture, industry, and services) trends downwards in satisfied municipalities while their spending on nearly every other category increases. This suggests that municipalities enjoying oil windfalls de-emphasize investments in economic diversification, risking oil-dependency. Discoveries have no significant effects on debt (Appendix Figure A8), as municipalities have limited capacity to borrow.

Figure 8: Expenditures and Public Employment



Note: Spending is current (realized). Event study specifications include municipal and year fixed effects and are estimated using Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures, in order to accommodate large differences in scale of effects.

Figure 9: Public Investment and Economic Diversification

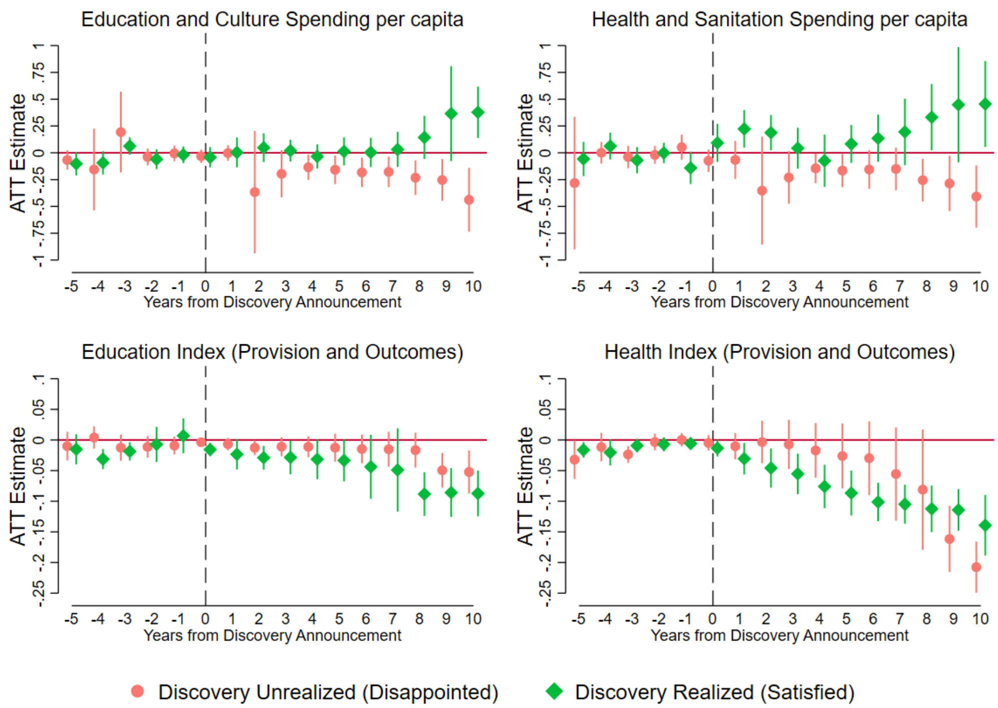


Note: Investment refers to public municipal investment (e.g., infrastructure). Economic development spending is the sum of spending to promote industry, services, and agriculture. Event study specifications include municipal and year fixed effects and are estimated using the Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported.

Provision of public goods such as health and education is an integral part of municipalities' role in Brazil's federal system. Figure 10 illustrates effects of discovery announcements on public goods spending and indices of real public goods provision taken from the FIRJAN Municipal Development Index (FIRJAN, 2019). In satisfied municipalities, per capita spending on education and culture increases by 37% after 10 years, and spending on health and sanitation increases by 42%. Despite these significant increases, index measures of public goods provision show significant declines. The disconnect between public goods spending and outcomes suggests municipalities dealing with oil booms may lack the capacity to spend windfalls efficiently or suffer leakage of oil revenues into corruption.[15] Disappointed municipalities experience declining education (-40%) and health (-30%) spending and indices of education and health provision ten years on. In Appendix A9, I present estimates of discovery effects on disaggregated measures of public goods provision.

[15]Brazilian municipalities are required by law to dedicate set percentages of their revenues to health and education spending (Fioravante et al., 2006). Thus, when major revenue windfalls arrive, municipalities may rush to increase spending without having a well-developed investment plan in place, leading to waste and inefficiency.

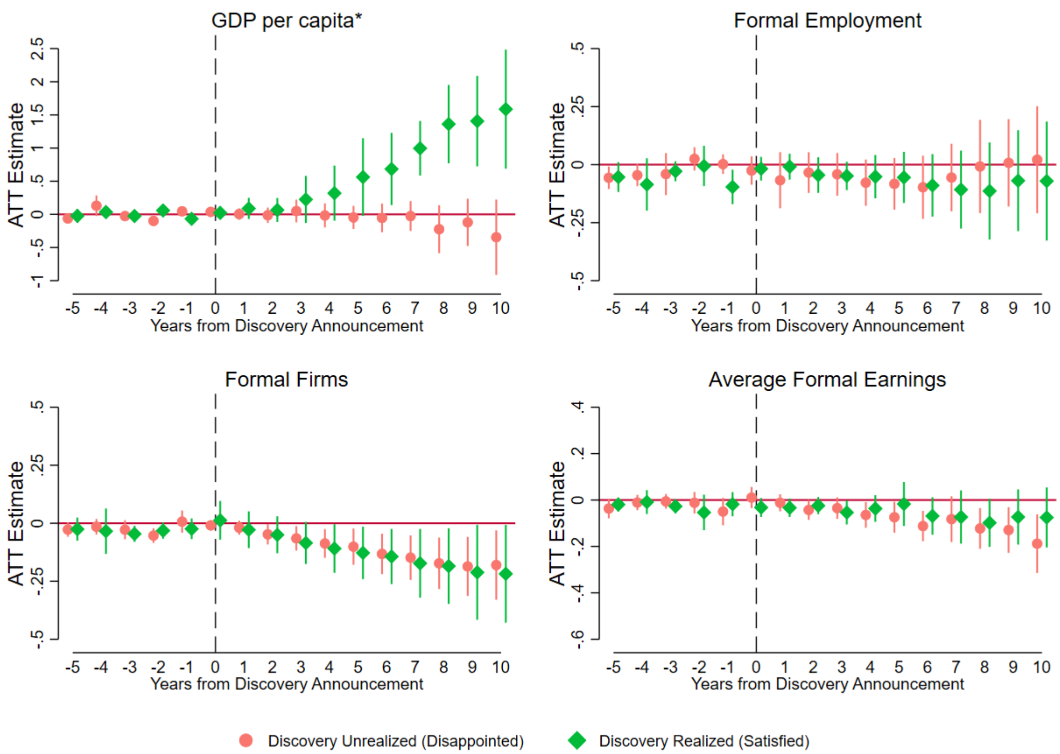
Figure 10: Public Goods Spending & Performance Indices



Note: Education and Health Indices are drawn from the FIRJAN Municipal Development Index (FIRJAN, 2020). The Education Index is composed of: enrollment and graduation rates, grade-age distortion, hours in class, share of teachers with college degrees, and IDEB test scores. The Health Index is composed of: proportion of pregnant women receiving >7 pre-natal visits, deaths of undefined causes, and avoidable infant mortality. Event studies include municipal and year fixed effects and are estimated using the Callaway and Sant'Anna (2021) *csdid* estimator. Monetary values are transformed using inverse hyperbolic sine and deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported.

Offshore oil and gas discoveries exert limited direct economic impacts on aligned municipalities (Cavalcanti et al., 2019). Discoveries may, however, act indirectly through their effects on municipal governance. In Figure 11, I present event studies of discovery impacts on GDP per capita and indicators of formal economic activity. Realized discoveries have large positive effects on GDP per capita in satisfied municipalities (+289% ten years on). Oil and gas revenue transfers enter GDP directly as part of the government budget, and do not exert equally large effects on real economic activity as measured by formal employment, number of formally registered firms, and average annual formal earnings. In fact, these indicators exhibit null or significantly negative trends after discovery announcements in satisfied municipalities. In disappointed municipalities, effects on GDP per capita are statistically indistinguishable from zero, and indicators of formal economic activity are null or significantly negative after discovery announcements.

Figure 11: GDP and Formal Economic Indicators



Note: Formal employment (total number of formally registered workers), firms (total number of formally registered firms, excluding single-person firms), and average earnings (average annual formal earnings) are computed from RAIS. Event study specifications include municipal and year fixed effects and are estimated using Callaway and Sant'Anna (2021) *csdid* estimator. Continuous monetary outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures, in order to accommodate large differences in scale of effects.

6.1 Robustness Tests

To assess the sensitivity of event study estimates to choice of estimator and control group, I re-estimate specifications using different combinations of estimator (CS and TWFE) and control group (Wells and Matched). Results are largely stable in sign, magnitude, and significance across these different combinations, as reported in Appendix Tables C1-C2. Appendix Figures C7-C11 report event studies produced by the preferred specification and matched control group, confirming that results are robust to this modification. To test the robustness of event studies to model selection, I re-estimate specifications for key outcomes using alternative forecasting and matching parameters. These variations include alternative revenue expectation forecasts (which shift marginal municipalities between satisfied and disappointed categories), and a non-parametric definition of satisfied/disappointed that measures whether or not oil production increased between the discovery announcement and 2017 by more than a factor of 2. I construct alternative matched control groups by matching on baseline *outcomes* (per capita revenues and spending), rather than characteristics. I also re-estimate event studies using the full sample of municipalities in coastal states. Finally, I re-estimate my preferred specification with standard errors clustered at the micro-region (groups of approximately 10 adjacent municipalities) and meso-region (groups of approximately 40 adjacent municipalities) levels to account for potential spatial correlation. I report results from these robustness exercises in Appendix Figures C1-C6. Results are stable across alternative specifications.

6.2 Political Selection Mechanism

Do local political responses contribute to disappointed places' negative outcomes and satisfied places' inability to improve public goods provision? In Table 1, I present results from difference-in-difference specifications that regress outcomes related to electoral competition, campaign fundraising, and candidate selection on municipality and year fixed effects and a treatment indicator that (i) turns on after the first discovery announcement (for the CS estimator), or (ii) turns on when a discovery announcement occurred in the four years prior to an election (for the TWFE estimator). Each column of Table 1 presents results from a different combination of control sample (Wells and Matched) and estimator (CS and TWFE) to assess robustness.

Interpreting the preferred specification (CS estimator and Wells control group), I find that discovery announcements significantly *increase* the number of competitive candidates running for council (+4.7% from a control mean of 29.9) and *decrease* the number of competitive candidates running for mayor (-14.1% from a control mean of 1.9)[16] Divergence in results between council and mayoral candidates may be due to higher barriers to entry for mayoral candidates, leading to consolidation in mayoral races. Discoveries significantly increase number and value of donations to municipal candidates (+11.7% and +19.5%, respectively). Finally, discoveries induce less-educated candidates to run for election, with average schooling levels falling by 3.7%.

In Appendix B11, I report analogous results from estimates of the effects of a discovery announcement on *winning* candidate characteristics and public employment patronage, defined as the number and share of campaign donors hired to discretionary municipal public jobs (*cargos comissionados*) after their candidate wins a local election. Results indicate that discovery announcements reduce the average schooling levels of elected candidates by 17.7%, which in turn could reduce governing capacity and the quality of public service delivery. Announcements have no detectable effects on the intensity of patronage.

6.3 Political Turnover Mechanism

When there is a shortfall between discovery expectations and realized oil revenues, are incumbent politicians punished electorally? Since voters cannot perfectly observe politicians' quality or honesty, they may vote according to observable performance, such as public goods provision. Disappointment could result in a fiscal crunch, requiring local leaders to cut spending. Voters may also interpret lack of revenue windfalls after promising discovery announcements as an indicator of corruption or in-

[16] To compute number of competitive candidates, I adopt a methodology from Niemi and Hsieh (2002). For candidate i in election e, let v_{ie} be the number of votes received, let $\sum_i v_{ie}$ be total votes cast for council, and let θ_{ie} be share of total council votes received by i. Let S_m be the number of council seats in municipality m. Consider a candidate to be competitive if $\theta_{ie} > (1/(1+S_m))/8$. For mayors, I consider candidates to be competitive if they receive more than 10% of total votes.

Table 1: Discovery Effects on Elections

	CS Wells	CS Match	TWFE Wells	TWFE Match	$\bar{DV}$ (IHS)
Electoral Competition					
Council Candidates (Total)	0.172	0.070	0.131	0.046	5.18
	(0.235)	(0.037)	(0.122)	(0.032)	
Council Candidates (Comp.)	0.098	0.066	0.070	0.061	4.09
	(0.105)	(0.037)	(0.061)	(0.034)	
Mayoral Candidates (Total)	0.065	0.054	0.041	0.035	1.98
	(0.068)	(0.050)	(0.052)	(0.048)	
Mayoral Candidates (Comp.)	-0.129	-0.087	0.001	0.008	1.41
	(0.045)	(0.046)	(0.046)	(0.047)	
Campaign Fundraising					
Total Number of Donations	0.157	0.164	0.169	0.149	6.77
	(0.092)	(0.069)	(0.087)	(0.091)	
Total Value of Donations	0.238	0.114	0.131	0.119	13.72
	(0.120)	(0.113)	(0.078)	(0.083)	
Candidate Characteristics					
Share of Candidates Female	-0.010	-0.006	-0.008	-0.016	0.26
	(0.010)	(0.120)	(0.007)	(0.005)	
Avg. Candidate Age	-0.031	0.000	0.001	-0.002	4.46
	(0.014)	(0.011)	(0.005)	(0.004)	
Avg. Candidate Schooling	-0.031	-0.009	-0.030	-0.024	2.40
	(0.014)	(0.010)	(0.009)	(0.006)	
Municipality FEs	Y	Y	Y	Y	
Election Period FEs	Y	Y	Y	Y	
n (municipality-election periods)	404	3,745	404	3,745	

Table reports results from estimation of the following difference-in-differences specification: $Y_{me} = \delta_m + \lambda_e + \beta T_{me} + \epsilon_{me}$, where Y_{me} measures municipal electoral competition, fundraising, or candidate characteristics, δ_m and λ_e are municipality and election FEs, and T_{me} is a treatment dummy that equals 1 after a discovery was announced during the previous four-year election period in a municipality m's offshore catchment zone. Standard errors are clustered at the municipality level. Columns 1-4 report coefficient estimates and standard errors for specific control group-estimator pairs. Column 1 reports the preferred specification, which uses the Callaway and Sant'Anna (2021) (CS) *csdid* estimator with municipalities that had offshore exploratory wells drilled since 2000, but no discoveries, as a control group. Column 2 reports results using CS estimator and a control group matched with discovery-treated municipalities on baseline characteristics using Coarsened Exact Matching. Columns 3 and 4 report results from wells and matched control groups using the two-way fixed effects (TWFE) OLS estimator. Column 5 reports control group dependent variable means for each outcome for the Wells sample. Monetary values are deflated to constant 2010 BRL. Continuous variables are transformed using the inverse hyperbolic sine transformation.

competence, and punish incumbents accordingly. Incumbents may exacerbate these dynamics by stoking euphoria, claiming credit, or making promises after discovery announcements that prove impossible to keep when discovery expectations are disappointed.

Table 2 reports results from regressions of a reelection indicator on a binary indicator of disappointment at the time of an election. I estimate linear probability models (interpreted here) and logit models to check robustness to model selection, controlling for candidates' age, sex, and schooling and state and year fixed effects. Findings suggest council incumbents are 5 percentage points less likely to win reelection when their municipality was disappointed by discovery expectations over the last four years. Mayors are 11.9 percentage points less likely to win reelection. *Satisfaction* with discovery outcomes has insignificant effects on reelection rates. Akhtari et al. (2022) and Toral (2021) show municipal political turnover in Brazil leads to administrative disruptions and reduced provision and quality of public goods and services. Disappointment, by decreasing reelection rates for incumbents, may thus make it more difficult for municipal governments to adapt to oil revenue shortfalls.

6.4 Testing Additional Mechanisms

I test for in-migration in response to discovery announcements using data on (i) total municipal population, (ii) number of formally employed in-migrants, and (iii) total number of in-migrants calculated from Brazil's latest available 2010 census. Results, reported in Appendix Figure C5, indicate that discoveries did not provoke significant internal migration. Limited migration effects may be due to the negligible or negative impacts discoveries exert on local public goods provision and economic activity.

I disaggregate discovery effects on formal employment, formally registered firms, and average formal earnings by sector to explore heterogeneous effects and the possibility of subnational Dutch Disease after discovery announcements (Appendix Figures A11-A13). In disappointed municipalities, formal employment declines significantly in

Table 2: Effects of Disappointment/Satisfaction on Incumbent Reelection

	Disappointed		Satisfied	
	LPM	Logit	LPM	Logit
Mayor	-0.119	-0.136	-0.011	-0.011
	(0.070)	(0.089)	(0.030)	(0.030)
Controls	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
Election Period FEs	Y	Y	Y	Y
$\bar{DV}$ (Share Reelected in Controls)	0.476	0.476	0.476	0.476
n (candidate-election periods)	10,815	10,815	10,850	10,850
Council	-0.050	-0.042	-0.000	-0.001
	(0.017)	(0.016)	(0.009)	(0.010)
Controls	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
Election Period FEs	Y	Y	Y	Y
$\bar{DV}$ (Share Reelected in Controls)	0.616	0.616	0.616	0.616
n (candidate-election periods)	160,169	160,169	160,945	160,945

Table reports coefficient estimates (marginal effects for logit models) with standard errors in parentheses. $Disappointed_{me}$ is a binary indicator identical to that used to classify municipalities in event study specifications, assuming a value of 1 when the ratio of realized oil revenue growth over the previous election period over expected oil revenue growth over that period < 0.4. $Satisfied_{me}$ is a binary indicator that takes a value of 1 when the ratio of realized to expected revenue growth ≥ 0.4. Control municipalities consist of all untreated municipalities in coastal states. State and election period fixed effects are included, as well as candidate-level covariates (age, sex, and education level). *** p<0.01, ** p<0.05, * p<0.1

the construction sector (-47% ten years on). Activity in this sector, which is especially dependent on government contracts and spending, may relocate as disappointment becomes evident.[17] Formally registered firms and formal employment in the manufacturing sector remain unchanged in both disappointed and satisfied municipalities after discovery announcements, while average formal earnings in manufacturing trend downward. These findings corroborate Cavalcanti et al. (2019) – who find limited direct economic effects of offshore oil discoveries – and suggest that indirect Dutch Disease channels (i.e., the *spending effect* in Corden and Neary (1982)) are limited in this context.

Finally, formulaic transfer revenues from federal and state governments decline significantly in disappointed municipalities (-16% ten years on). Non-oil transfers

[17] Since Brazilian municipalities collect taxes on real estate transactions (ITBI), service providers (ISS), and urban properties (IPTU) (Egestor, 2020), declining construction activity may weaken the local tax base. Tax revenues trend downward in disappointed places after discoveries, falling by 34% after ten years.

make up 75-90% of most municipal budgets. I disaggregate transfer revenues in Appendix A7 to show disappointed municipalities suffer significant cuts in the following transfers: FUNDEF/FUNDEB (which funds primary and secondary schools and is calculated on a per-student basis), FPM (calculated based on municipal population), and Lei Kandir (calculated based on value added in goods and services for export). These transfers account for 47.4%, 44.4%, and 0.72% of total transfers to municipalities, respectively. A fuller understanding of what drives changes in transfers to disappointed municipalities is an avenue for future research.

7 Discussion

Only 18 of the 48 Brazilian municipalities affected by offshore discovery announcements between 2000-2017 ultimately receive more than half of the revenues they could have expected based on a standard offshore forecasting model. Municipalities do not exhibit anticipatory fiscal responses to discovery announcements, potentially due to limits imposed by a fiscal responsibility law (i.e., a balanced budget rule). This finding contrasts with Mihalyi and Scurfield (2020), who document the worsening of debt sustainability in 9 out of 12 African countries in the immediate aftermath of major oil or gas discoveries. Evidently, institutions such as Brazil's fiscal responsibility law may play an important role in tempering fiscal excesses after discoveries.

By focusing on subnational units, my findings reveal emergent properties of discovery impacts at the local level. Local governments typically face borrowing constraints, reducing their capacity to accumulate discovery-collateralized debt relative to national governments. On the other hand, local governments may potentially be more susceptible to elite capture and rent-seeking (Armand et al., 2020; Bardhan and Mookherjee, 2000). Though not a major factor in the Brazilian context, internal migration in response to discoveries could affect subnational units while not appearing in country-level studies (Wilson, 2022). Foreign direct investment booms (Toews and Vézina, 2020) and real exchange rate appreciation (Harding et al., 2016) after discoveries are more likely to affect national, rather than subnational outcomes.

Municipalities where discovery expectations are satisfied enjoy large increases in per capita revenue and spending 10 years after the first discovery announcement, but experience worsening or stagnant public goods provision and formal economic activity. These outcomes highlight one face of the Resource Curse: failure to convert resource windfalls into investments or public goods that would transform natural capital into long-term economic development. Mechanisms underlying ineffective windfall spending may include rent-seeking and impaired state capacity: I document that discoveries reduce average schooling levels of candidates and elected leaders, which is indicative of rent-seeking (Baragwanath, 2020) and which may reduce governing capacity in discovery-affected places (Melo and Tigre, 2022).

Disappointed places experience expectation shocks after discovery announcements, but never receive anticipated windfalls. Relative to never-treated controls, disappointed municipalities experience lower revenues, spending, and investment, as well as worsened indicators of public goods provision and formal economic activity ten years on. These outcomes illustrate a second, less-discussed face of the Resource Curse: delays, disappointment, and consequent adjustment costs associated with the uncertainty and volatility of resource sectors. These costs include increased political turnover: incumbent politicians' reelection rates are reduced when municipalities are disappointed at the time of an election. On top of entry into office of less-educated politicians, increased political turnover in disappointed places disrupts administration, planning capacity, and public service delivery (Akhtari et al., 2022).

My study highlights several policy takeaways. First, revenue allocation rules that concentrate resource revenues in specific places exacerbate discovery uncertainty – as well as exposure to price volatility – and make local governance more difficult. Spreading risk over a wider exploration portfolio would smooth idiosyncratic outcomes in individual fields, dilute disappointment, and avoid overwhelming local administrative capacity in places that ultimately receive windfalls. Regulators can establish rules for discovery announcements to ensure they reflect realistic development prospects. Finally, there are often strong political incentives to generate euphoria and claim credit after major discovery announcements. Leaders should work to manage expectations, given that negative discovery realizations may reduce reelection rates for incumbents. National leaders should actively communicate with local leaders in discovery-affected regions to transmit good practices and support capacity-building in preparation for windfalls. Along these lines, discovery-affected municipalities in Brazil are developing innovative policies to manage uncertain oil revenues, including a universal basic income program (e.g., Maricá) and sovereign wealth funds (e.g., Niterói).

In the face of growing pressure to transition away from fossil fuels, disappointment after discovery announcements is likely to become more common in the future – highlighting the importance of studying governance under discovery uncertainty and political economic reactions to resource shortfalls and shocks.

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Online Appendix

Winning and Losing the Resource Lottery:
Governance after Uncertain Oil Discoveries

Erik Katovich

Table of Contents

A Supplementary Figures

A.1 Descriptive Figures

Figure A1: News Coverage of Oil Discoveries in *O Globo*

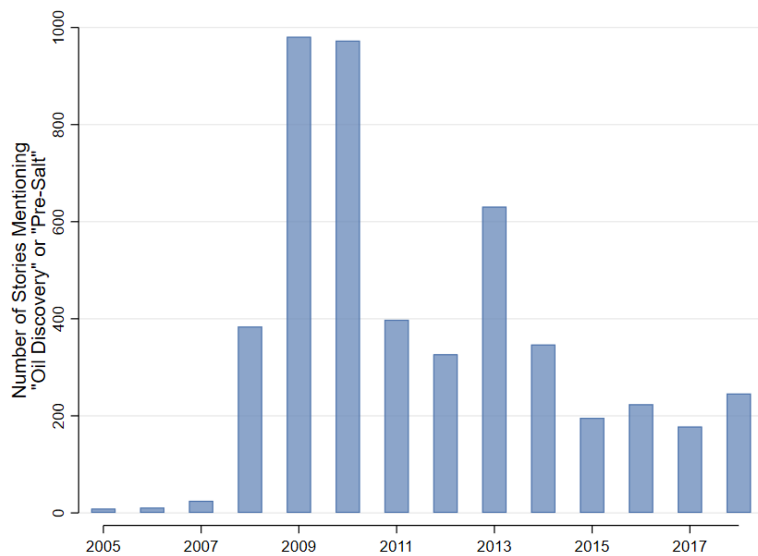


Figure A2: Offshore Discovery Announcement and News Coverage

(a) CVM Discovery Announcement

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.

(b) News Story in *O Globo*

Novo poço confirma potencial de petróleo leve em Tupi

O Globo [1 1] O Globo . O Globo ; Rio de Janeiro [Rio de Janeiro]04 June 2009.

ProQuest document link

FULL TEXT

RIO - A Petrobras informou, nesta quinta-feira, 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 recuperáveis 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.

Localizado a uma distância de 33 quilômetros 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.

Clique aqui e confira a localização dos blocos do pré-sal

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, comprovada através de amostragens de petróleo leve (cerca de 30º API) em reservatórios localizados em profundidade de cerca de 5.000 metros, foi comunicada àAgência Nacional do Petróleo, Gás Natural e Biocombustíveis - ANP nesta quinta-feira.

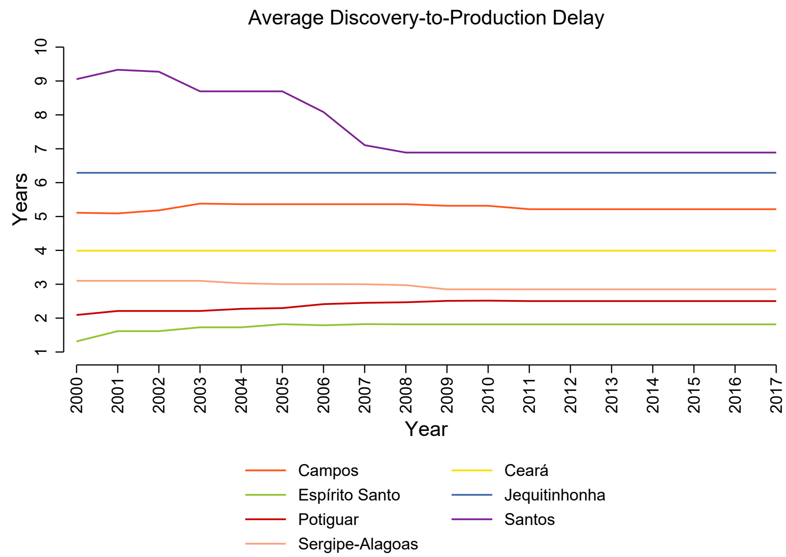
Após a conclusão da perfuração, o consórcio formado pela Petrobras, BG Group e Galp, para a exploração do bloco BM-S-11, onde fica a área de Tupi, dará continuidade às atividades e investimentos previstos no Plano de Avaliação aprovado pela ANP e que prevê a perfuração de outros poços na área.

O petróleo no bloco de Tupi configurou-se, após anúncio em novembro de 2007, na primeira grande descoberta da Petrobras no pré-sal da bacia de Santos.

No dia 1º de maio, foi realizada a extração em alto mar do primeiro óleo do Campo de Tupi. O presidente Luiz Inácio Lula da Silva não foi àplataforma Cidade de São Vicente para a extração por questão de segurança, devido ao mau tempo na região, mas participou de uma cerimônia na Marina da Glória, na companhia do governador do Rio de Janeiro, Sergio Cabral, durante a qual expressou todo o seu entusiasmo com os avanços da estatal. Ele afirmou que essa conquista da Petrobras equivale "à segunda independência do Brasil".

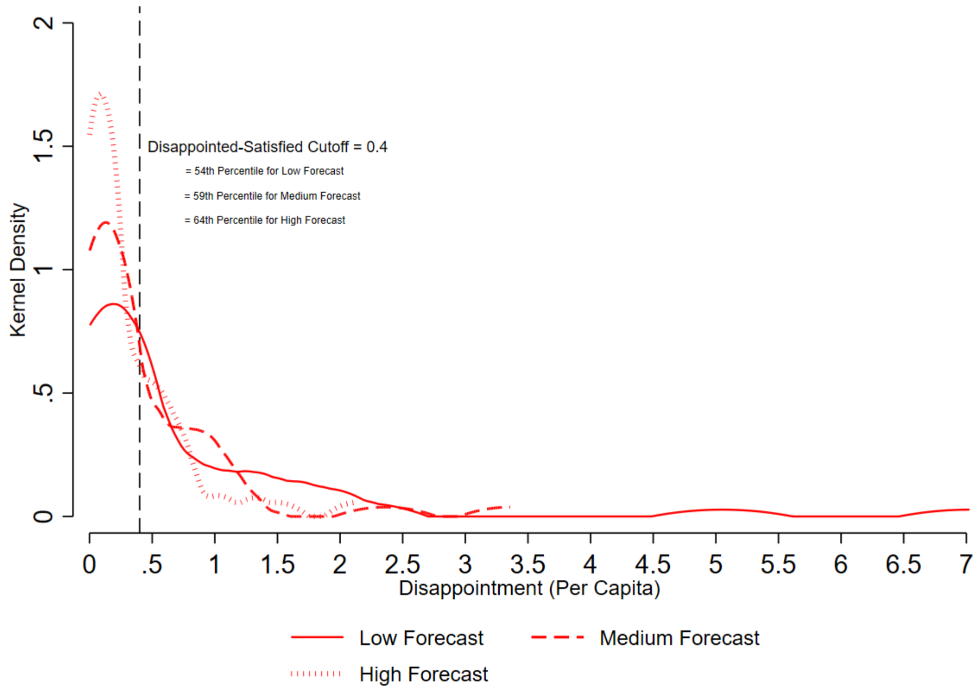
Leia também: Exploração no pré-sal começa sem nova regulação

Figure A3: Moving Average of Basin-Level Delay Between Discovery Announcement and Commercial Production



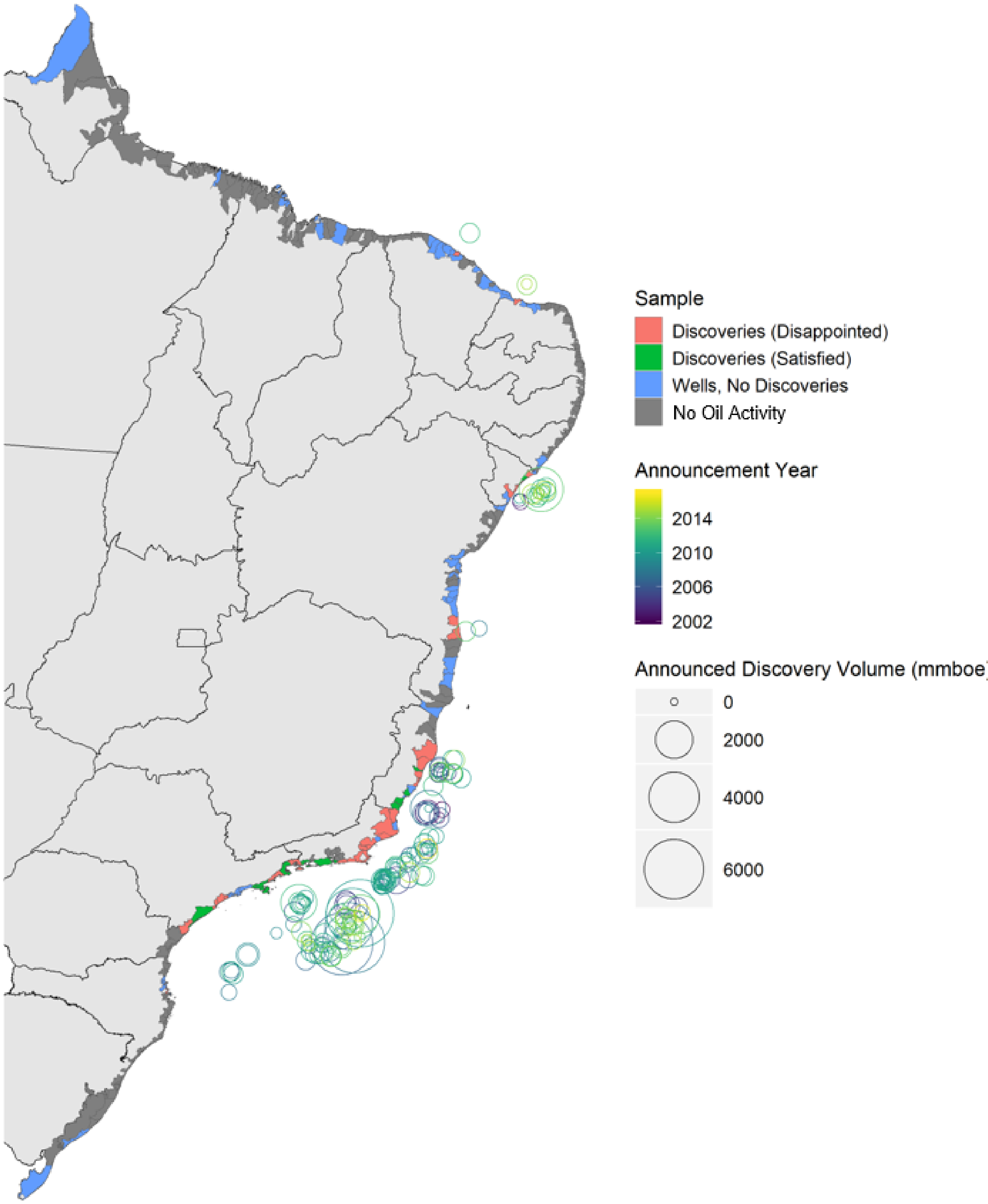
Note: Basin-level averages are aggregated from field-level delays. Sedimentary basins are region-scale geological formations in the earth's crust with common internal features, making basin-level average outcomes informative for new fields within that basin.

Figure A4: Distribution of Forecast Errors Across Treated Municipalities



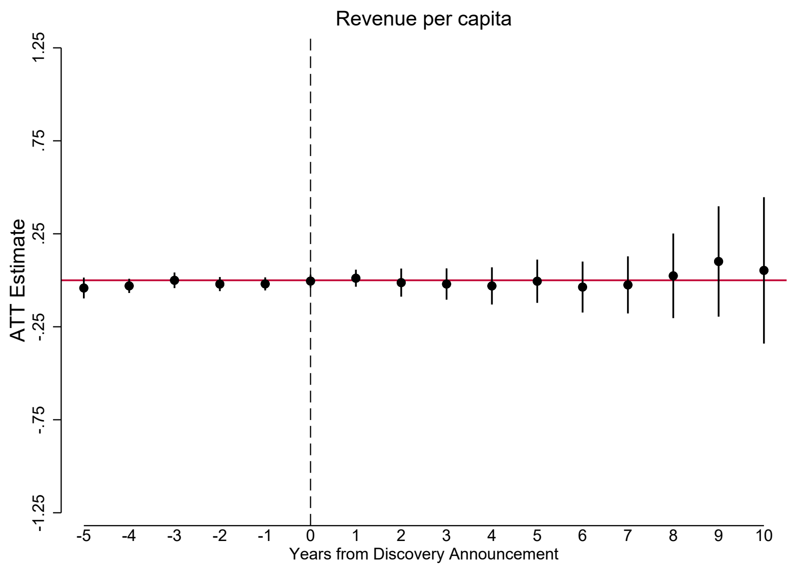
Note: I compute $Disappointment_{m,2017}$ by comparing expected growth in per capita revenue between the year of the event and the end of the sample with realized growth over this period: $Disappointment_m, 2017 = \frac{\frac{Royalties_{m,2017}}{Royalties_{m,t0}}}{\frac{E(Royalties_{m,2017}}{Royalties_{m,t0}}}$ For the purpose of event studies, I classify municipalities as "disappointed" if $Disappointment_{m,2017}$ is less than 0.4, suggesting their realized oil revenue grew by less than 40% of what they expected by 2017. I classify municipalities values of $Disappointment_{m,2017}$ above 0.4 as "satisfied."

Figure A5: Brazil: Major Offshore Discoveries and Affected Municipalities



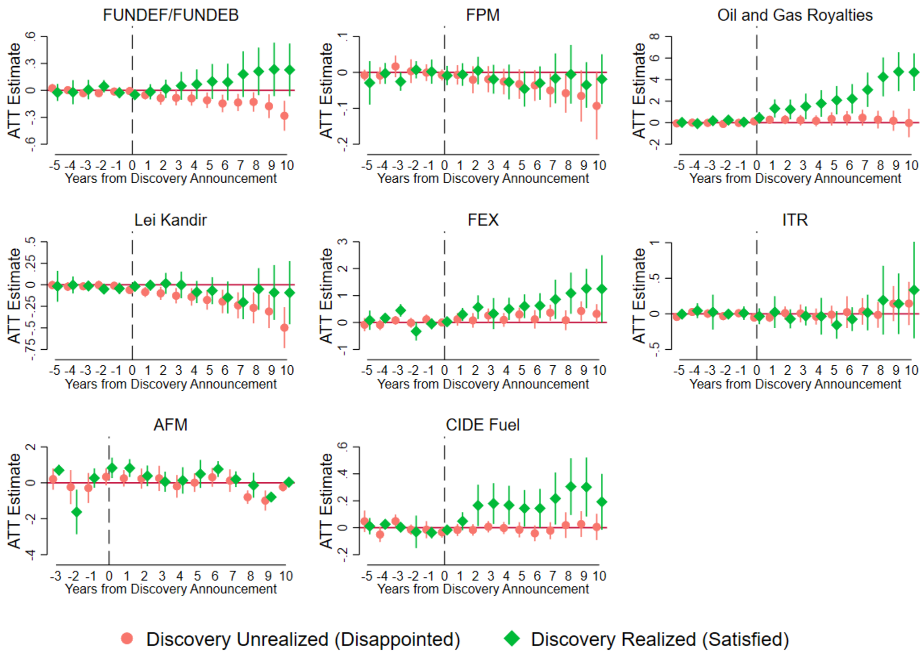
A.2 Additional Results Figures

Figure A6: All Discovery-Treated Municipalities: Revenue per capita



Note: Event study is estimated analogously to those described in Figure 7.

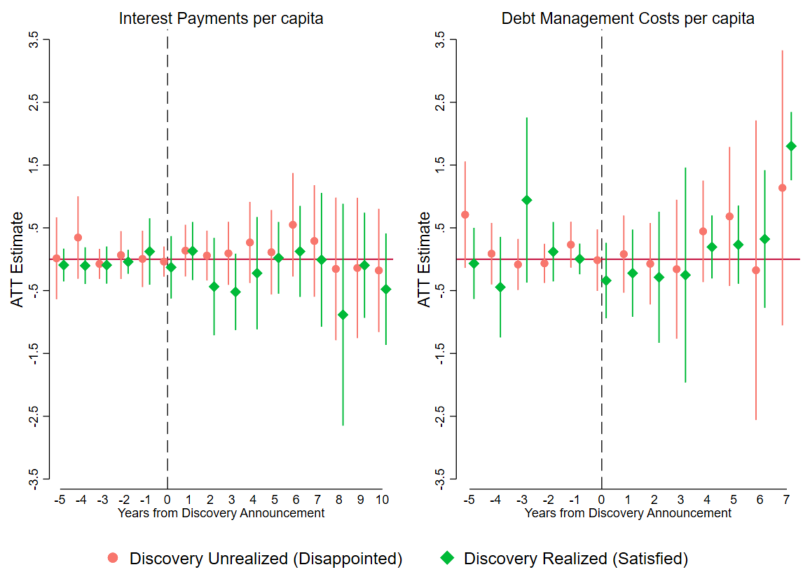
Figure A7: Federal and State Transfers (per capita)



Note: Formulaic federal and state transfers to municipal governments

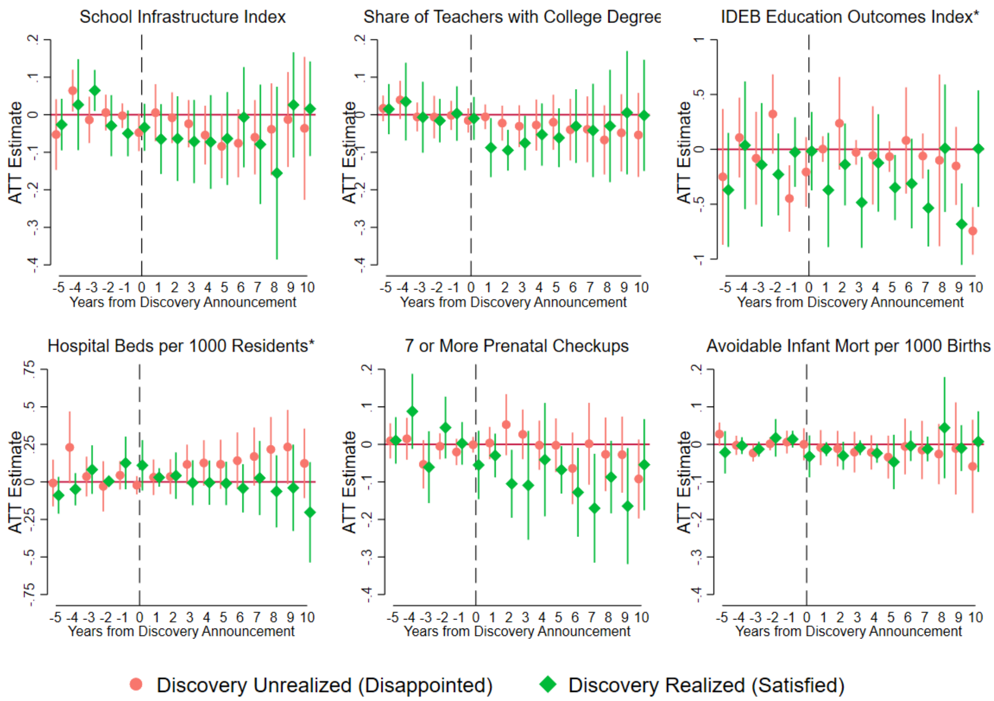
- **FUNDEF (to 2006)/FUNDEB (2007 onwards)** (*Fundo de Manutenção e Desenvolvimento do Ensino Fundamental e de Valorização do Magistério/Fundo de Manutenção e Desenvolvimento da Educação Básica e de Valorização dos Profissionais da Educação*): Federal and state transfers to municipal governments to finance primary and secondary education, calculated based on number of students in different modalities of instruction, as reported in prior year's Basic Education Census. Accounts for 47.4% of total transfers to municipalities between 2000-2017.
- **FPM** (*Fundo de Participação dos Municípios*): Federal transfer to municipal governments in proportion to population. Accounts for 44.4% of total transfers to municipalities.
- **Royalties**: Financial compensations transferred from federal to specific municipalities affected by oil and gas production, mining, and hydroelectric plants. Calculated in proportion to resource value and other factors. Accounts for 6.2% of total transfers to municipalities.
- **Lei Kandir/FEX** (*Auxílio Financeiro para o Fomento das Exportações*): Federal transfers to municipal governments to compensate for tax dispensation granted to export-oriented goods and services to promote export competitiveness, calculated in proportion to the value of these goods per negotiations between states and the Ministry of the Economy. Accounts for 0.72% and 0.39% of total transfers to municipalities, respectively.
- **ITR** (*Imposto Territorial Rural*): Tax on rural properties, proportional to size and land-use, collected jointly by federal and municipal governments. Municipalities may request to collect fully and retain 100% of revenues. Accounts for 0.35% of total transfers to municipalities.
- **AFM** (*Apoio/Auxílio Financeiro aos Municípios*): Sporadic and exceptional transfer from federal to municipal governments made to support municipalities through moments of transitory financial strain. Accounts for 0.30% of total transfers to municipalities.
- **CIDE-Combustíveis** (*Contribuição de intervenção no domínio econômico incidente sobre as operações realizadas com combustíveis*): federal transfer of portion of tax on importation and commercialization of gas. Accounts for 0.27% of total transfers to municipalities.

Figure A8: Debt



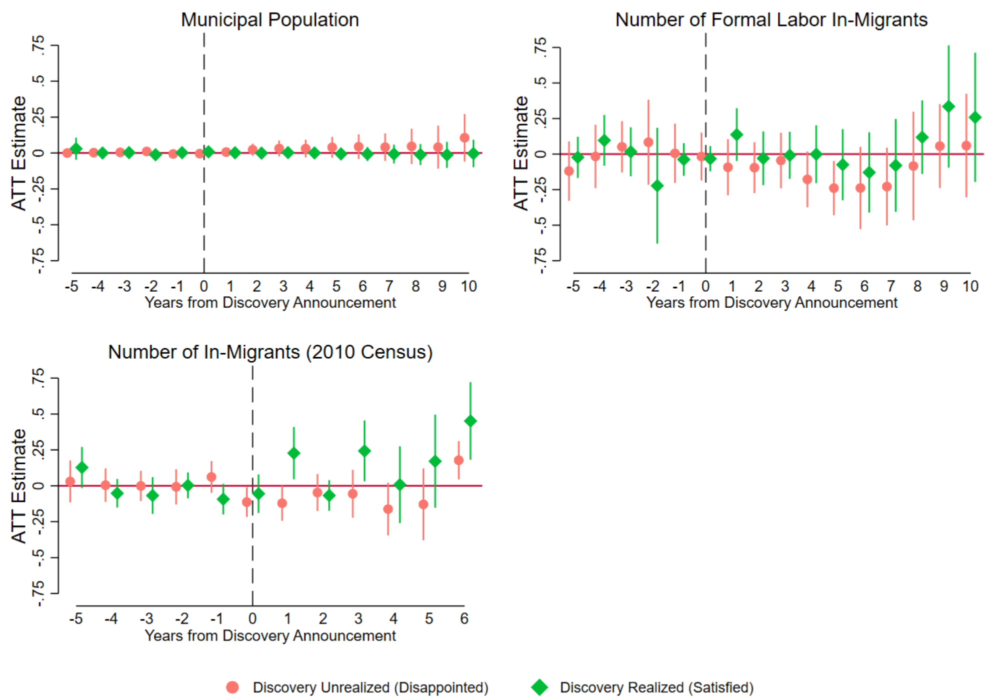
Note: Debt share of revenue is calculated by summing expenditures on debt (processed, unprocessed, and liquidating), debt service, debt restructuring, interest, and *restos a pagar*.

Figure A9: Public Goods Provision and Quality



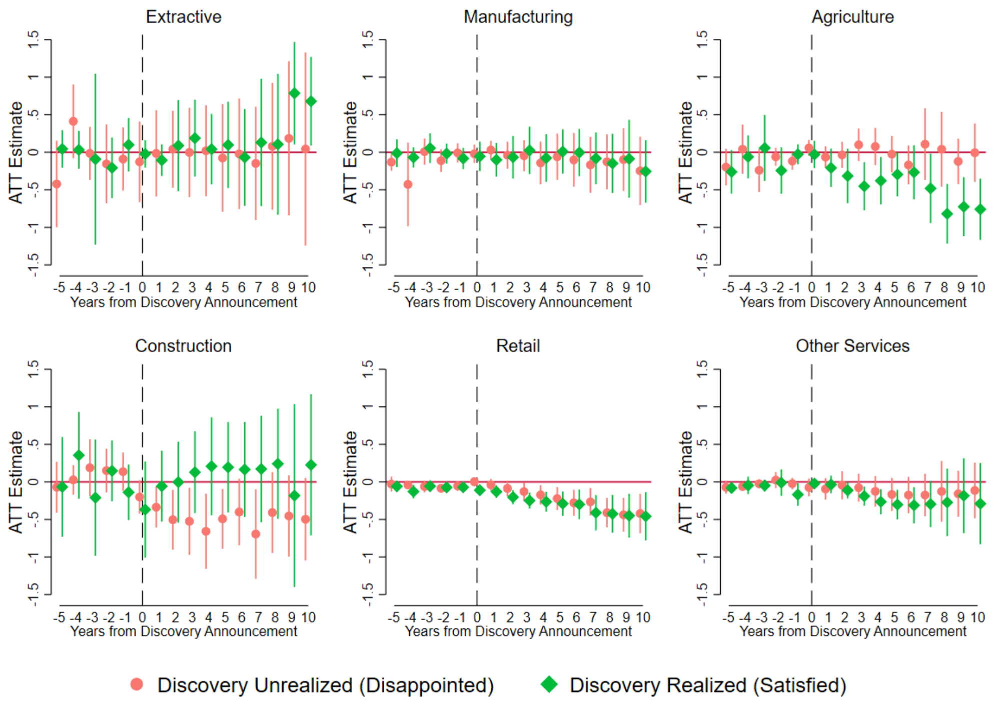
Note: School infrastructure index, constructed from Basic Education Census, is a simple sum of three indicators: school has library, science lab, and computer lab. IDEB is a biannual measure of school quality, including test scores and graduation rates. Hospital beds per 1000 residents refers to municipal hospital beds only. Prenatal visits measures the share of pregnant women receiving at least the recommended 7 health checkups prior to giving birth. Health data are drawn from DataSUS. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures to accommodate large differences in scale of effects.

Figure A10: Population and In-Migration



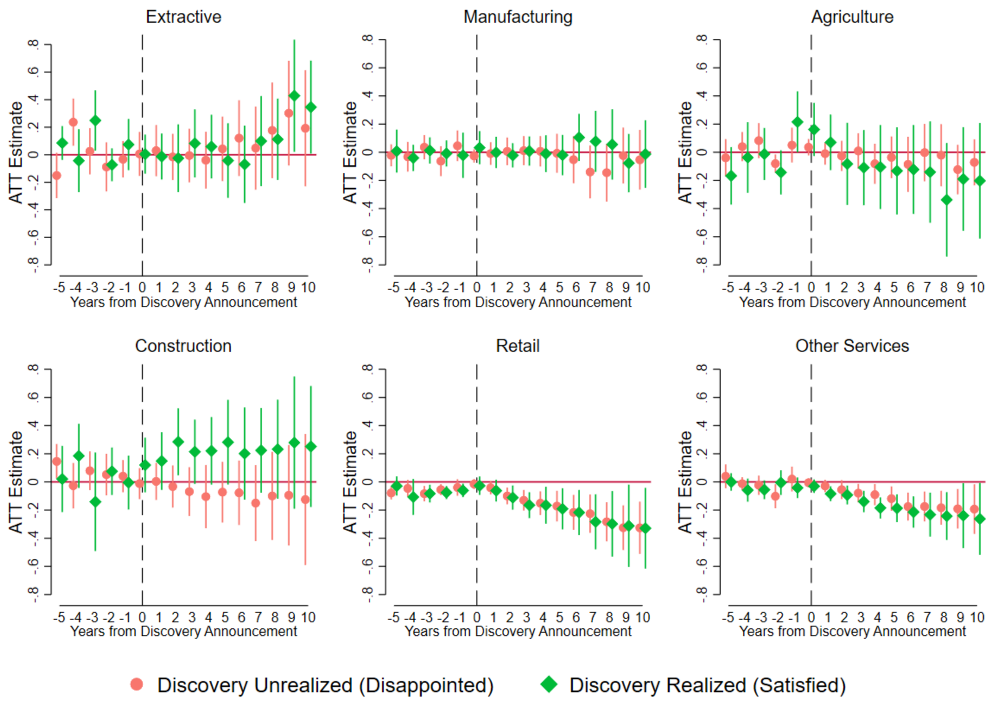
Note: Population data are drawn from IBGE. Formal labor in-migrants are calculated from RAIS, and total the number of formally registered workers whose primary employment was located in any other municipality in year t-1, and located in the municipality of interest in year t. The total number of in-migrants is calculated from the Demographic Censuses of 2000 and 2010 using retrospective migration questions. Data for the 2020 Demographic Census are not yet available, limiting the extent of these figures to the 2000-2010 window. This window misses a large proportion of the later effects of oil discoveries. All outcomes are transformed using the inverse hyperbolic sine transformation.

Figure A11: Number of Formal Employees by Sector



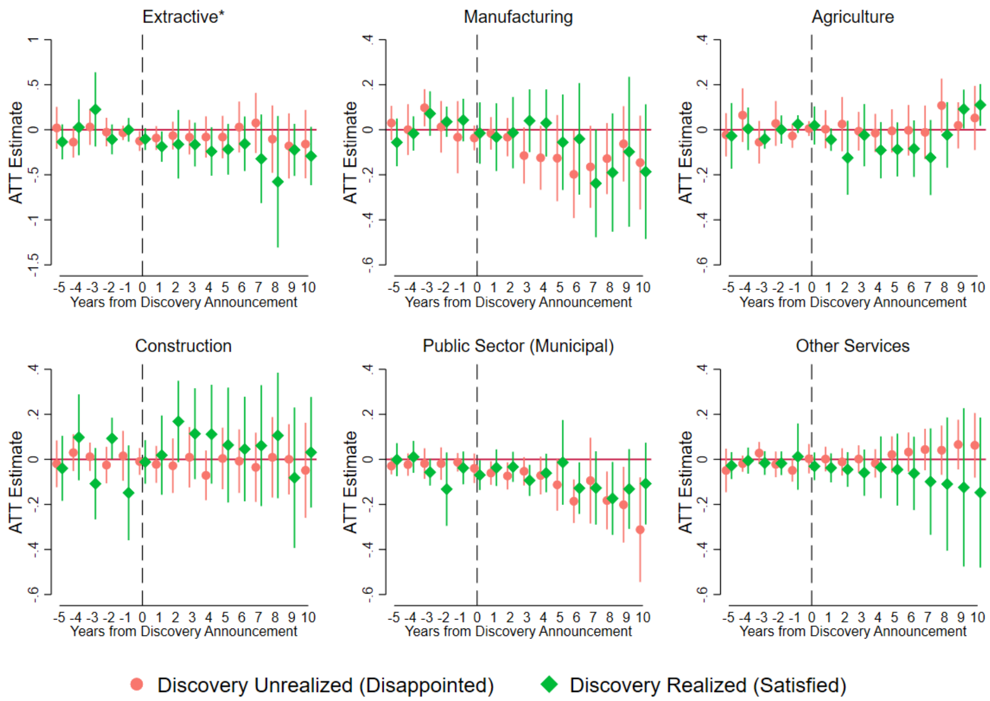
Note: Data on formal employment are drawn from RAIS. Number of employees is transformed using inverse hyperbolic sine transformation. Sectors are defined following the standard procedure in Dahis (2020).

Figure A12: Number of Formal Firms by Sector



Note: Data on formal firms are drawn from RAIS. Firms with only one employee are excluded to avoid counting independent contractors as firms. Number of firms is transformed using inverse hyperbolic sine transformation. Sectors are defined following the standard procedure in Dahis (2020).

Figure A13: Average Formal Earnings by Sector



Note: Data on formal earnings are drawn from RAIS. Formal earnings reflect total annual labor earnings across all formal jobs in that municipality-sector-year. Monetary values are deflated to constant 2010 BRL and transformed using the inverse hyperbolic sine transformation. Sectors are defined following the standard procedure in Dahis (2020).

B Supplementary Tables

B.1 Descriptive Tables

Table B1: Oil Company Discovery Announcements to *Comissão de Valores Mobiliários*

Company	% Wells in ANP Database	No. Wells Drilled	No. Discovery Announcements
Petróleo Brasileiro S.A - Petrobras	75.743	1402	134
OGX (Dommo Energia)	5.132	95	36
Equinor Brasil/Energy	5.078	94	0
Shell Brasil	2.485	46	0
Petro Rio O&G/Jaguar	2.107	39	0
Total E&P do Brasil	0.756	14	0
Enauta Energia S.A./Queiroz Galvão E&P	0.648	12	5
Perenco Brasil	0.540	10	0
Karoon Petroleo e Gas S.A.	0.432	8	1
Exxon Mobil Brasil	0.216	4	0
Chevron Brasil	0.054	1	0
Total	**93.2**	**1725**	177

[1] Other operators checked: Anadarko, BP, Devon, Eni, Maha, OP Energia, Repsol Sinopec, Texaco, Vanco, Wintershall, ONGC, Esso, Amerada Hess, Unocal, SHB; no CVM Market Communications available
[2] ANP made 2 discovery announcements that were reported in media but not by companies
[3] Petrobras often publishes market communications on behalf of its partners. Since it frequently partners with other companies on specific concessions, many companies' discoveries were reported in Petrobras announcements.

Table B2: Disappointed/Satisfied Classifications Under Alternative Forecasts

	Outcome (per capita)			Outcome (total)		
Municipality	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
ANGRADOSREIS33	D	D	D	D	D	D
ARACAJU28	D	D	D	D	D	D
ARACRUZ32	D	D	D	D	D	D
ARARUAMA33	D	D	D	D	D	D
AREIABRANCA24	D	D	D	D	D	D
ARMACAODOSBUZIOS33	D	D	D	D	D	D
ARRAIALDOCABO33	D	D	D	D	D	D
BALNEARIOCAMBORIU42	D	D	D	D	D	D
BARRADOSCOQUEIROS28	D	D	D	D	D	D
CABOFRIO33	D	D	D	D	D	D
CAMPOSDOSGOYTACAZES33	D	D	D	D	D	D
CANANEIA35	D	D	D	D	D	D
CANAVIEIRAS29	D	D	D	D	D	D
CASIMIRODEABREU33	D	D	D	S	S	D
ITANHAEM35	D	D	D	D	D	D
ITAPEMA42	D	D	D	D	D	D
ITAPORANGADAJUDA28	D	D	D	D	D	D
LINHARES32	D	D	D	S	D	D
MONGAGUA35	D	D	D	D	D	D
PACATUBA28	D	D	D	D	D	D
PARACURU23	D	D	D	D	D	D
PERUIBE35	D	D	D	D	D	D
QUISSAMA33	D	D	D	D	D	D
RIODASOSTRAS33	D	D	D	D	D	D
SAOFRANCISCODEITABAPOANA33	D	D	D	D	D	D
SAQUAREMA33	D	D	D	D	D	D
SERRA32	D	D	D	D	D	D
UBATUBA35	D	D	D	D	D	D
UNA29	D	D	D	D	D	D
VILAVELHA32	D	D	D	D	D	D
ANCHIETA32	S	S	S	S	S	S
CARAGUATATUBA35	S	S	S	S	S	S
FUNDAO32	S	S	S	S	S	S
IGUAPE35	S	S	S	S	S	S
ILHABELA35	S	S	S	S	S	S
ILHACOMPRIDA35	S	S	S	S	S	S
ITAPEMIRIM32	S	S	S	S	S	S
MACAE33	S	D	D	S	S	S
MANGARATIBA33	S	S	S	S	S	S
MARATAIZES32	S	S	D	S	S	D
MARICA33	S	D	D	S	S	D
NITEROI33	S	S	S	S	S	S
PARATI33	S	S	D	S	S	S
PIRAMBU28	S	S	S	S	S	S
PRESIDENTEKENNEDY32	S	S	S	S	S	S
RIODEJANEIRO33	S	S	S	S	S	S
SAOSEBASTIAO35	S	S	S	S	S	S
VITORIA32	S	D	D	S	D	D
Total Disappointed	**30**	**33**	**35**	**28**	**30**	**33**
Total Satisfied	**18**	**15**	**13**	**20**	**18**	**15**
Percent Disappointed	**62.5**	**68.8**	**72.9**	**58.3**	**62.5**	**68.8**

Note: D indicates that the municipality was Disappointed and S indicates that the municipality was satisfied under alternative forecasting definitions.

Table B3: Baseline (Year 2000) Descriptive Statistics

	Treated Samples		Control Samples		
	D	**S**	**Wells**	**Match-D**	**Match-S**
Latitude	-19.50	-21.82	-13.04	-20.21	-20.00
	(6.25)	(3.13)	(9.59)	(7.91)	(8.13)
Dist. from State Capital	116.62	88.59	150.15	192.14	92.79
	(85.35)	(57.12)	(120.02)	(143.64)	(38.81)
Population (Thousands)	91.88	398.53	55.42	38.11	56.82
	(122.23)	(1,367.51)	(81.82)	(77.30)	(471.41)
GDP per capita	17,769	13,779	6,552	6,814	7,840
	(26,418)	(12,003)	(6,735)	(7,261)	(9,641)
Annual Income p.c.	3,135	4,065	1,985	2,474	2,688
	(131)	(183)	(129)	(92)	(123)
Income Gini Coefficient	0.57	0.57	0.56	0.55	0.53
	(0.05)	(0.04)	(0.07)	(0.06)	(0.06)
Municipal Dev.Index	0.60	0.64	0.50	0.57	0.57
	(0.07)	(0.09)	(0.10)	(0.09)	(0.13)
Urban Share of Pop.	0.83	0.80	0.66	0.68	0.66
	(0.21)	(0.22)	(0.24)	(0.20)	(0.25)
% HHs w. Water/Sewer	7.76	3.63	20.56	10.03	10.67
	(8.01)	(3.95)	(19.57)	(12.19)	(15.81)
% Empl. in Extractive	1.07	0.96	1.03	0.44	0.45
	(2.01)	(1.98)	(3.57)	(1.01)	(0.96)
% Formally Employed	46.14	47.39	34.39	46.19	45.58
	(12.45)	(12.46)	(16.47)	(15.70)	(19.09)
Total Revenue p.c.	1,628	1,729	1,011	969	1,220
	(1,478)	(1,047)	(809)	(2,993)	(3,840)
Tax Revenue p.c.	209.3	395.5	123.3	71.4	114.7
	(224.4)	(438.5)	(276.0)	(459.8)	(596.1)
Oil Revenue p.c.	420.6	161.8	129.7	15.1	10.2
	(999.4)	(334.7)	(412.9)	(100.4)	(43.4)
Total Spending p.c.	1,222	1,435	807	857	1,062
	(973)	(812)	(554)	(2,913)	(3,745)
Public Invest. p.c.	161.0	123.1	98.2	55.0	69.7
	(223.9)	(110.3)	(172.1)	(116.9)	(143.8)
n	30	18	53	836	500

Note: Sample means with standard deviations in parentheses are reported for treated samples (D = Disappointed and S = Satisfied), as well as alternative control groups: Wells (never-treated municipalities with exploratory offshore wells completed after 1999), Match (D) (never-treated municipalities matched to Disappointed municipalities on geographic and pre-treatment characteristics using coarsened exact matching), and Match (S) (never-treated municipalities matched on Satisfied municipalities in the same manner). Monetary values are deflated to constant 2010 Brazilian Reals. Reported values are from baseline year 2000.

Table B4: Conditional Random Assignment: Baseline Characteristics

	$\mathbb{1}(Wells = 1)$	$\mathbb{1}(Discovery = 1)$	$\mathbb{1}(Satisfied = 1)$
Outcome	**p-value**	**p-value**	**p-value**
Population	0.261	0.661	0.206
GDP	0.016	0.902	0.235
Municipal Develop. Index	0.192	0.163	0.183
Urban Share of Population	0.484	0.600	0.123
Income per capita	0.022	0.673	0.404
Income Gini Coefficient	0.858	0.017	0.192
% Employed in Extractive	0.046	0.802	0.226
% Formally Employed	0.667	0.496	0.450
% Homes w. Water & Sewer	0.755	0.823	0.958
Sample	Municipalities on Coast	Municipalities w. Wells	Municipalities w. Discoveries
Observations	277	101	48

All regressions are estimated separately using OLS on cross-sectional municipality-level datasets and controlling for the following geographical controls: distance to federal and state capitals, latitude, and state fixed effects. All distances and monetary values use the inverse hyperbolic sine transformation. Outcomes are measured in 2000 (prior to discovery treatment) with the exception of GDP, which is reported in 2002. Model p-values associated with parameter β_1 from Equation 9 are reported. Insignificant p-values indicate that the outcome variable measured at baseline was not significantly predictive of that municipality getting wells, offshore discoveries, or a successful discovery realization in the post-2000 period.

Table B5: Conditional Random Assignment: Political Alignment

	$\mathbb{1}(Wells = 1)$	$\mathbb{1}(Discovery = 1)$	$\mathbb{1}(Satisfied = 1)$
Outcome	**p-value**	**p-value**	**p-value**
Cumulative Party Align. w. Governor	0.417	0.604	0.926
Cumulative Party Align. w. President	0.953	0.680	0.160
State Capital Dummy	0.091	0.745	0.198
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

Regressions in the first panel are estimated separately using OLS on cross-sectional municipality-level datasets and controlling for the following geographical controls: distance to federal and state capitals, latitude, and state fixed effects. All distances use the inverse hyperbolic sine transformation. Cumulative party alignment with governor is the number of years since 2000 in which the municipal mayor's political party was the same as the state governor's party. Likewise, cumulative party alignment with president is the number of years in which the mayor's party was the same as the federal president's party. Regressions in the second panel are estimated separately using logit models on municipality-year panel datasets and controlling for the same geographical controls. Contemporaneous party alignment with governor (likewise for president) is an indicator variable that takes a value of 1 in years when the municipal mayor's political party is the same as the state governor's party (or federal president's party). Model p-values associated with parameter β_1 from Equation 8 are reported.

B.2 Results Tables

Table B6: Revenues: ATT Estimates and Sample Characteristics

Disappointed Municipalities

	Total Rev.		Rev. p.c.		Oil Rev. p.c.		Tax Rev. p.c.		Transfer Rev. p.c.	
Time	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.
-5	-0.025	0.026	-0.026	0.027	-0.070	0.053	-0.111	0.045	0.008	0.013
-4	-0.003	0.021	-0.010	0.021	0.002	0.035	-0.050	0.057	-0.004	0.011
-3	0.019	0.027	0.014	0.027	-0.016	0.059	-0.086	0.032	-0.002	0.011
-2	-0.020	0.022	-0.035	0.025	-0.116	0.062	-0.074	0.037	-0.008	0.015
-1	-0.007	0.022	-0.009	0.023	-0.015	0.047	-0.117	0.062	-0.005	0.010
0	0.009	0.021	0.004	0.019	0.129	0.098	0.058	0.059	-0.010	0.012
+1	0.000	0.021	-0.018	0.021	0.277	0.178	0.156	0.077	-0.029	0.015
+2	-0.042	0.032	-0.084	0.041	0.281	0.216	0.008	0.087	-0.048	0.023
+3	-0.06	0.036	-0.112	0.049	0.226	0.247	-0.079	0.143	-0.043	0.026
+4	-0.063	0.043	-0.117	0.059	0.168	0.262	-0.029	0.180	-0.047	0.025
+5	-0.049	0.043	-0.106	0.061	0.349	0.314	-0.223	0.172	-0.058	0.026
+6	-0.111	0.047	-0.165	0.072	0.416	0.339	-0.299	0.201	-0.08	0.030
+7	-0.105	0.051	-0.166	0.070	0.460	0.378	-0.391	0.201	-0.075	0.032
+8	-0.192	0.068	-0.277	0.095	0.284	0.419	-0.323	0.245	-0.067	0.036
+9	-0.203	0.081	-0.287	0.113	0.177	0.478	-0.311	0.232	-0.09	0.044
+10	-0.408	0.103	-0.52	0.157	-0.030	0.676	-0.268	0.296	-0.142	0.058
$\overline{DV}$ (IHS)	19.38		8.37		4.35		6.07		6.88	
$\overline{DV}$	130,495,959		2,158		38.73		216.34		486.31	
n	1,392		1,392		1,494		1,392		1,441	
Units	83		83		83		83		81	

Satisfied Municipalities

	Total Rev.		Rev. p.c.		Oil Rev. p.c.		Tax Rev. p.c.		Transfer Rev. p.c.	
Time	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.
-5	-0.035	0.060	-0.068	0.060	0.027	0.181	-0.282	0.092	-0.034	0.033
-4	-0.066	0.037	-0.068	0.036	-0.083	0.149	-0.18	0.059	-0.015	0.029
-3	-0.022	0.032	-0.026	0.033	0.182	0.217	-0.057	0.057	-0.022	0.015
-2	-0.005	0.027	0.003	0.027	0.244	0.197	-0.050	0.051	0.014	0.011
-1	-0.031	0.021	-0.035	0.026	0.059	0.108	-0.16	0.052	-0.003	0.017
0	-0.007	0.029	-0.014	0.030	0.45	0.273	0.022	0.066	-0.033	0.013
+1	0.059	0.046	0.055	0.045	1.317	0.431	0.010	0.088	-0.027	0.018
+2	0.089	0.062	0.087	0.062	1.23	0.468	-0.006	0.110	-0.002	0.024
+3	0.114	0.057	0.108	0.061	1.509	0.607	0.039	0.120	-0.012	0.029
+4	0.101	0.074	0.103	0.076	1.783	0.629	-0.069	0.223	-0.008	0.034
+5	0.143	0.096	0.146	0.100	2.085	0.671	-0.025	0.231	-0.006	0.043
+6	0.128	0.107	0.130	0.112	2.221	0.695	-0.373	0.452	-0.004	0.044
+7	0.212	0.137	0.214	0.143	3.055	0.814	-0.143	0.249	0.035	0.054
+8	0.481	0.163	0.489	0.171	4.246	0.921	-0.334	0.342	0.050	0.054
+9	0.739	0.215	0.748	0.221	4.733	0.923	-0.001	0.307	0.040	0.063
+10	0.76	0.238	0.754	0.243	4.689	0.889	0.010	0.287	0.045	0.053
$\overline{DV}$ (IHS)	19.27		8.34		4.08		6.37		6.83	
$\overline{DV}$	116,902,735		2,094		29.56		292.03		462.59	
n	1,211		1,211		1,278		1,211		1,225	
Units	71		71		71		71		69	

Tables report coefficient estimates and robust asymptotic standard errors for municipal revenue outcomes for disappointed (top) and satisfied (bottom) samples. Disappointed municipalities received less than 40% of revenues expected from discovery announcements by 2017; satisfied municipalities received more than 40%. Never-treated control units are municipalities that received exploratory offshore wells in catchment zone after 1999, but no discoveries. Transfer Revenues per capita exclude oil and gas transfers. $\overline{DV}$ reports the mean of the dependent variable in period t-1. Specifications include municipality and year fixed effects and cluster standard errors at municipality-level. Estimates are generated using Callaway and Sant'Anna (2021) *csdid* estimator with bootstrapped standard errors (seed=39627236). Continuous outcome variables use inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL.

Table B7: Expenditure and Public Employment: ATT Estimates and Sample Characteristics

Disappointed Municipalities

	Tot. Spend		Spend p.c.		Ad. Spend p.c.		Person. Spend p.c.		Empl. p.c.	
Time	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.
-5	-0.076	0.034	-0.076	0.037	-0.005	0.068	-0.088	0.036	0.000	0.002
-4	0.004	0.025	-0.003	0.025	-0.109	0.077	-0.008	0.025	-0.001	0.001
-3	-0.009	0.023	-0.014	0.024	0.017	0.061	-0.002	0.032	0.001	0.002
-2	-0.041	0.025	-0.056	0.028	-0.041	0.045	-0.055	0.027	-0.001	0.002
-1	-0.028	0.026	-0.030	0.026	-0.007	0.060	-0.013	0.029	0.000	0.002
0	-0.006	0.029	-0.011	0.027	0.001	0.070	-0.009	0.027	0.000	0.002
+1	-0.002	0.027	-0.020	0.025	-0.011	0.054	-0.036	0.023	-0.003	0.004
+2	-0.029	0.031	-0.071	0.033	-0.355	0.242	-0.064	0.034	-0.002	0.003
+3	-0.040	0.033	-0.092	0.041	-0.085	0.089	-0.091	0.042	-0.003	0.004
+4	-0.026	0.035	-0.08	0.046	-0.125	0.081	-0.097	0.046	-0.004	0.003
+5	-0.050	0.043	-0.107	0.056	-0.18	0.096	-0.145	0.056	-0.005	0.004
+6	-0.087	0.050	-0.142	0.066	-0.138	0.093	-0.173	0.063	-0.008	0.005
+7	-0.093	0.054	-0.154	0.063	-0.132	0.097	-0.175	0.064	-0.004	0.005
+8	-0.156	0.068	-0.242	0.077	-0.277	0.135	-0.267	0.080	-0.004	0.008
+9	-0.18	0.076	-0.264	0.086	-0.396	0.129	-0.311	0.093	-0.004	0.006
+10	-0.318	0.092	-0.43	0.121	-0.621	0.167	-0.498	0.130	-0.009	0.008
$\overline{DV}$ (IHS)	18.71		7.70		6.55		7.51		0.05	
$\overline{DV}$	66,775,902		1,104		349.62		913.11		0.05	
n	1,392		1,392		1,313		1,392		1,494	
Units	83		83		83		83		83	

Satisfied Municipalities

	Tot. Spend		Spend p.c.		Ad. Spend p.c.		Person. Spend p.c.		Empl. p.c.	
Time	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.
-5	-0.059	0.052	-0.092	0.039	-0.051	0.093	-0.121	0.049	-0.002	0.004
-4	-0.044	0.041	-0.046	0.041	-0.232	0.121	-0.001	0.043	-0.012	0.008
-3	0.030	0.038	0.027	0.037	0.046	0.062	-0.009	0.036	0.010	0.007
-2	-0.025	0.032	-0.017	0.033	-0.071	0.107	-0.017	0.030	0.000	0.002
-1	-0.027	0.030	-0.031	0.033	-0.363	0.397	-0.05	0.026	-0.004	0.003
0	-0.073	0.045	-0.081	0.046	0.335	0.281	-0.028	0.023	0.002	0.005
+1	-0.055	0.045	-0.059	0.045	0.313	0.301	-0.029	0.034	0.000	0.004
+2	-0.005	0.052	-0.007	0.050	0.409	0.330	-0.019	0.040	0.006	0.005
+3	-0.017	0.058	-0.022	0.058	0.446	0.340	0.006	0.051	0.003	0.005
+4	-0.012	0.051	-0.010	0.054	0.592	0.384	-0.005	0.055	0.009	0.005
+5	0.007	0.068	0.010	0.068	0.555	0.372	0.013	0.072	0.014	0.006
+6	-0.011	0.068	-0.008	0.069	0.432	0.382	-0.012	0.074	0.016	0.007
+7	0.061	0.073	0.063	0.073	0.693	0.577	0.044	0.086	0.007	0.011
+8	0.111	0.111	0.120	0.107	1.074	0.620	0.081	0.108	0.016	0.011
+9	0.247	0.130	0.256	0.132	1.561	0.781	0.235	0.132	0.029	0.015
+10	0.283	0.110	0.277	0.105	1.535	0.745	0.278	0.121	0.029	0.013
$\overline{DV}$ (IHS)	18.75		7.83		6.13		7.58		0.05	
$\overline{DV}$	69,501,078		1,257		229.72		979.31		0.05	
n	1,211		1,211		1,138		1,211		1,278	
Units	71		71		71		71		71	

Tables report coefficient estimates and robust asymptotic standard errors for municipal expenditure and public employment outcomes for disappointed (top) and satisfied (bottom) samples. Disappointed municipalities received less than 40% of revenues expected from discovery announcements by 2017; satisfied municipalities received more than 40%. Never-treated control units are municipalities that received exploratory offshore wells in catchment zone after 1999, but no discoveries. Spending variables refer to current (realized) spending. $\overline{DV}$ reports the mean of the dependent variable in period t-1. Specifications include municipality and year fixed effects and cluster standard errors at municipality-level. Estimates are generated using Callaway and Sant'Anna (2021) *csdid* estimator with bootstrapped standard errors (seed=39627236). Continuous outcome variables use inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL.

Table B8: Invest. & Diversification: ATT Estimates & Sample Characteristics

Disappointed Municipalities

	Investment p.c.		Diversif. Spends p.c.	
Time	Coef.	St. Err.	Coef.	St. Err.
-5	0.215	0.155	0.202	0.413
-4	0.047	0.094	-0.078	0.361
-3	0.202	0.118	0.296	0.354
-2	-0.242	0.116	-0.233	0.294
-1	0.144	0.106	-0.273	0.265
0	-0.146	0.100	-0.020	0.328
+1	-0.191	0.159	0.032	0.366
+2	-0.334	0.140	-0.013	0.342
+3	-0.418	0.175	-0.225	0.359
+4	-0.398	0.199	-0.171	0.345
+5	-0.46	0.213	-0.213	0.314
+6	-0.533	0.205	-0.311	0.332
+7	-0.612	0.197	-0.023	0.355
+8	-0.873	0.245	-0.142	0.359
+9	-0.655	0.291	-0.013	0.436
+10	-1.262	0.332	0.084	0.485
$\overline{DV}$ (IHS)	6.03		3.17	
$\overline{DV}$	207.86		11.88	
n	1,423		1,494	
Units	83		83	

Satisfied Municipalities

	Investment p.c.		Diversif. Spend. p.c.	
Time	Coef.	St. Err.	Coef.	St. Err.
-5	-0.190	0.264	-0.053	0.493
-4	0.057	0.246	0.806	0.417
-3	0.398	0.246	0.410	0.277
-2	-0.117	0.128	-0.782	0.319
-1	-0.128	0.248	0.261	0.216
0	-0.003	0.356	-0.229	0.248
+1	-0.004	0.373	-0.532	0.440
+2	0.339	0.410	-0.210	0.411
+3	-0.141	0.458	-0.393	0.426
+4	0.315	0.415	-0.428	0.447
+5	0.394	0.455	-0.615	0.492
+6	0.078	0.525	-0.721	0.551
+7	0.485	0.591	-1.092	0.774
+8	1.156	0.688	-1.244	0.873
+9	1.440	0.892	-0.848	0.960
+10	1.471	0.698	-1.066	0.625
$\overline{DV}$ (IHS)	5.54		3.58	
$\overline{DV}$	127.34		17.92	
n	1,230		1,278	
Units	71		71	

Tables report coefficient estimates and robust asymptotic standard errors for municipal investment and economic promotion spending for disappointed (top) and satisfied (bottom) samples. Disappointed municipalities received less than 40% of revenues expected from discovery announcements by 2017; satisfied municipalities received more than 40%. Never-treated control units are municipalities that received exploratory offshore wells in catchment zone after 1999, but no discoveries. Investment refers to public municipal investment (e.g., infrastructure). Economic diversification spending is the sum of municipal spending to promote industry, services, and agriculture. $\overline{DV}$ reports the mean of the dependent variable in period t-1. Specifications include municipality and year fixed effects and cluster standard errors at municipality-level. Estimates are generated using Callaway and Sant'Anna (2021) *csdid* estimator with bootstrapped standard errors (seed=39627236). Continuous outcome variables use inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL.

Table B9: Public Goods: ATT Estimates and Sample Characteristics

Disappointed Municipalities

	Ed. Spending p.c.		Health Spending p.c.		Ed. Index		Health Index	
Time	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.
-5	-0.067	0.046	-0.282	0.315	-0.010	0.012	-0.032	0.016
-4	-0.156	0.194	0.000	0.051	0.004	0.009	-0.012	0.012
-3	0.193	0.192	-0.039	0.053	-0.013	0.011	-0.024	0.007
-2	-0.039	0.040	-0.020	0.042	-0.011	0.009	-0.003	0.007
-1	-0.005	0.037	0.052	0.060	-0.009	0.007	0.000	0.005
0	-0.032	0.031	-0.074	0.053	-0.004	0.003	-0.005	0.006
+1	-0.002	0.037	-0.066	0.090	-0.007	0.005	-0.010	0.011
+2	-0.366	0.291	-0.352	0.257	-0.013	0.006	-0.003	0.018
+3	-0.196	0.112	-0.23	0.125	-0.011	0.008	-0.007	0.020
+4	-0.135	0.060	-0.145	0.071	-0.011	0.009	-0.017	0.023
+5	-0.158	0.068	-0.165	0.078	-0.013	0.012	-0.026	0.027
+6	-0.182	0.070	-0.155	0.092	-0.015	0.012	-0.030	0.031
+7	-0.178	0.073	-0.151	0.102	-0.015	0.015	-0.056	0.039
+8	-0.232	0.082	-0.255	0.101	-0.017	0.015	-0.081	0.050
+9	-0.253	0.099	-0.286	0.132	-0.05	0.014	-0.162	0.027
+10	-0.439	0.152	-0.408	0.148	-0.052	0.018	-0.208	0.021
$\overline{DV}$ (IHS)	6.97		6.82		0.69		0.73	
$\overline{DV}$	532.11		457.99		0.75		0.80	
n	1,392		1,392		996		996	
Units	83		83		83		83	

Satisfied Municipalities

	Ed. Spending p.c.		Health Spending p.c.		Ed. Index		Health Index	
Time	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.
-5	-0.102	0.055	-0.057	0.082	-0.015	0.012	-0.016	0.007
-4	-0.094	0.055	0.063	0.064	-0.031	0.008	-0.02	0.011
-3	0.063	0.041	-0.069	0.062	-0.019	0.008	-0.009	0.006
-2	-0.060	0.047	-0.001	0.049	-0.007	0.015	-0.007	0.006
-1	-0.019	0.040	-0.141	0.077	0.007	0.015	-0.006	0.004
0	-0.041	0.048	0.092	0.091	-0.016	0.005	-0.013	0.007
+1	0.003	0.071	0.223	0.089	-0.023	0.013	-0.031	0.013
+2	0.048	0.068	0.188	0.084	-0.029	0.010	-0.046	0.016
+3	0.020	0.052	0.043	0.097	-0.028	0.014	-0.055	0.017
+4	-0.034	0.057	-0.074	0.125	-0.032	0.017	-0.076	0.018
+5	0.013	0.067	0.082	0.090	-0.033	0.018	-0.087	0.019
+6	0.004	0.070	0.136	0.112	-0.044	0.027	-0.101	0.016
+7	0.032	0.084	0.195	0.158	-0.049	0.035	-0.105	0.016
+8	0.143	0.103	0.332	0.158	-0.088	0.018	-0.112	0.019
+9	0.366	0.226	0.449	0.274	-0.086	0.020	-0.114	0.017
+10	0.378	0.122	0.455	0.205	-0.087	0.019	-0.139	0.025
$\overline{DV}$ (IHS)	7.01		6.71		0.78		0.82	
$\overline{DV}$	553.83		410.28		0.86		0.92	
n	1,208		1,208		852		852	
Units	71		71		71		71	

Tables report coefficient estimates and robust asymptotic standard errors for municipal public goods spending and real public goods provision for disappointed (top) and satisfied (bottom) samples. Disappointed municipalities received less than 40% of revenues expected from discovery announcements by 2017; satisfied municipalities received more than 40%. Never-treated control units are municipalities that received exploratory offshore wells in catchment zone after 1999, but no discoveries. Education and Health Indices are drawn from the FIRJAN Municipal Development Index (FIRJAN, 2020), a comprehensive measure of municipal development published annually by FIRJAN, a nonprofit. The Education Index is an aggregate score ranging from 0-1, composed of the following indicators: early childhood enrollment rates, graduation rates, grade-age distortion, hours spent in class, share of teachers with college degrees, and IDEB test scores. The Health Index is an aggregate score ranging from 0-1, composed of the following indicators: proportion of pregnant women receiving >7 pre-natal visits, deaths of undefined causes, and avoidable infant mortality. $\overline{DV}$ reports the mean of the dependent variable in period t-1. Specifications include municipality and year fixed effects and cluster standard errors at municipality-level. Estimates are generated using Callaway and Sant'Anna (2021) *csdid* estimator with bootstrapped standard errors (seed=39627236). Continuous outcome variables use inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL.

Table B10: GDP & Econ. Activity: ATT Estimates & Sample Characteristics

Disappointed Municipalities

	GDP p.c.		Employment		Firms		Avg. Earnings	
Time	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.
-5	-0.062	0.024	-0.057	0.025	-0.027	0.016	-0.037	0.021
-4	0.13	0.079	-0.046	0.024	-0.015	0.017	-0.011	0.017
-3	-0.025	0.031	-0.041	0.046	-0.028	0.021	-0.006	0.016
-2	-0.098	0.036	0.025	0.026	-0.053	0.016	-0.012	0.024
-1	0.046	0.029	0.002	0.021	0.007	0.024	-0.05	0.03
0	0.038	0.030	-0.025	0.031	-0.009	0.011	0.011	0.023
1	0.005	0.044	-0.067	0.062	-0.019	0.015	-0.012	0.019
2	-0.013	0.059	-0.034	0.045	-0.048	0.022	-0.043	0.022
3	0.050	0.087	-0.042	0.047	-0.065	0.027	-0.035	0.024
4	-0.016	0.092	-0.078	0.051	-0.087	0.032	-0.064	0.028
5	-0.046	0.089	-0.083	0.057	-0.101	0.04	-0.074	0.034
6	-0.053	0.110	-0.098	0.069	-0.132	0.044	-0.112	0.033
7	-0.025	0.115	-0.056	0.074	-0.148	0.049	-0.082	0.05
8	-0.224	0.185	-0.008	0.102	-0.173	0.057	-0.123	0.045
9	-0.120	0.182	0.008	0.096	-0.186	0.065	-0.129	0.05
10	-0.345	0.290	0.021	0.118	-0.180	0.076	-0.188	0.064
$\overline{DV}$ (IHS)	3.51		10.18		7.321		7.465	
$\overline{DV}$	16.71		13,185		756		873	
n	1,162		1,494		1,494		1,494	
Units	83		83		83		83	

Satisfied Municipalities

	GDP p.c.		Employment		Firms		Avg. Earnings	
Time	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.	Coef.	St. Err.
-5	-0.023	0.053	-0.053	0.033	-0.025	0.025	-0.019	0.015
-4	0.035	0.032	-0.085	0.058	-0.034	0.05	-0.009	0.026
-3	-0.024	0.037	-0.028	0.022	-0.046	0.018	-0.027	0.016
-2	0.060	0.035	-0.006	0.044	-0.032	0.018	-0.054	0.039
-1	-0.067	0.033	-0.096	0.038	-0.024	0.023	-0.018	0.027
0	0.022	0.048	-0.018	0.026	0.013	0.043	-0.032	0.021
1	0.089	0.081	-0.009	0.028	-0.028	0.040	-0.033	0.020
2	0.066	0.092	-0.045	0.039	-0.050	0.041	-0.024	0.019
3	0.225	0.181	-0.049	0.031	-0.085	0.046	-0.054	0.026
4	0.320	0.212	-0.052	0.048	-0.109	0.053	-0.037	0.029
5	0.563	0.299	-0.055	0.056	-0.128	0.058	-0.017	0.048
6	0.684	0.278	-0.089	0.069	-0.143	0.061	-0.069	0.041
7	0.997	0.210	-0.108	0.086	-0.173	0.076	-0.073	0.058
8	1.361	0.301	-0.114	0.107	-0.185	0.083	-0.098	0.053
9	1.406	0.348	-0.069	0.111	-0.212	0.104	-0.073	0.061
10	1.587	0.458	-0.071	0.131	-0.218	0.107	-0.075	0.066
$\overline{DV}$ (IHS)	3.35		10.23		7.19		7.50	
$\overline{DV}$	14.23		13,861		663.05		904.02	
n	994		1,278		1278		1278	
Units	71		71		71		71	

Tables report coefficient estimates and robust asymptotic standard errors for municipal GDP per capita and formal economic activity indicators for disappointed (top) and satisfied (bottom) samples. Disappointed municipalities received less than 40% of revenues expected from discovery announcements by 2017; satisfied municipalities received more than 40%. Never-treated control units are municipalities that received exploratory offshore wells in catchment zone after 1999, but no discoveries. GDP per capita is drawn from IBGE. Number of formal employees and firms and average formal earnings are calculated from RAIS linked employer-employee administrative records. $\overline{DV}$ reports the mean of the dependent variable in period t-1. Specifications include municipality and year fixed effects and cluster standard errors at municipality-level. Estimates are generated using Callaway and Sant'Anna (2021) *csdid* estimator with bootstrapped standard errors (seed=39627236). Continuous outcome variables use inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL.

Table B11: Discovery Effects on Winner Characteristics and Patronage

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

Table reports results from estimation of the following difference-in-differences specification: $Y_{me} = \delta_m + \lambda_e + \beta T_{me} + \epsilon_{me}$, where Y_{me} are outcomes measuring average characteristics of winning candidates (mayor and municipal council) and measures of patronage intensity, δ_m and λ_e are municipality and election period FEs, and T_{me} is a binary treatment dummy that takes a value of 1 if a major offshore oil or gas discovery was announced during the previous four-year election period in a municipality m's offshore catchment zone. T_{me} may turn on multiple times for a municipality. Standard errors are clustered at the municipality level in all specifications. Column 1 reports coefficient estimates and standard errors using a two-way fixed effects (TWFE) OLS estimator with the wells control group. Column 2 reports results using the TWFE estimator and treated and control groups matched on baseline characteristics. Measures of patronage intensity are generated by merging complete registries of campaign donors to successful municipal candidates (mayors or all politicians) with complete registries of formal employees from RAIS using unique stable ID number (CPFs). Using these merges, I keep instances in which campaign donors to successful candidates are hired during that candidate's term in office into a commissioned public job, which are filled at the discretion of local politicians. Three measures of patronage intensity are regressed on discovery treatment: (i) number of campaign donors to successful candidates who are hired to commissioned posts during those candidates' terms in office; (ii) share of total commissioned hires who were campaign donors; (iii) share of campaign donors who are hired to commissioned posts. Number of donors is transformed using the inverse hyperbolic sine transformation. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

C Robustness Checks and Extensions

C.1 Robustness Across Samples and Estimators

Table C1: Treatment Effects at $t + 10$ in **Disappointed** Municipalities

	CS Wells	CS Matched	TWFE Wells	TWFE Matched
Total Revenue (Millions)	-0.41	-0.24	-0.20	-0.07
	(0.10)	(0.10)	(0.08)	(0.07)
Revenue p.c.	-0.52	-0.46	-0.26	-0.23
	(0.16)	(0.17)	(0.11)	(0.10)
Tax Revenue p.c.	-0.27	-0.18	-0.35	-0.34
	(0.30)	(0.27)	(0.23)	(0.18)
Oil Revenue p.c.	-0.03	0.46	0.16	0.50
	(0.68)	(0.69)	(0.43)	(0.39)
Transfer Revenue p.c.	-0.14	-0.13	-0.07	-0.06
	(0.06)	(0.05)	(0.04)	(0.04)
Total Spending (Millions)	-0.32	-0.10	-0.17	0.00
	(0.09)	(0.09)	(0.07)	(0.07)
Spending p.c.	-0.43	-0.32	-0.23	-0.14
	(0.12)	(0.13)	(0.08)	(0.07)
Investment p.c.	-1.26	-1.33	-0.70	-0.80
	(0.33)	(0.34)	(0.28)	(0.26)
Personnel Spending p.c.	-0.50	-0.35	-0.26	-0.16
	(0.13)	(0.14)	(0.09)	(0.08)
Education Spending p.c.	-0.44	-0.37	-0.25	-0.19
	(0.15)	(0.14)	(0.10)	(0.09)
Health Spending p.c.	-0.41	-0.46	-0.24	-0.33
	(0.15)	(0.11)	(0.12)	(0.11)
Education Index	-0.05	-0.04	-0.03	-0.01
	(0.02)	(0.01)	(0.02)	(0.01)
Health Index	-0.21	-0.17	-0.09	-0.03
	(0.02)	(0.01)	(0.03)	(0.02)
GDP p.c.	-0.35	-0.24	-0.12	-0.12
	(0.29)	(0.32)	(0.17)	(0.15)
Population	0.11	0.22	0.05	0.14
	(0.08)	(0.09)	(0.08)	(0.07)
# Mfg. Employees	-0.25	0.28	-0.18	0.31
	(0.23)	(0.19)	(0.21)	(0.17)
# Construct. Employees	-0.50	-0.46	-0.79	-0.56
	(0.28)	(0.21)	(0.28)	(0.18)
Avg. Formal Earnings	-0.26	-0.04	-0.11	-0.02
	(0.15)	(0.14)	(0.05)	(0.04)
n (municipality-years)	1,494	15,570	1,494	15,570

Note: Each column reports coefficient estimates and standard errors for the $t + 10$ period of event studies of **disappointed** municipalities for a specific control group-estimator pair. Event study specifications include fully saturated relative time indicators, municipality and year fixed effects, and cluster standard errors at the municipality-level. Column 1 reports results from the preferred specification, which uses the Callaway and Sant'Anna (2021) (CS) *csdid* estimator (with bootstrapped standard errors, seed=39627236) and municipalities that had offshore exploratory wells drilled since 2000, but no discoveries, as a control group. Column 2 reports results using the CS estimator and a control group matched with disappointed municipalities on baseline characteristics using Coarsened Exact Matching. Columns 3 and 4 report results from wells and matched control groups using the two-way fixed effects (TWFE) OLS estimator. Monetary values are deflated to constant 2010 BRL$. All outcomes are transformed using the inverse hyperbolic sine transformation.

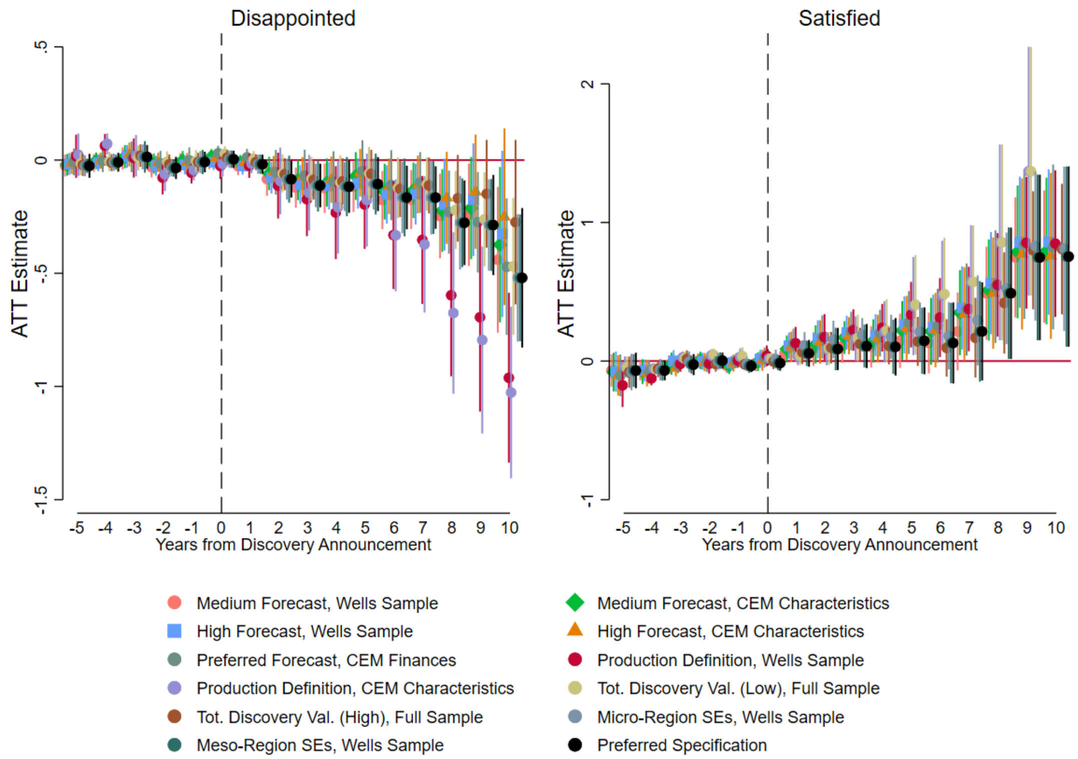
Table C2: Treatment Effects at $t + 10$ in **Satisfied** Municipalities

	CS Wells	CS Matched	TWFE Wells	TWFE Matched
Total Revenue (Millions)	0.76	0.92	0.65	0.83
	(0.24)	(0.27)	(0.20)	(0.19)
Revenue p.c.	0.75	0.86	0.66	0.77
	(0.24)	(0.27)	(0.20)	(0.19)
Tax Revenue p.c.	0.01	0.27	-0.21	0.07
	(0.29)	(0.27)	(0.30)	(0.26)
Oil Revenue p.c.	4.69	5.32	4.35	4.49
	(0.89)	(0.94)	(0.68)	(0.69)
Transfer Revenue p.c.	0.05	0.09	0.04	0.08
	(0.05)	(0.05)	(0.05)	(0.05)
Total Spending (Millions)	0.28	0.45	0.24	0.43
	(0.11)	(0.11)	(0.12)	(0.11)
Spending p.c.	0.28	0.37	0.25	0.38
	(0.11)	(0.11)	(0.12)	(0.11)
Investment p.c.	1.47	1.42	0.82	0.92
	(0.70)	(0.79)	(0.71)	(0.72)
Personnel Spending p.c.	0.28	0.42	0.19	0.32
	(0.12)	(0.12)	(0.11)	(0.10)
Education Spending p.c.	0.38	0.43	0.35	0.41
	(0.13)	(0.10)	(0.20)	(0.19)
Health Spending p.c.	0.46	0.30	0.34	0.31
	(0.21)	(0.22)	(0.23)	(0.19)
Education Index	-0.09	-0.08	-0.04	0.00
	(0.02)	(0.00)	(0.02)	(0.02)
Health Index	-0.14	-0.11	-0.07	0.02
	(0.03)	(0.02)	(0.03)	(0.03)
GDP p.c.	1.59	1.75	1.42	1.51
	(0.46)	(0.58)	(0.31)	(0.30)
Population	-0.004	0.06	-0.01	0.06
	(0.05)	(0.03)	(0.05)	(0.04)
# Mfg. Employees	-0.26	0.18	-0.21	0.25
	(0.21)	(0.19)	(0.22)	(0.17)
# Construct. Employees	0.23	0.19	0.07	0.17
	(0.48)	(0.49)	(0.39)	(0.33)
Avg. Formal Wage	-0.14	0.09	-0.09	0.00
	(0.16)	(0.16)	(0.05)	(0.04)
n (municipality-years)	1,278	9,012	1,278	9,012

Note: Each column reports coefficient estimates and standard errors for the $t + 10$ period of event studies of **satisfied** municipalities for a specific control group-estimator pair. Event study specifications include fully saturated relative time indicators, municipality and year fixed effects, and cluster standard errors at the municipality-level. Column 1 reports results from the preferred specification, which uses the Callaway and Sant'Anna (2021) (CS) *csdid* estimator (with bootstrapped standard errors, seed=39627236) and municipalities that had offshore exploratory wells drilled since 2000, but no discoveries, as a control group. Column 2 reports results using the CS estimator and a control group matched with satisfied municipalities on baseline characteristics using Coarsened Exact Matching. Columns 3 and 4 report results from wells and matched control groups using the two-way fixed effects (TWFE) OLS estimator. Monetary values are deflated to constant 2010 BRL$. All outcomes are transformed using the inverse hyperbolic sine transformation.

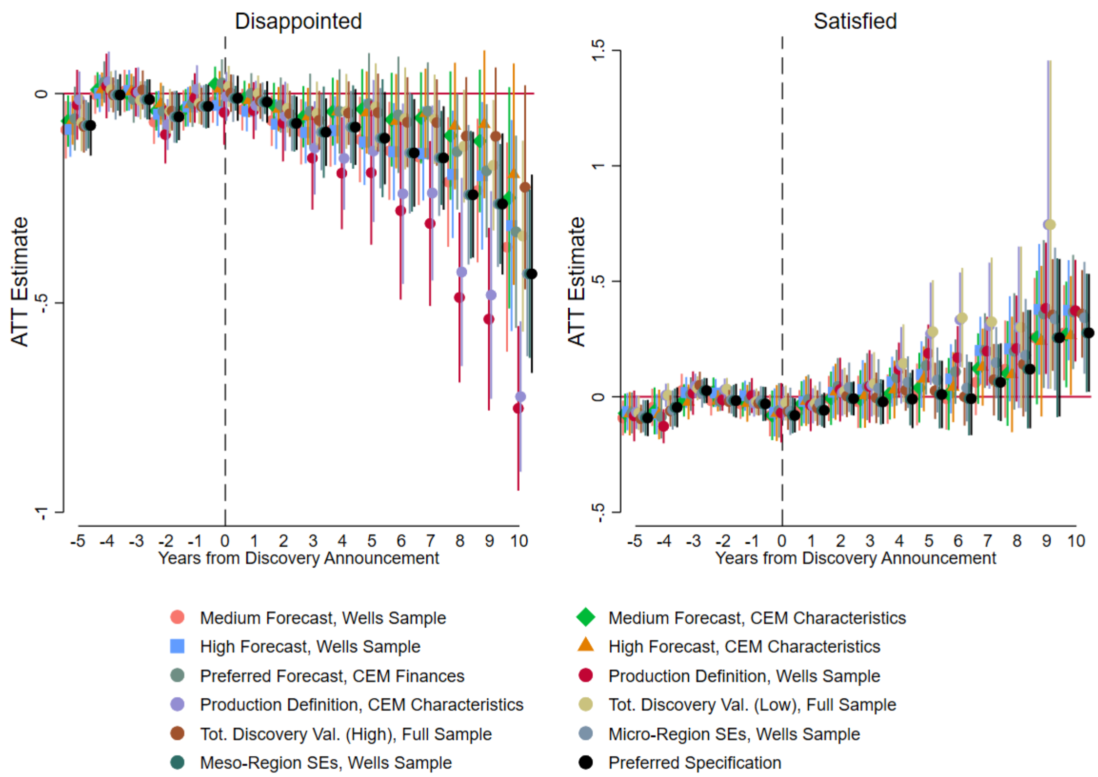
C.2 Robustness to Alternative Model Specifications

Figure C1: Robustness: Revenues per capita



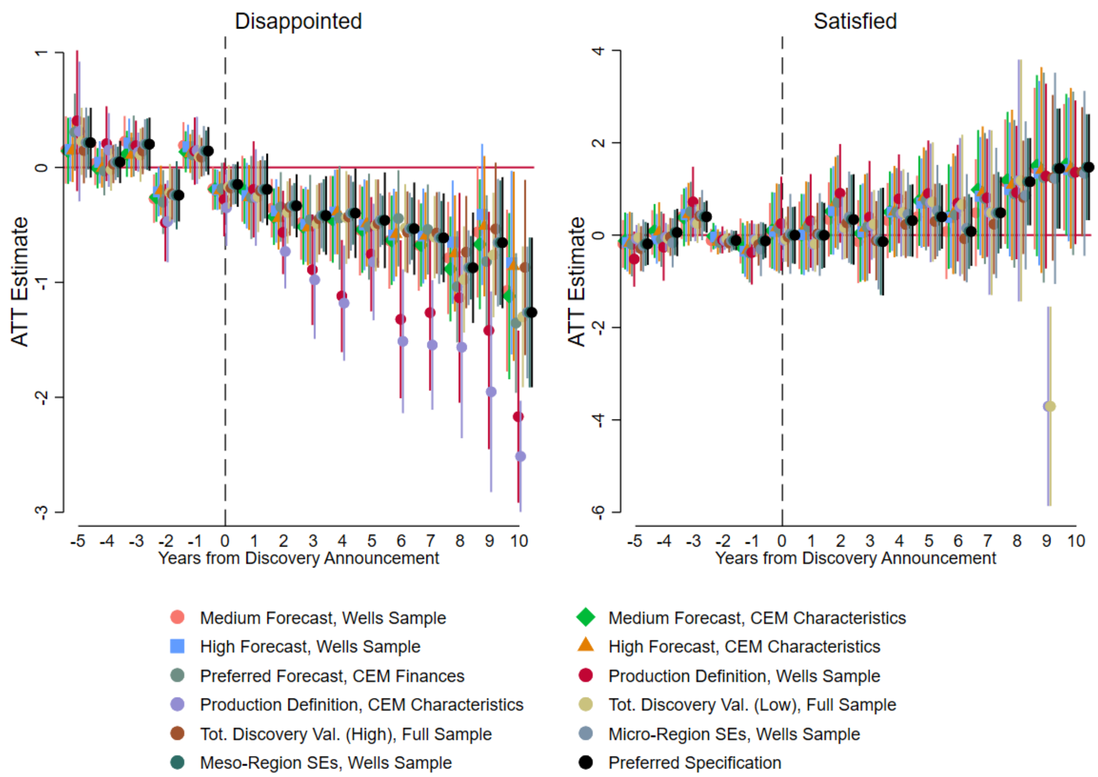
Note: Event studies are estimated separately using Callaway and Sant'Anna (2021) estimator with municipality and year FEs and standard errors clustered at municipality-level, and plotted together for visual comparison. The **Preferred Specification** (also reported in main results section) uses conservative low forecasts of per capita discovery expectations to categorize disappointed and satisfied municipalities, and compares treated places to the Wells control group, which received offshore exploratory drilling but no discoveries during study period. **Medium Forecast, Wells Sample** and **Medium Forecast, CEM Characteristics** use more optimistic forecasting parameters to categorize disappointed and satisfied municipalities, and compare treated units to Wells control group and never-treated municipalities matched on baseline characteristics using Coarsened Exact Matching (CEM) procedure, respectively. **High Forecast, Wells Sample** and **High Forecast, CEM Characteristics** use even more optimistic forecasting parameters to categorize disappointed and satisfied treatment groups. Municipality classifications using these alternative forecasting parameters are reported in Appendix B2. **Preferred Forecast, CEM Finances** uses main forecasting parameters to categorize disappointed and satisfied municipalities and a control group of never-treated municipalities that match treated units on baseline public finance variables (outcomes). **Production Definition, Wells Sample** and **Production Definition, CEM Characteristics** use an alternative categorization of discovery-treated municipalities into disappointed and satisfied, wherein satisfied municipalities are those that produce more than twice as much oil equivalent in 2017 as they did at the time of discovery announcement; disappointed municipalities are those that produce less than twice as much. This definition avoids assumptions built into the expectations forecasting model. **Total Discovery Value (Low), Full Sample** and **Total Discovery Value (High), Full Sample** use total, rather than per capita discovery volume announcements to compute forecasts, with the former using conservative low forecasts and the latter using optimistic high forecasts, and use the full sample of all municipalities in coastal states as a control group. **Micro-Region Standard Errors, Wells Sample** and **Meso-Region Standard Errors, Wells Sample** re-estimate the preferred specification with standard errors clustered at alternative levels to account for spatial and serial correlation: micro-regions (approximately 10 adjacent municipalities, comparable to a commuting zone) and meso-regions (approximately 40-50 adjacent municipalities). Revenues per capita are transformed using inverse hyperbolic sine and deflated to constant 2010 BRL.

Figure C2: Robustness: Expenditures per capita



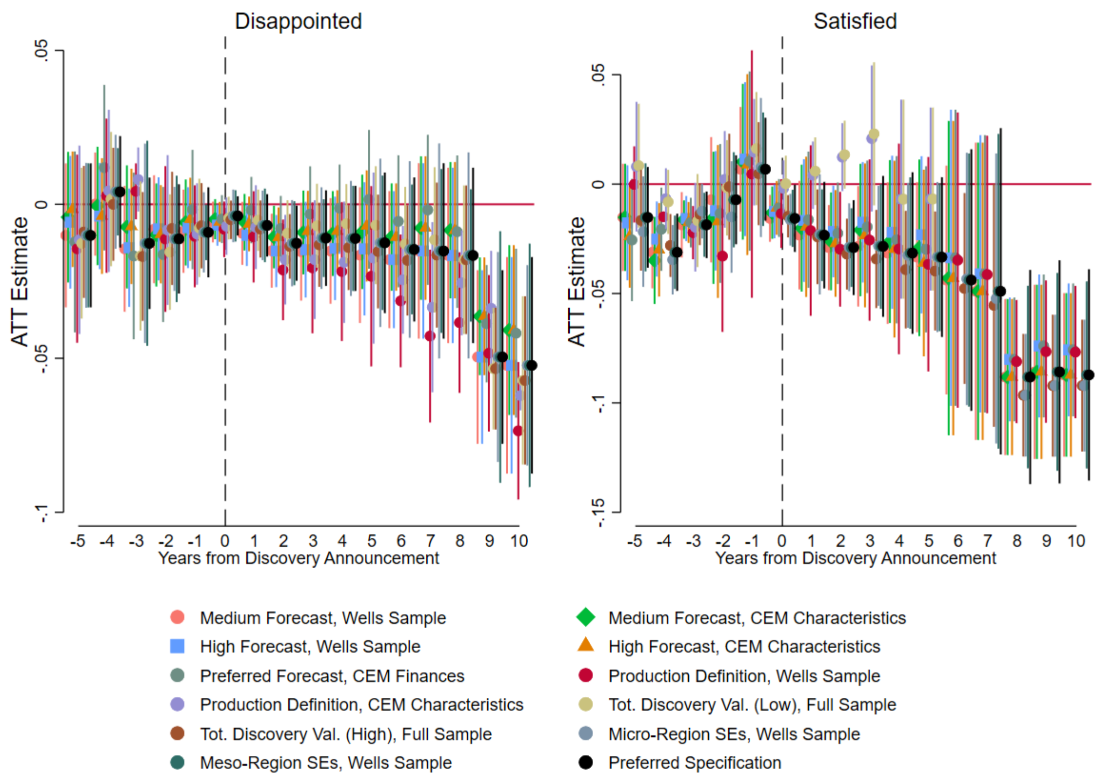
Note: Event studies are estimated separately using Callaway and Sant'Anna (2021) estimator with municipality and year FEs and standard errors clustered at municipality-level, and plotted together for visual comparison. The **Preferred Specification** (also reported in main results section) uses conservative low forecasts of per capita discovery expectations to categorize disappointed and satisfied municipalities, and compares treated places to the Wells control group, which received offshore exploratory drilling but no discoveries during study period. **Medium Forecast, Wells Sample** and **Medium Forecast, CEM Characteristics** use more optimistic forecasting parameters to categorize disappointed and satisfied municipalities, and compare treated units to Wells control group and never-treated municipalities matched on baseline characteristics using Coarsened Exact Matching (CEM) procedure, respectively. **High Forecast, Wells Sample** and **High Forecast, CEM Characteristics** use even more optimistic forecasting parameters to categorize disappointed and satisfied treatment groups. Municipality classifications using these alternative forecasting parameters are reported in Appendix B2. **Preferred Forecast, CEM Finances** uses main forecasting parameters to categorize disappointed and satisfied municipalities and a control group of never-treated municipalities that match treated units on baseline public finance variables (outcomes). **Production Definition, Wells Sample** and **Production Definition, CEM Characteristics** use an alternative categorization of discovery-treated municipalities into disappointed and satisfied, wherein satisfied municipalities are those that produce more than twice as much oil equivalent in 2017 as they did at the time of discovery announcement; disappointed municipalities are those that produce less than twice as much. This definition avoids assumptions built into the expectations forecasting model. **Total Discovery Value (Low), Full Sample** and **Total Discovery Value (High), Full Sample** use total, rather than per capita discovery volume announcements to compute forecasts, with the former using conservative low forecasts and the latter using optimistic high forecasts, and use the full sample of all municipalities in coastal states as a control group. **Micro-Region Standard Errors, Wells Sample** and **Meso-Region Standard Errors, Wells Sample** re-estimate the preferred specification with standard errors clustered at alternative levels to account for spatial and serial correlation: micro-regions (approximately 10 adjacent municipalities, comparable to a commuting zone) and meso-regions (approximately 40-50 adjacent municipalities). Expenditures per capita are transformed using inverse hyperbolic sine and deflated to constant 2010 BRL.

Figure C3: Robustness: Investment per capita



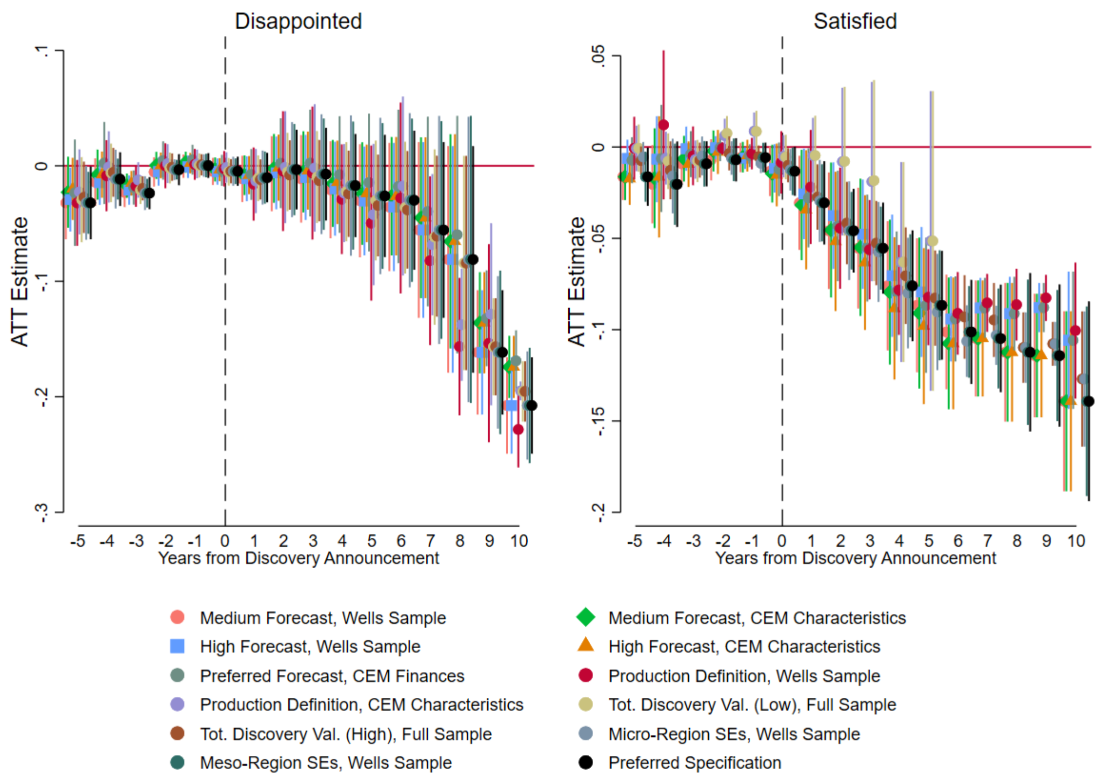
Note: Event studies are estimated separately using Callaway and Sant'Anna (2021) estimator with municipality and year FEs and standard errors clustered at municipality-level, and plotted together for visual comparison. The **Preferred Specification** (also reported in main results section) uses conservative low forecasts of per capita discovery expectations to categorize disappointed and satisfied municipalities, and compares treated places to the Wells control group, which received offshore exploratory drilling but no discoveries during study period. **Medium Forecast, Wells Sample** and **Medium Forecast, CEM Characteristics** use more optimistic forecasting parameters to categorize disappointed and satisfied municipalities, and compare treated units to Wells control group and never-treated municipalities matched on baseline characteristics using Coarsened Exact Matching (CEM) procedure, respectively. **High Forecast, Wells Sample** and **High Forecast, CEM Characteristics** use even more optimistic forecasting parameters to categorize disappointed and satisfied treatment groups. Municipality classifications using these alternative forecasting parameters are reported in Appendix B2. **Preferred Forecast, CEM Finances** uses main forecasting parameters to categorize disappointed and satisfied municipalities and a control group of never-treated municipalities that match treated units on baseline public finance variables (outcomes). **Production Definition, Wells Sample** and **Production Definition, CEM Characteristics** use an alternative categorization of discovery-treated municipalities into disappointed and satisfied, wherein satisfied municipalities are those that produce more than twice as much oil equivalent in 2017 as they did at the time of discovery announcement; disappointed municipalities are those that produce less than twice as much. This definition avoids assumptions built into the expectations forecasting model. **Total Discovery Value (Low), Full Sample** and **Total Discovery Value (High), Full Sample** use total, rather than per capita discovery volume announcements to compute forecasts, with the former using conservative low forecasts and the latter using optimistic high forecasts, and use the full sample of all municipalities in coastal states as a control group. **Micro-Region Standard Errors, Wells Sample** and **Meso-Region Standard Errors, Wells Sample** re-estimate the preferred specification with standard errors clustered at alternative levels to account for spatial and serial correlation: micro-regions (approximately 10 adjacent municipalities, comparable to a commuting zone) and meso-regions (approximately 40-50 adjacent municipalities). Municipal public investment per capita is transformed using inverse hyperbolic sine and deflated to constant 2010 BRL.

Figure C4: Robustness: Education Provision and Outcomes



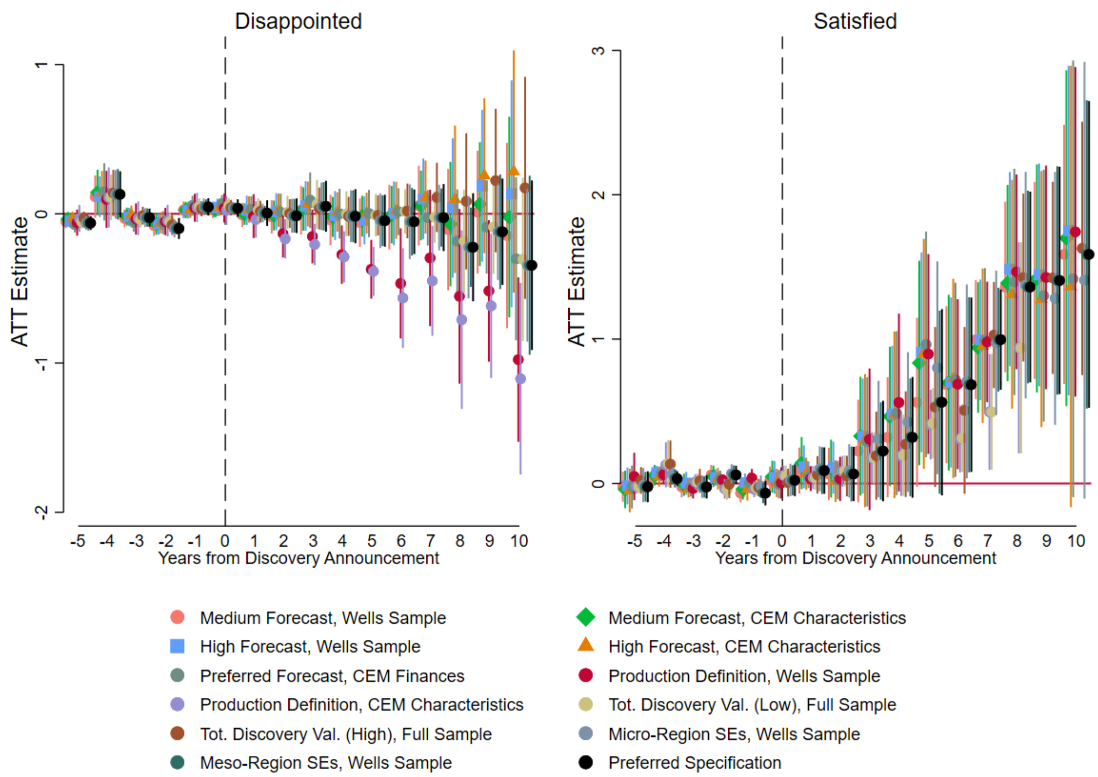
Note: Event studies are estimated separately using Callaway and Sant'Anna (2021) estimator with municipality and year FEs and standard errors clustered at municipality-level, and plotted together for visual comparison. The **Preferred Specification** (also reported in main results section) uses conservative low forecasts of per capita discovery expectations to categorize disappointed and satisfied municipalities, and compares treated places to the Wells control group, which received offshore exploratory drilling but no discoveries during study period. **Medium Forecast, Wells Sample** and **Medium Forecast, CEM Characteristics** use more optimistic forecasting parameters to categorize disappointed and satisfied municipalities, and compare treated units to Wells control group and never-treated municipalities matched on baseline characteristics using Coarsened Exact Matching (CEM) procedure, respectively. **High Forecast, Wells Sample** and **High Forecast, CEM Characteristics** use even more optimistic forecasting parameters to categorize disappointed and satisfied treatment groups. Municipality classifications using these alternative forecasting parameters are reported in Appendix B2. **Preferred Forecast, CEM Finances** uses main forecasting parameters to categorize disappointed and satisfied municipalities and a control group of never-treated municipalities that match treated units on baseline public finance variables (outcomes). **Production Definition, Wells Sample** and **Production Definition, CEM Characteristics** use an alternative categorization of discovery-treated municipalities into disappointed and satisfied, wherein satisfied municipalities are those that produce more than twice as much oil equivalent in 2017 as they did at the time of discovery announcement; disappointed municipalities are those that produce less than twice as much. This definition avoids assumptions built into the expectations forecasting model. **Total Discovery Value (Low), Full Sample** and **Total Discovery Value (High), Full Sample** use total, rather than per capita discovery volume announcements to compute forecasts, with the former using conservative low forecasts and the latter using optimistic high forecasts, and use the full sample of all municipalities in coastal states as a control group. **Micro-Region Standard Errors, Wells Sample** and **Meso-Region Standard Errors, Wells Sample** re-estimate the preferred specification with standard errors clustered at alternative levels to account for spatial and serial correlation: micro-regions (approximately 10 adjacent municipalities, comparable to a commuting zone) and meso-regions (approximately 40-50 adjacent municipalities). Education provision and outcomes are measured using an index provided by FIRJAN (2019). The Education Index is an aggregate score ranging from 0-1, composed of the following indicators: early childhood enrollment rates, graduation rates, grade-age distortion, hours spent in class, share of teachers with college degrees, and IDEB test scores.

Figure C5: Robustness: Health Provision and Outcomes



Note: Event studies are estimated separately using Callaway and Sant'Anna (2021) estimator with municipality and year FEs and standard errors clustered at municipality-level, and plotted together for visual comparison. The **Preferred Specification** (also reported in main results section) uses conservative low forecasts of per capita discovery expectations to categorize disappointed and satisfied municipalities, and compares treated places to the Wells control group, which received offshore exploratory drilling but no discoveries during study period. **Medium Forecast, Wells Sample** and **Medium Forecast, CEM Characteristics** use more optimistic forecasting parameters to categorize disappointed and satisfied municipalities, and compare treated units to Wells control group and never-treated municipalities matched on baseline characteristics using Coarsened Exact Matching (CEM) procedure, respectively. **High Forecast, Wells Sample** and **High Forecast, CEM Characteristics** use even more optimistic forecasting parameters to categorize disappointed and satisfied treatment groups. Municipality classifications using these alternative forecasting parameters are reported in Appendix B2. **Preferred Forecast, CEM Finances** uses main forecasting parameters to categorize disappointed and satisfied municipalities and a control group of never-treated municipalities that match treated units on baseline public finance variables (outcomes). **Production Definition, Wells Sample** and **Production Definition, CEM Characteristics** use an alternative categorization of discovery-treated municipalities into disappointed and satisfied, wherein satisfied municipalities are those that produce more than twice as much oil equivalent in 2017 as they did at the time of discovery announcement; disappointed municipalities are those that produce less than twice as much. This definition avoids assumptions built into the expectations forecasting model. **Total Discovery Value (Low), Full Sample** and **Total Discovery Value (High), Full Sample** use total, rather than per capita discovery volume announcements to compute forecasts, with the former using conservative low forecasts and the latter using optimistic high forecasts, and use the full sample of all municipalities in coastal states as a control group. **Micro-Region Standard Errors, Wells Sample** and **Meso-Region Standard Errors, Wells Sample** re-estimate the preferred specification with standard errors clustered at alternative levels to account for spatial and serial correlation: micro-regions (approximately 10 adjacent municipalities, comparable to a commuting zone) and meso-regions (approximately 40-50 adjacent municipalities). Education provision and outcomes are measured using an index provided by FIRJAN (2019). The Health Index is an aggregate score ranging from 0-1, composed of the following indicators: proportion of pregnant women receiving >7 pre-natal visits, deaths of undefined causes, and avoidable infant mortality.

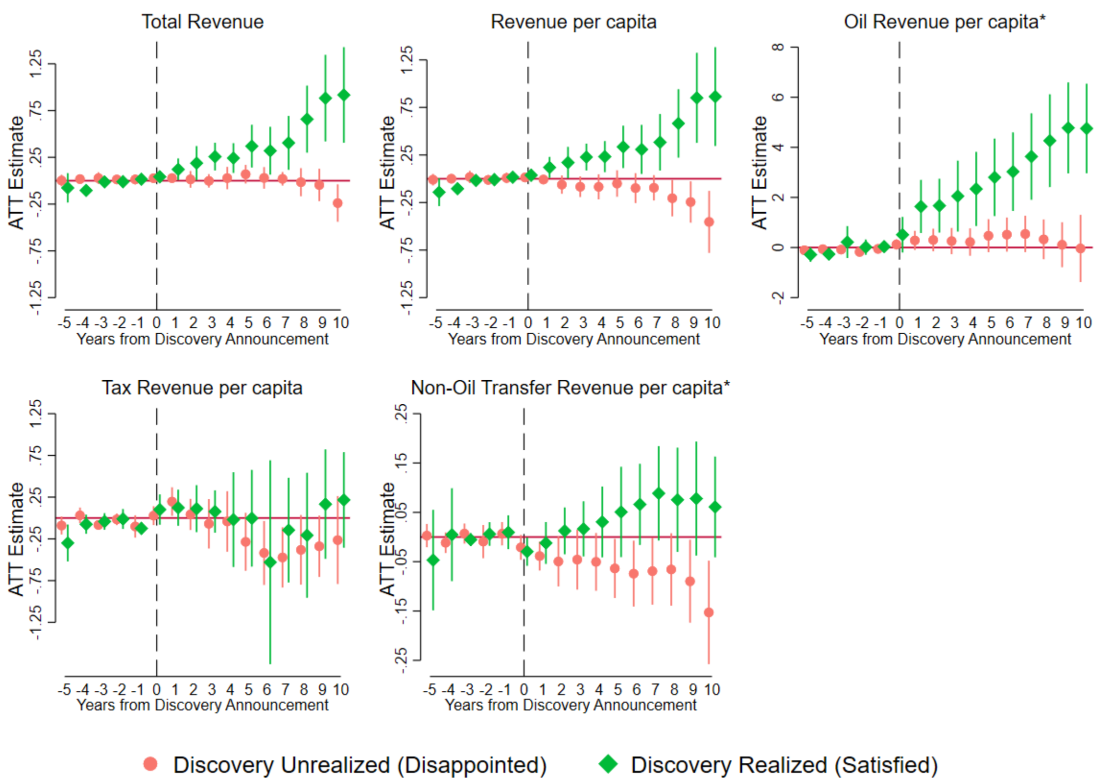
Figure C6: Robustness: GDP



Note: Event studies are estimated separately using Callaway and Sant'Anna (2021) estimator with municipality and year FEs and standard errors clustered at municipality-level, and plotted together for visual comparison. The **Preferred Specification** (also reported in main results section) uses conservative low forecasts of per capita discovery expectations to categorize disappointed and satisfied municipalities, and compares treated places to the Wells control group, which received offshore exploratory drilling but no discoveries during study period. **Medium Forecast, Wells Sample** and **Medium Forecast, CEM Characteristics** use more optimistic forecasting parameters to categorize disappointed and satisfied municipalities, and compare treated units to Wells control group and never-treated municipalities matched on baseline characteristics using Coarsened Exact Matching (CEM) procedure, respectively. **High Forecast, Wells Sample** and **High Forecast, CEM Characteristics** use even more optimistic forecasting parameters to categorize disappointed and satisfied treatment groups. Municipality classifications using these alternative forecasting parameters are reported in Appendix B2. **Preferred Forecast, CEM Finances** uses main forecasting parameters to categorize disappointed and satisfied municipalities and a control group of never-treated municipalities that match treated units on baseline public finance variables (outcomes). **Production Definition, Wells Sample** and **Production Definition, CEM Characteristics** use an alternative categorization of discovery-treated municipalities into disappointed and satisfied, wherein satisfied municipalities are those that produce more than twice as much oil equivalent in 2017 as they did at the time of discovery announcement; disappointed municipalities are those that produce less than twice as much. This definition avoids assumptions built into the expectations forecasting model. **Total Discovery Value (Low), Full Sample** and **Total Discovery Value (High), Full Sample** use total, rather than per capita discovery volume announcements to compute forecasts, with the former using conservative low forecasts and the latter using optimistic high forecasts, and use the full sample of all municipalities in coastal states as a control group. **Micro-Region Standard Errors, Wells Sample** and **Meso-Region Standard Errors, Wells Sample** re-estimate the preferred specification with standard errors clustered at alternative levels to account for spatial and serial correlation: micro-regions (approximately 10 adjacent municipalities, comparable to a commuting zone) and meso-regions (approximately 40-50 adjacent municipalities). Municipal GDP per capita is transformed using inverse hyperbolic sine and deflated to constant 2010 BRL.

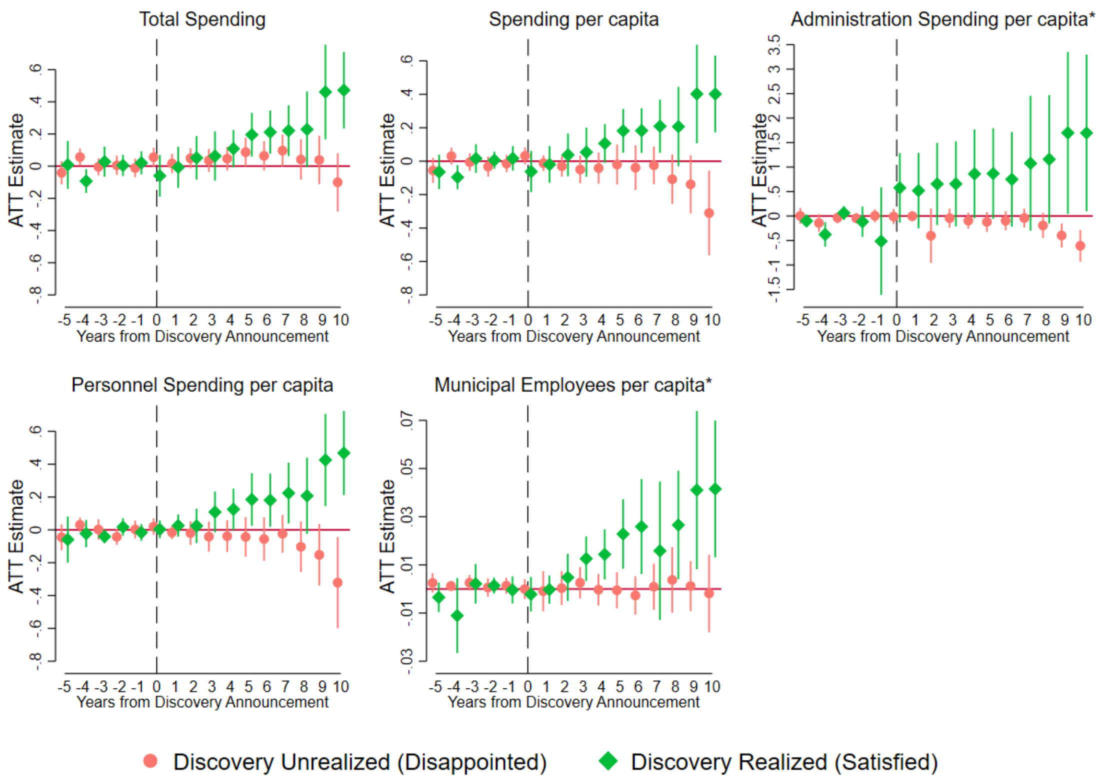
C.3 Event Studies with Matched Controls

Figure C7: Matched Controls: Revenues



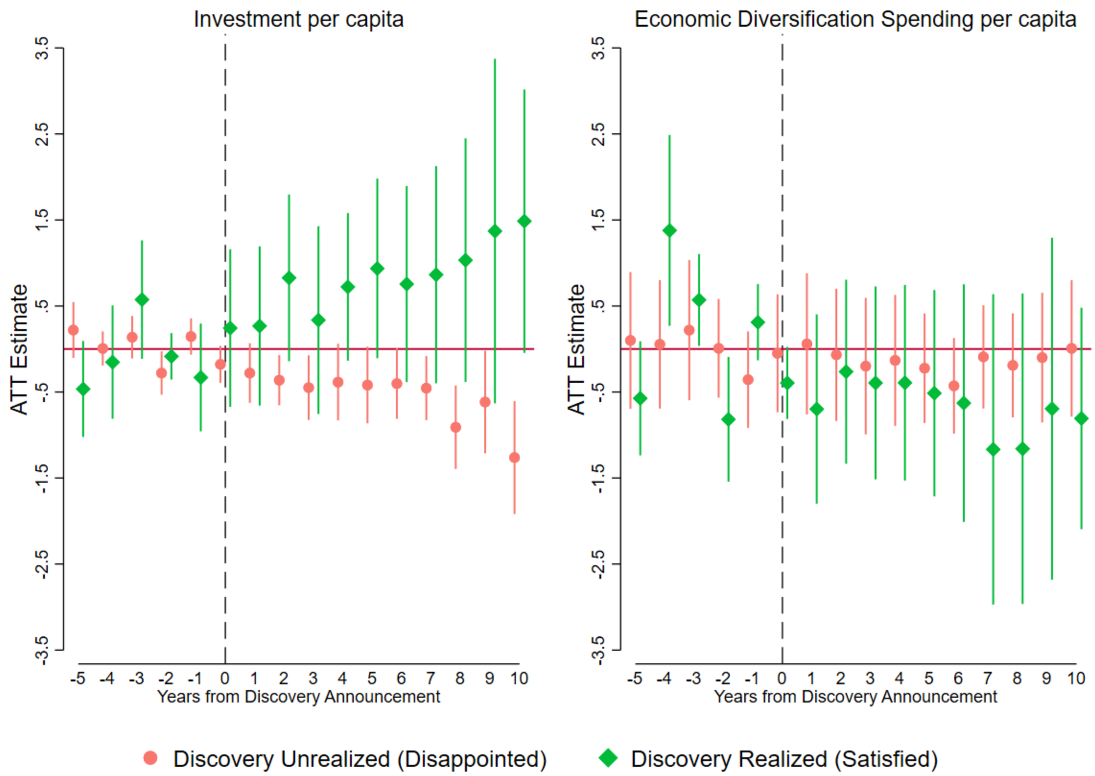
Note: For all of the following figures, event studies are estimated separately for Disappointed and Satisfied municipalities relative to Matched Controls–identified using Coarsened Exact Matching on pre-treatment GDP, population, distance from state capital, latitude, and municipal development index–and superimposed on the same graph for visual comparison. Event study specifications include municipal and year fixed effects and are estimated using Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures, in order to accommodate large differences in scale of effects.

Figure C8: Matched Controls: Expenditures and Employment



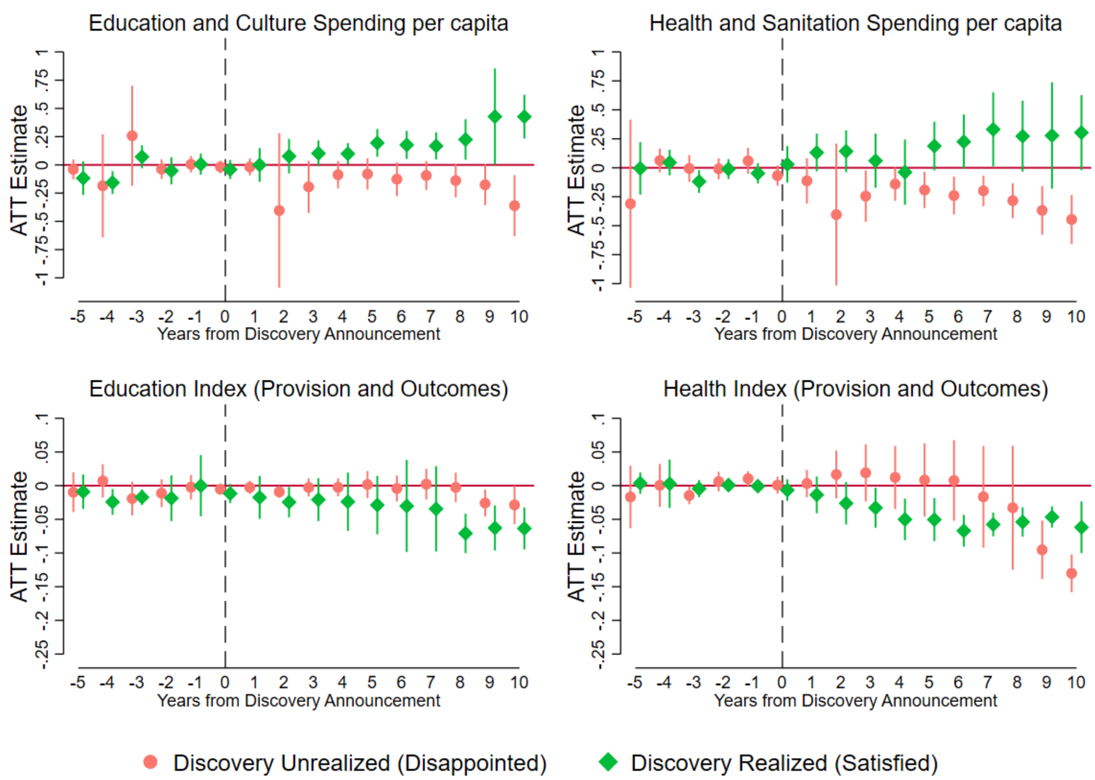
Note: For all of the following figures, event studies are estimated separately for Disappointed and Satisfied municipalities relative to Matched Controls–identified using Coarsened Exact Matching on pre-treatment GDP, population, distance from state capital, latitude, and municipal development index–and superimposed on the same graph for visual comparison. Event study specifications include municipal and year fixed effects and are estimated using Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures, in order to accommodate large differences in scale of effects.

Figure C9: Matched Controls: Investment and Economic Diversification



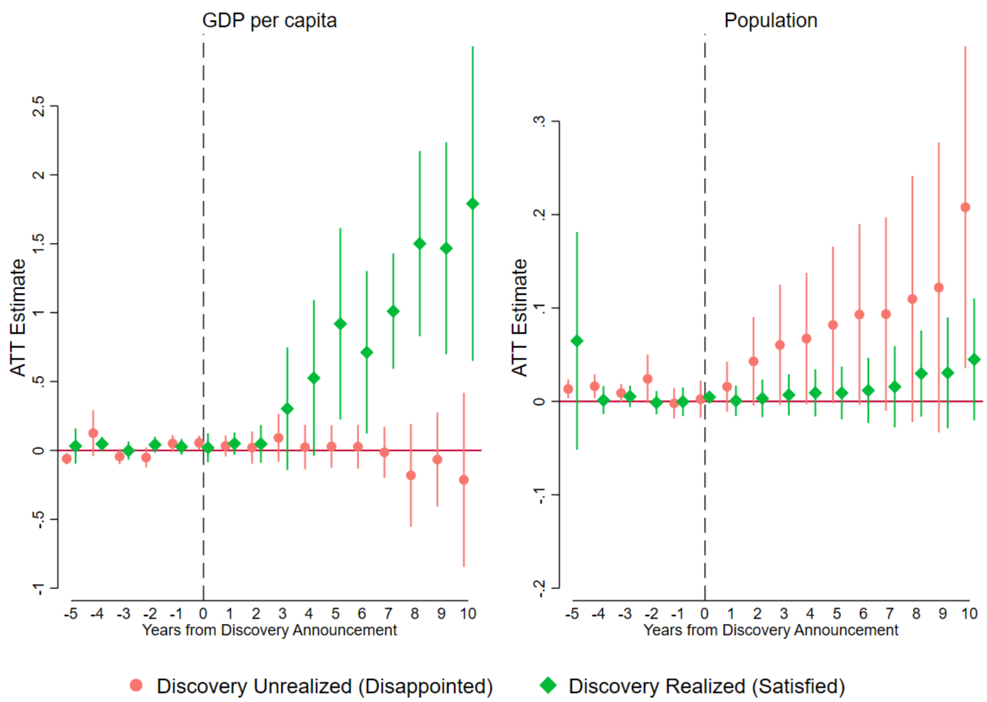
Note: For all of the following figures, event studies are estimated separately for Disappointed and Satisfied municipalities relative to Matched Controls–identified using Coarsened Exact Matching on pre-treatment GDP, population, distance from state capital, latitude, and municipal development index–and superimposed on the same graph for visual comparison. Event study specifications include municipal and year fixed effects and are estimated using Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures, in order to accommodate large differences in scale of effects. Investment refers to public municipal investment (e.g., infrastructure). Economic development spending is the sum of municipal spending to promote industry, services, and agriculture.

Figure C10: Matched Controls: Public Goods Spending & Performance



Note: For all of the following figures, event studies are estimated separately for Disappointed and Satisfied municipalities relative to Matched Controls–identified using Coarsened Exact Matching on pre-treatment GDP, population, distance from state capital, latitude, and municipal development index–and superimposed on the same graph for visual comparison. Event study specifications include municipal and year fixed effects and are estimated using Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures, in order to accommodate large differences in scale of effects. Education and Health Indices are drawn from the FIRJAN Municipal Development Index (FIRJAN, 2020), a comprehensive measure of municipal development published annually by FIRJAN, a nonprofit. The Education Index is an aggregate score ranging from 0-1, composed of the following indicators: early childhood enrollment rates, graduation rates, grade-age distortion, hours spent in class, share of teachers with college degrees, and IDEB test scores. The Health Index is an aggregate score ranging from 0-1, composed of the following indicators: proportion of pregnant women receiving >7 pre-natal visits, deaths of undefined causes, and avoidable infant mortality.

Figure C11: Matched Controls: GDP & Population



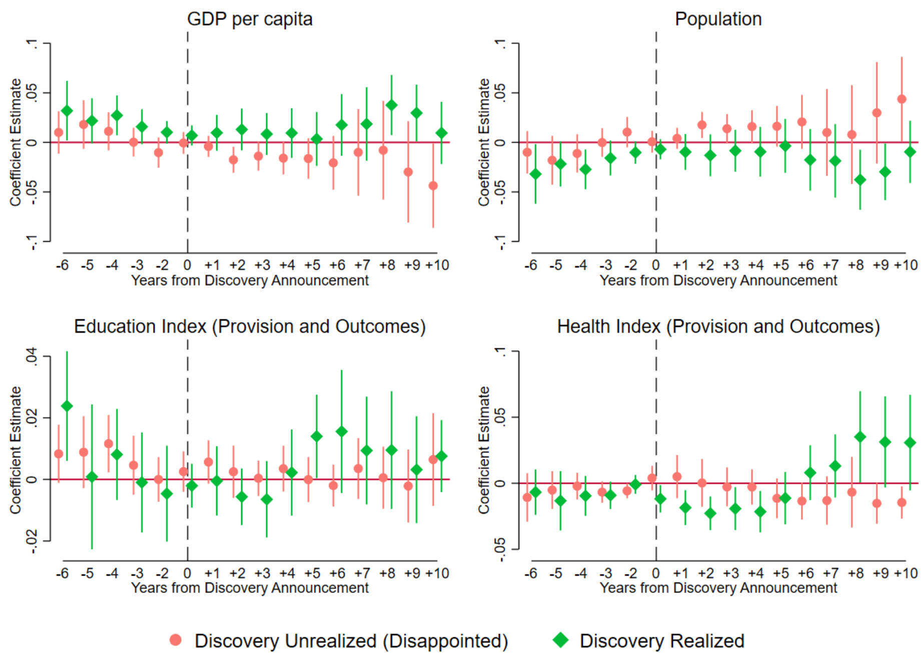
Note: For all of the following figures, event studies are estimated separately for Disappointed and Satisfied municipalities relative to Matched Controls–identified using Coarsened Exact Matching on pre-treatment GDP, population, distance from state capital, latitude, and municipal development index–and superimposed on the same graph for visual comparison. Event study specifications include municipal and year fixed effects and are estimated using Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine transformation. Monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. *Asterisks indicate that a different y-axis scale is used from the rest of the sub-figures, in order to accommodate large differences in scale of effects.

C.4 Event Studies with Multiple Events

Following the method proposed in Sandler and Sandler (2014), I estimate an event study specification that is identical to the matched controls specification, but with the inclusion of relative time dummies for each discovery announcement that occurred within a municipality between 2000 and 2017, rather than time indicators relative to only the first discovery. I report results from this alternative specification in Figures C12-C13.

Figure C12: Event Study with Multiple Events: Public Finances

Figure C13: Event Study with Multiple Events: Other Outcomes



C.5 Sample Means Over Time

Figure C14: Sample Means: Treated Municipalities and Never-Treated Controls (Municipalities with Post-2000 Exploratory Wells but No Discoveries (n=53))

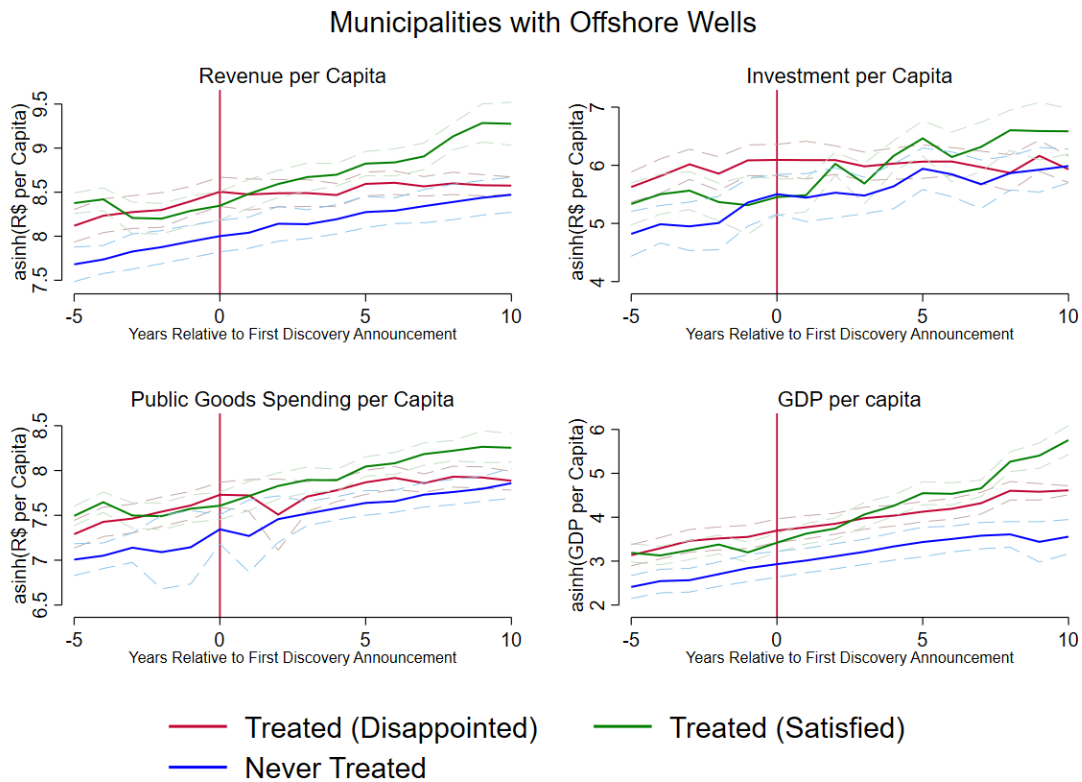
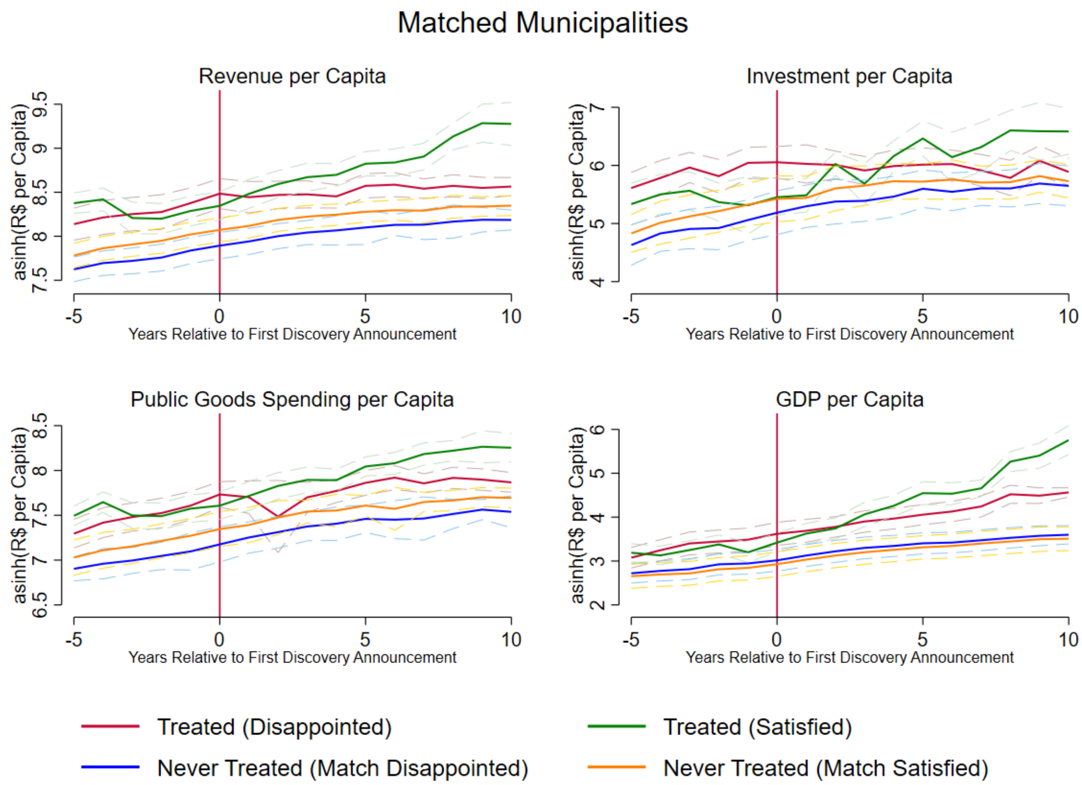
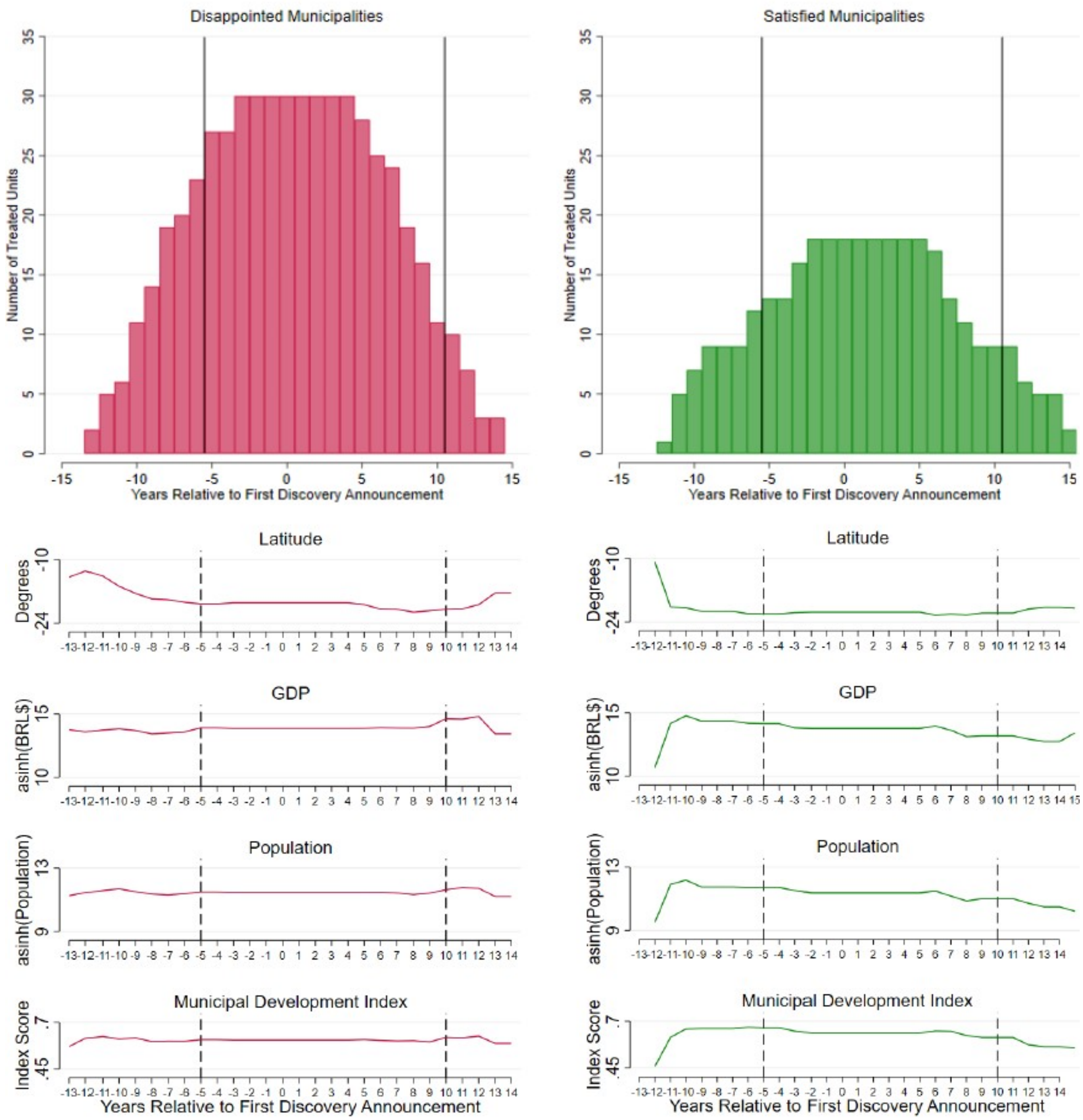


Figure C15: Sample Means: Treated Municipalities and Never-Treated Controls (Coarsened Exact Matching, Separately for Disappointed (n=836) and Satisfied (n=500))



C.6 Sample Balance Across Relative Time Indicators

Figure C16: Treated Unit Balance Across Relative Time Indicators

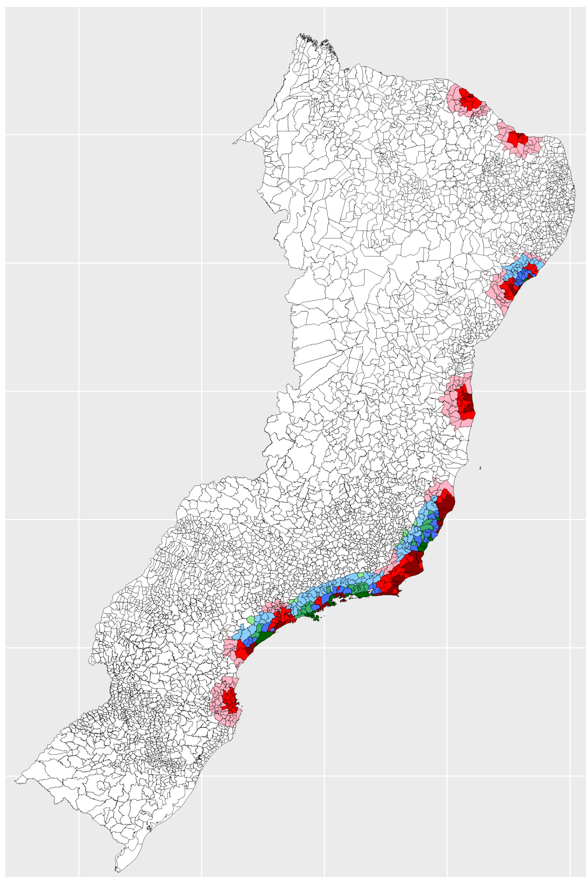


Note: Bar graphs depict number of treated units in each relative time period, where t=0 represents the year of the first major discovery announcement for a municipality. Vertical black lines indicate the extent of periods included in the analysis. Given the limited time-frame in sample (2000-2017), the number of treated units observed declines as relative years become more distant. Since only a small number of municipalities receive discovery announcements, I do not impose a balanced sample requirement in event studies, as this would substantially reduce statistical power in periods distant from t=0. Further, I extend event studies forward to t+10 since there is an approximate 10-year delay between discovery and peak production in offshore fields. To assess whether panel imbalance may lead to problems of comparability in the treated group across time, I plot means of key baseline characteristics (latitude, GDP, population, and municipal development index) across the range of relative year indicators.

C.7 Spatial Spillovers from Discoveries

Do discovery announcements create spatial spillovers onto neighboring municipalities? Spillovers affecting public finance and governance outcomes should be limited, since public spending and goods provision are undertaken within municipal boundaries and mostly restricted to municipal residents. Private sector outcomes may be more sensitive to spatial spillovers, as firms and workers can relocate in response to discovery announcements, though direct economic effects of offshore oil extraction are limited. I estimate spatial spillovers onto non-treated neighbors following the spillover-robust difference-in-difference specification proposed by Clarke (2017).

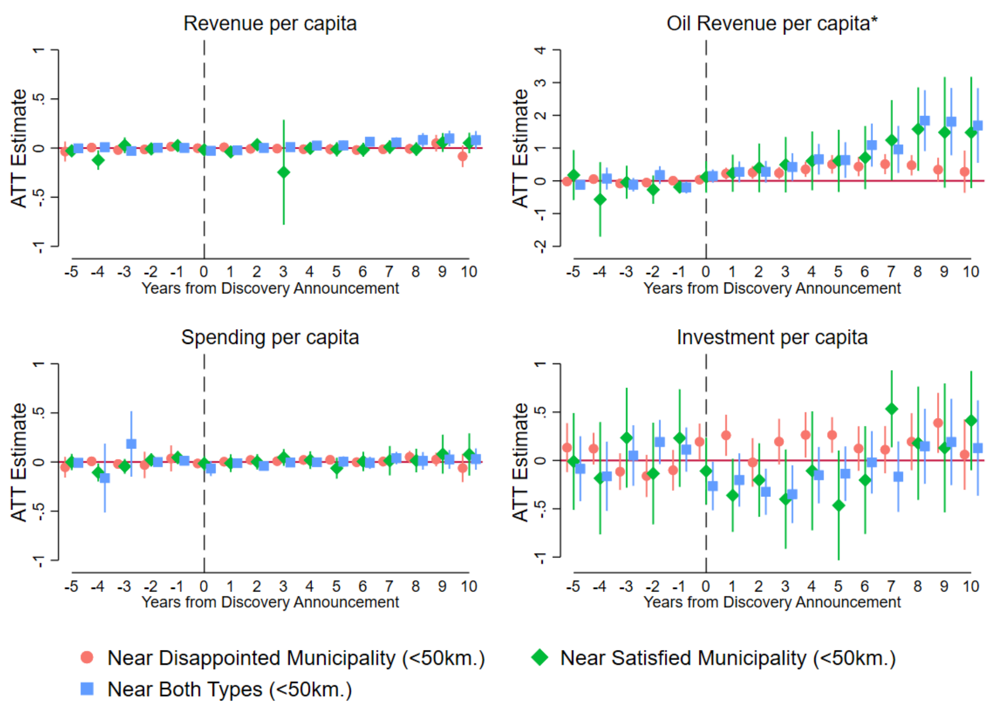
Figure C17: Municipalities Near/Far from Disappointed/Satisfied/Both



Note: Map depicts treated and control groups for spatial spillover analysis. Dark red and green municipalities are directly treated by discoveries and thus omitted. Medium red, green, and blue municipalities are near (≤50 km.) disappointed, satisfied, or both types of municipalities, respectively, and thus "treated" by their spatial proximity. Light red, green, and blue municipalities are far (50-100 km.) from disappointed, satisfied, or both types of municipalities, respectively, and serve as controls.

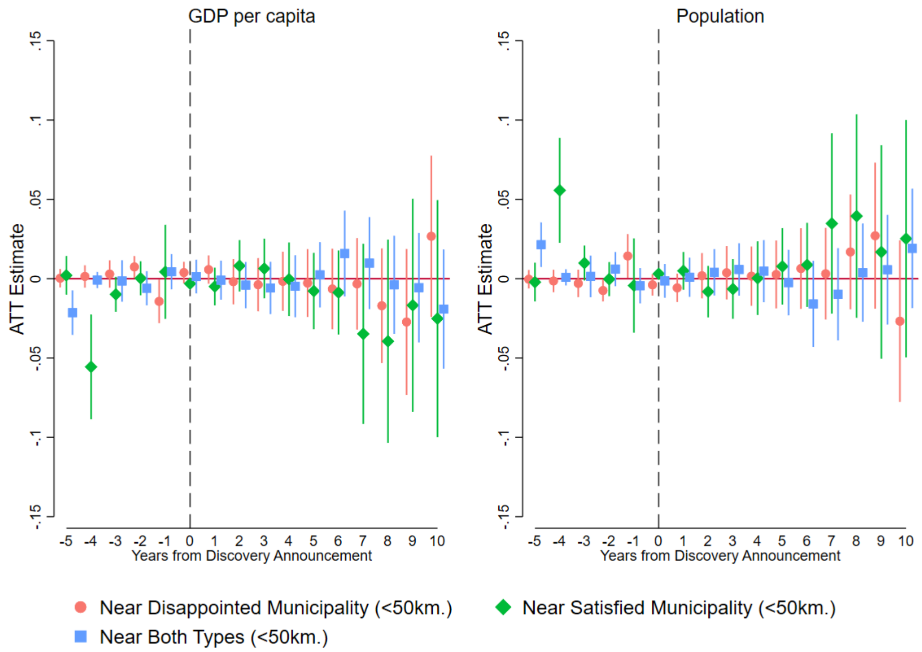
Analyzing spatial spillovers from satisfied and disappointed municipalities is complicated by tight geographical bunching of these two groups, leading to neighbors that are near both types. To accommodate this, I create three treatment types and control groups: 1) municipalities near/far from disappointed (0-50 km. and 50-100 km., respectively); 2) municipalities near/far from satisfied (0-50 km. and 50-100 km., respectively); and 3) municipalities near/far from both (0-50 km. and 50-100 km., respectively). I map these groups in Figure C17, where dark red and green are discovery-treated units, medium red and light red are near and far from disappointed, respectively, medium green and light green are near and far from satisfied, and medium blue and light blue are near and far from both. I estimate event study specifications where the nearby municipalities are the treated group, far municipalities are the control group, and directly-treated units are omitted, including municipal and year fixed effects and implementing the Callaway and Sant'Anna (2021) estimator.

Figure C18: Public Finances in Near (0-50km) vs Far (50-100km) Munic.



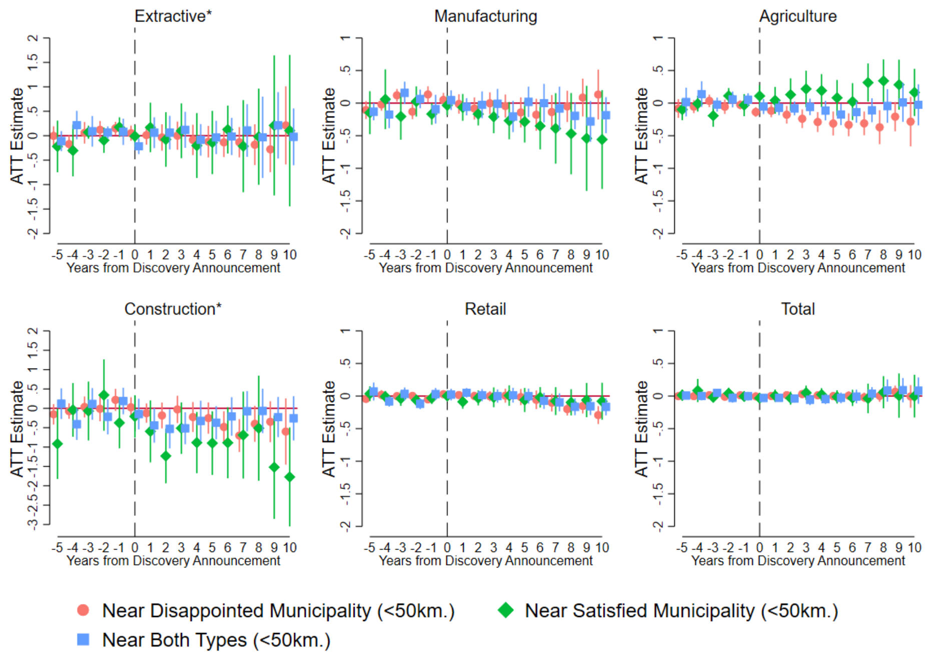
Note: Event study specifications include municipal and year fixed effects and are estimated using Callaway and Sant'Anna (2021) *csdid* estimator. Continuous outcomes are transformed using inverse hyperbolic sine, and monetary values are deflated to constant 2010 BRL. Standard errors are clustered at the municipality level and 95% confidence intervals are reported. Directly-treated municipalities are omitted.

Figure C19: Other Outcomes in Near (0-50km) vs Far (50-100km) Munic.



Note: See note for Figure C18.

Figure C20: Formal Empl. in Near (0-50km) vs Far (50-100km) Munic.



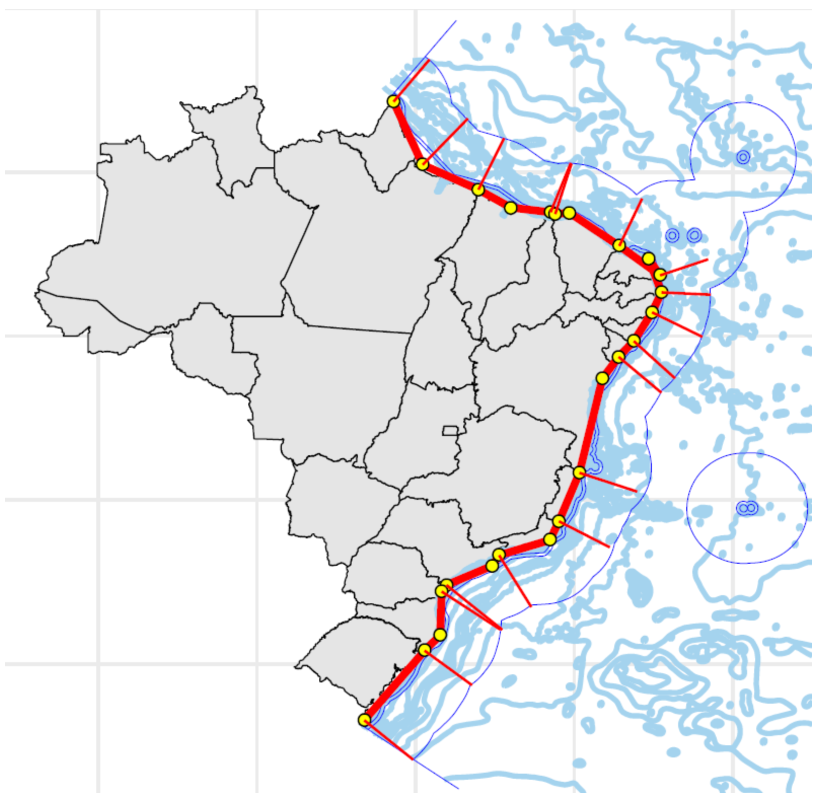
Note: See note for Figure C18.

D Explanatory Notes

D.1 Reconstructing Geodesic Projection Maps

To reconstruct the geodesic projections used by IBGE and ANP to determine municipal offshore oil royalty distribution, I draw on documents from IBGE that define state boundary points and projections rules (IBGE, 2009). I begin by plotting state boundary points and state projections out to Brazil's maritime limit, as illustrated in Figure D1.

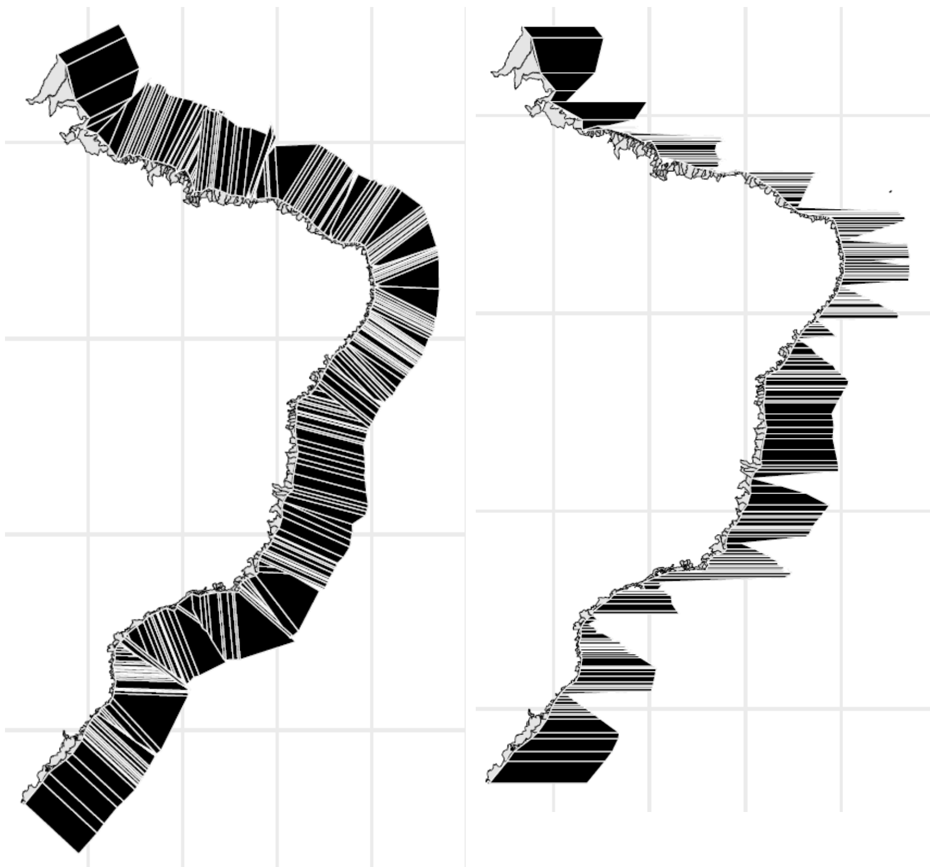
Figure D1: Brazil: Coastal Line and State Boundary Projections



I next generate orthogonal and parallel projections of each coastal municipal boundary to the maritime limit, cutting off projections when they intersect state boundaries. I manually adjust boundary projections to account for special exceptions to standard rules, as in the case of Rio de Janeiro. I next create catchment zones for each municipality by generating polygons with vertices defined by coastal boundary points and intersections of coastal boundary projections with the maritime limit. Figure D2 illustrates these catchment zones.

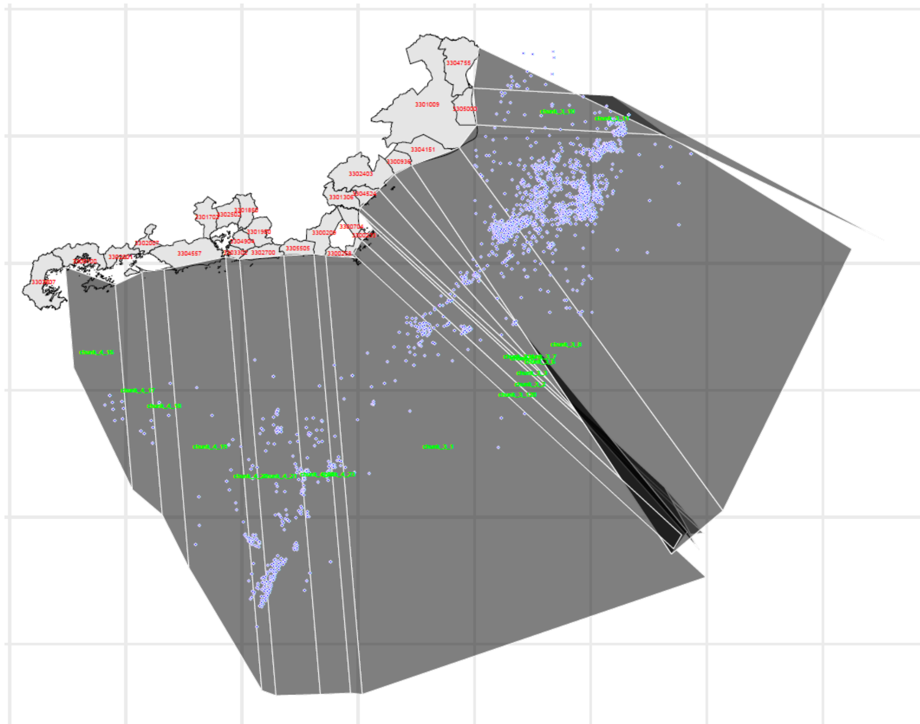
Figure D2: "Catchment Zones" (polygons) for Each Coastal Municipality

(a) Orthogonal Polygons (b) Parallel Polygons



Finally, I plot all wells (including discovery wells) within these catchment zones, as illustrated for the case of Rio de Janeiro state in Figure D3.

Figure D3: Rio de Janeiro: Offshore Wells Overlaid on Orthogonal Projections



I create a crosswalk file that ties each catchment zone to its aligned municipality, and use this file to attach municipality code identifiers to each catchment zone. This allows me to collapse the well registry to the municipality level. I provide a complete R code and raw data package at:
https://github.com/ekatovich/Brazil_GeodesicProjections
This repository contains everything necessary to recreate these geodesic projections.

D.2 Municipal Royalty Distribution Formula

Allocation of offshore oil royalties in Brazil follows a formula first established in 1986 (Laws 7.453/85 and 7.525/86), and modified by the far-reaching Petroleum Law of 1997 (Law 9.478/97). Royalties are distributed monthly to federal, state, and municipal governments and the Brazilian navy by the National Oil Agency (ANP). Yearly royalties can be determined using cumulative values reported in December of each year. The royalty distribution formula is complex, and readers are referred to the ANP's Royalties Calculation Guide (in Portuguese) for a full description (ANP, 2001).

Royalties are assessed on gross value of offshore production. The royalty allocation formula is divided into two main parts: (i) the first 5%, and (ii) royalties in excess of the first 5%. The first 5% of gross production value in field f in year y, denoted W_{my} are allocated to municipality m according to:

$$W_{my} = \sum_f \left[Alignment_{mfy} * (0.05)(P^{oil}_{fy} * V^{oil}_{fy} + P^{gas}_{fy} * V^{gas}_{fy}) * (0.3)\right] \quad (7)$$

where $Alignment_{mfy}$ is the share of field f that is geographically aligned with the orthogonal or parallel projections of municipality m's boundaries onto the continental shelf, 0.05 is the first 5% tax rate, P^{oil}_{fy} and P^{oil}_{fy} are the reference prices for oil and gas, respectively, V^{oil}_{fy} and V^{gas}_{fy} are the volumes of oil and gas produced, respectively, and 0.3 is the share of first 5% royalties allocated to municipalities. Royalties allocated to m are summed across all relevant fields, f, since municipal boundaries may align with multiple fields.

Royalties in excess of the first 5% are allocated according to:

$$Z_{my} = \sum_f \left[Alignment_{mfy} * (Tax_{fy} - 0.05)(P^{oil}_{fy} * V^{oil}_{fy} + P^{gas}_{fy} * V^{gas}_{fy}) * (0.225)\right] \quad (8)$$

where everything is defined as in Equation 9, except that the royalty tax rate is set at $Tax_{fy} - 0.05$, a field-specific tax rate determined by the productivity of each field. Rates typically range from 5% (implying no royalties in excess of the base 5%) to 12% for very productive fields. 22.5% of royalties in excess of 5% of gross value of production are allocated to municipalities, leading the formula in Equation 10 to be multiplied by 0.225. Total royalties allocated in year y to municipality m are then calculated using the following formula:

$$R_{my} = \mathbb{1}(neighbor_{my}) * (W_{my} * (f(population_{my} + g(infrastructure_{my})) + \mathbb{1}(producer_m) * Z_{my} \tag{9}$$

In this final formula, the first 5% of royalties are allocated to municipality m if it is a neighbor of a producer municipality (including if it is a producer itself). If m is in the mesoregion of a producer municipality or is itself a producer municipality, the first 5% royalties it receives are weighted according to functions of municipal population and hosting of oil and gas infrastructure, such as pipelines, terminals, or refineries. If m is a producer municipality, it receives the full value of Z_{my}.

D.3 Data Sources and Cleaning Procedures

Table D1 summarizes data sources used in this paper.

Table D1: Data Sources

Data	Source	Years	Raw Level	Analysis Level
Discovery Announcements	CVM	2000-2017	Well	Municipality
Oil Royalties & Special Part.	ANP	1999-2017	Municipality	Municipality
Offshore Well Shapefiles	ANP	2000-2017	Well	Municipality
Oil and Gas Production	ANP	2005-2017	Well	Municipality
Municipality Shapefiles	IBGE	2010	Municipality	Municipality
Public Finances	FINBRA & IPEA	2000-2017	Municipality	Municipality
Employment & Firm Entry	RAIS	2000-2017	Individual	Municipality
Federal and State Transfers	Tesouro Nacional	2000-2017	Municipality	Municipality
Elections (Candidates)	TSE	2000-2016	Individual	Municipality
Elections (Donations)	TSE	2004-2016	Individual	Municipality
Health Indicators	SUS	2000-2017	Municipality	Municipality
Education Indicators	Basic Ed Census	2000-2017	School	Municipality
Education Outcomes	IDEB	2005-2017	School	Municipality
Municipal Development Index	FIRJAN	2000, 2005-16	Municipality	Municipality
Municipality Characteristics	Census	2000, 2010	Individual	Municipality
Brent Crude Oil Prices	FRED	2000-2017	World	World
Currency Deflator	IPEA (INPC)	2000-2017	Brazil	Brazil
Interest Rate	IPEA (Selic)	2000-2017	Brazil	Brazil

Municipal Public Finances

I create a panel (2000-2017) on municipal public finances using FINBRA/SICONFI, the System of Fiscal and Accounting Information for the Brazilian Public Sector, organized by the Brazilian National Treasury. This dataset contains over 700 accounting variables related to municipal public finances, including disaggregated revenues and spending, and investments. I supplement these data with public finances data from the Institute for Applied Economic Reserach (IPEA), which cleans and simplifies the raw FINBRA data.

Municipal Elections

I draw data on the 2000, 2004, 2008, 2012, and 2016 municipal elections from the *Tribunal Supremo Eleitoral* (TSE), or Supreme Electoral Tribunal. The TSE publishes disaggregated data on each mayoral and city council candidate in each election, including name, ID number, age, education level, occupation, political party, number of votes and donations received, and campaign spending. The TSE also publishes parallel datasets with information on each donation, including name and ID number of the donor, recipient, and donation value. Using these data, I construct a municipality-level panel with standard measures of political competition and selection. I also observe whether each candidate is an incumbent or not, allowing me to measure reelection rates.

News Coverage

I corroborate nearly all CVM discovery announcements with contemporaneous news coverage in *O Globo*, Rio de Janeiro's newspaper of record. I use the search terms "*descoberta de petróleo*" (oil discovery) and "*pré-sal*" (Pre-Salt) within archived news records for *O Globo* dating from 2005-2017, maintained by the International Newsstream Database.

Formal Employment and Wages

I extract data on formal economic activity from the *Relação Anual de Informações Sociais* (RAIS), or Annual Report of Social Indicators. This dataset contains information on the universe of formal employees in Brazil, including wages and economic sector. It also contains a variable indicating the institutional category of each employer, allowing me to identify exactly which employees were employed by municipal governments. Using these detailed employment data, I create a municipality-level panel for years 2000-2017 with information for each municipal government on number of public employees. I also calculate number of employees, firms, and average earnings for economic sectors (agriculture, extractive, manufacturing, construction, retail, other services, and government using the sectoral classification in Dahis (2020).

Public Goods Provision and Quality

To measure real provision and quality of public goods at the municipality level, I focus on two essential areas: education and health. For education outcomes, I draw on the Basic Education Census (2000-2017) to construct a school infrastructure index, which is a simple sum of indicators for whether a municipal public school has a library, computer lab, and science lab. I also draw on the Basic Education Census to compute the ratio of teachers with some higher education over the total number of teachers in municipal public schools. I collapse both of these measures from the school to municipality level. Finally, I draw on biannual data from IDEB, which reports data on test scores and outcomes such as graduation rates. I report the main IDEB index score as a measure of realized school quality. For health outcomes, I draw on municipality-level data from Brazil's universal public health system, SUS, including share of pregnant women receiving 7 or more prenatal visits, avoidable infant mortalities, and municipal hospital beds.

Patronage

Adopting a methodology proposed by Colonnelli et al. (2020), I measure patronage as the rate at which winning mayoral candidates appoint their campaign donors to municipal public employment. While most public jobs in Brazil require individuals to pass an exam in order to qualify, each mayor is allotted a number of "commissioned posts" where they can appoint whoever they want. I observe whether these posts are more often filled by campaign supporters in municipalities that experience discoveries.

Baseline Municipal Characteristics and Institutional Capacity

I draw on municipal-level data for the year 2000 from the Demographic Census (IBGE, 2000) and FIRJAN Municipal Development Index (FMDI), a composite index of government capacity measured by formal employment statistics (share of workers formalized, formal income levels, and formal income Gini), education statistics (preschool enrollment rates, elementary school completion rates, year-on-year student progress rates, share of teachers with university of education, and test scores), and health statistics (share of mothers receiving adequate pre-natal care, undefined deaths, preventable infant deaths, and intensive care beds). I draw data on geographical characteristics from IPEA.

Oil Royalties and Special Participations

I draw on monthly data on oil and gas royalties and quarterly data on special participations distributed to Brazilian municipalities, made available by Brazil's National Oil Agency (ANP) for the years 1999-2017. I make raw data and code available to construct municipality-level monthly and yearly panels of royalty and special participation receipts for this period at: at:
`https://github.com/ekatovich/Royalties_and_SpecialParticipations`
The final panel produced by these scripts is balanced, e.g. contains observations for each of Brazil's 5570 municipalities for each of the months between January 1999 and December 2017. All monetary values are deflated into constant 2010 Brazilian Reals using Brazil's Indice Nacional de Precos ao Consumidor, published by IBGE. Geo-

graphical unit codes for municipality, microregion, mesoregion, and UF (state) are attached to each municipality name string reported in the raw royalties and special participations datasets, facilitating merges with other municipality-level datasets.