Does Oil Make Leaders Unaccountable?
Evidence from Brazil's offshore oil boom*

Joana Monteiro† CID/HKS

Claudio Ferraz‡ PUC-Rio

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Abstract

We examine the political economy mechanisms that link resource abundance and economic development by analyzing the recent increase in Brazil's oil production and the distribution of oil royalties to municipalities. We explore a fixed geographic rule which determines who receive oil royalties and investigate how incumbents spend oil windfall and the impact of these rents on local elections. We show that oil windfall creates a large incumbency advantage in the election that follows oil windfall boom, but this effect disappears in the medium-run. Royalty payments are associated with a large increase in the number of municipal employees, but we don't find any significant impact on household infrastructure, education and health supply. The pattern of the increase in public jobs indicates that voters reward increases in public sector and audit data suggest that institutions limit this increase. Taken together, our results indicate that oil does not make leaders unaccountable, and provide suggestive evidence that constraints on the executive branch restrained the the irresponsible use of oil revenues. These results point out that a democratic system is crucial to avoid the negative effects of resource abundance but also indicate that the institutions in place are not sufficient to transform natural resource wealth into economic development.

Key words: natural resources, elections, political accountability.
JEL: D72, D78, Q33.

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†Center for International Development, Harvard University

‡Department of Economics, Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio), Rua Marquês de São Vicente, 225- Gávea Rio de Janeiro, RJ, 22453-900, Brasil.

1 Introduction

For most developing countries, natural resource windfalls have had limited effects on long-run economic development (eg. Gabon, Nigeria, Venezuela). Several studies argue that this fact should be explained by the behavior of those who control the state (Ross (1999); Caselli & Cunningham (2009); Caselli (2006); Robinson et al. (2006)). In particular, a large literature argues that natural resource wealth impairs democracy, perpetuates autocratic regimes, and induces misgovernance (Barro (1999); Jensen & Wantchekon (2004); Ross (2001), Tsui (2011)). However, the negative effects of oil abundance on democracy have been recently challenged by studies which shows that the effects vary across regions and time (Dunning (2008); Ross (2009); Haber & Menaldo (2010)). Two main problems make the existing evidence far from conclusive. First, resource endowment is usually measured by production, which is endogenous to country level of development and institutions, being hard to interpret the results as causal estimates of the effect of resource abundance. Second, there is few micro evidence on how oil abundance affects political incentives, constraints, and competition faced by incumbent politicians which can elucidate why effects vary so much across regions.

This paper examines whether oil booms affect local democracy in Brazil's municipalities. Specifically, we study how electoral outcomes, the behavior of politicians in power, electoral competition and political selection change as municipalities are endowed with a fiscal windfall from oil boom. We do so by using variation across municipalities benefited from Brazil's recent oil production[1] boom and new rules for distributing oil royalties[2] to drilling regions. Over the last twelve years, oil output in Brazil more than doubled from 307 to 663 million barrels in 2008. Moreover, royalty payments increased from 5 to 10 percent of the production value and were indexed to oil international price. Hence, royalty payments made to municipalities increased by twenty-seven-fold in real terms from R$ 167 million in 1997 to R$ 4.7 billion in 2008, creating several "new" oil-rich municipalities. For a comparison, the FPM, the main federal transfer to municipalities in Brazil, increase by one-fold in the period. Municipalities lucky enough to be in front of an offshore oil field according to the geographic lines were disproportionately benefited and received a huge windfall, although the local economic impact of oil activity in their territory is arguably limited. To have an idea of the size of the budget impact, the top beneficiaries on average saw their municipal budget be increased by three-fold in real terms between 1997 and 2000, and then had it doubled from 2000 and 2004.

We begin our analysis by investigating how oil windfall affects local politics. We show that royalty payments create a large incumbency advantage in the short-run. In 2000, the first election after the boom, when all mayors could run for reelection, a one-standard-deviation increase in

[1] We use the term oil to denote oil and natural gas production since oil corresponds to the bulk of oil and gas production.

[2] We use the denomination royalty loosely throughout the paper to refer to royalties plus special quotas ("participações especiais". ANP calls the sum of both payments as "participações governamentais".

royalty value raises reelection chances by 16 percentage points, which implies a increase of 32 percent in reelection chance. However, this effect disappears in the medium-run since there is no incumbency advantage in 2008. We then analyze political competition and selection and show that the limited impact on these outcomes indicates that the incumbency advantage estimated for 2000 should be explained by the behavior of who are in power rather than through a decrease in political competition or by changes on the pool of candidates. We follow by analyzing how municipalities spend oil windfall. We show that municipalities report to increase all their expenses, but do not translate these extra expenditures into de facto public services measured by household infrastructure, health and educational outcomes. Oil-rich municipalities enlarge the public sector, by hiring more employees and increasing wages. The timing of increase in public jobs supports the idea that voters reward increases in the public sector. In addition, we show suggestive evidence that audits restrain the enlargement of the municipal public sector, which is an indication that institutions restrain mayors' strategies. Taken together, these results do not indicate that oil makes leaders unaccountable and suggest that a democratic system is crucial to avoid the negative effects of resource abundance. However, the institutions in place are not sufficient to transform natural resource wealth into economic development.

To the best of our knowledge, this is the first empirical paper that focus on understanding the political economy effects of natural resource abundance on a democratic context, where elections should make politicians accountable and political competition can balance incumbent's power. The literature so far has focus on understanding regime changes (Dunning (2008); Haber & Menaldo (2010)), how natural resource abundance can bring political instability (Caselli (2006)) or can help autocratic rulers to perpetuate in power (Acemoglu et al. (2004)). Our paper is directly related to two theoretical works that analyze the mechanisms through which the natural resource abundance affects politicians incentives in a democratic context. Caselli & Cunningham (2009) argue that revenue effect occur through two main channels: by increasing the value to stay in power and by raising competition over power. Robinson et al. (2006) show that incumbent politicians can use revenues from natural resources to spend in patronage in order to influence future election.[3] Therefore, our work is an empirical test for both models.

In addition, our work contributes to the literature by providing better estimates of the political economy effects of oil booms. Our empirical strategy presents several innovations. First, because most of oil production is offshore and oil revenue is distributed according to a fixed geographical rule, we can use it as exogenous windfall to incumbent. We also instrument royalty revenue by oil output in order to explore only the variation that comes from production and price shocks.

[3]There are at least two other types of mechanisms put forward in the existing literature to explain the political economy of the resource curse. One line of research argues that an increase in the stock of natural resources induces rent-seeking which distorts the incentives for productive investment (Baland & Francois (2000); Lane & Tornell (1996); Tornell & Lane (1999); Torvik (2002)). A second group is described in Gylfason (2001) and Leamer et al. (1999) who argue that politicians in resource rich environments do not have incentives to spend in education. The lack of human capital accumulation reduces long-run growth.

Second, we analyze oil royalties paid by Petrobras and other multinational companies to the Federal Government, which, in turn, redistribute them to municipalities. This allow us to circumvent the potential endogeneity in the decision to extract oil since we compare municipalities that do not influence production decisions. Moreover, by using variation across local governments within a country, we keep constant all the variation in macro institutions that might also affect long-term economic growth. Finally, since royalty payments increased considerably during the last decade, we have enough temporal variation in the data which allows for the estimation of fixed effect regressions. Therefore, by using panel-data for municipalities we are able to control for all potential geographical characteristics that are likely to affect resource availability, economic growth potential, and political outcomes.

This paper relates to a recent empirical literature that aims to understand political economy effects of resource windfalls. Vicente (2010) examines the effect of oil discovery announcements in São Tomé and Principe on measures of perceived corruption. Brollo et al. (2010) investigate the effect of federal transfers on reelection outcomes, political selection and corruption in Brazilian municipalities. They look at different types of federal transfers to municipalities and also show that they increase mayor reelection, but, contrary to us, find an impoverish in the pool of candidates.[4] Litschig & Morrison (2010) estimate that higher federal transfers in Brazil lead to higher spending and educational outcomes, which therefore improve incumbent party reelection probability. Our findings also complement a literature on voters' rationality. In particular, our work is related to Wolfers (2007) who present a model where voters cannot discern between incumbent's competence and luck. We find results in line with his work, which shows that governors in oil-producing states are likely to be reelected following a rise in oil prices, while their counterparts in the rust-belt are likely to be ousted. However, his analysis does not allow a comparison between short and medium-term effects.

Finally, this study complements recent papers that use geographical variation in oil availability within countries to examine the effects of oil abundance on long-run economic development and the quality of government. Michaels (2009) uses geological variation in oil abundance in U.S. counties to investigate the effects of oil specialization. He finds that the development of oil sector increased education and income per capita without causing ill effects on industrialization or inequality. More related to this study is Caselli & Michaels (2009) who use variation in oil abundance among Brazilian municipalities to assess the effects of resource abundance on local economic activity, public spending, public good provision, and living standards. They find only modest effects on non-oil GDP, public good provision, and no significant improvements in living standards, leading them to conclude that most of oil royalties received by municipalities go missing. This paper differs from Caselli & Michaels (2009) by the focus placed on the political economy mechanisms that link resource booms to long-run development. We also employ a different empirical strategy by focusing on

[4]However, the mechanism highlighted in their work is different from ours. Their model states that an incumbency advantage arises due to an impoverish in the pool of candidates.

municipalities located on the Brazilian coast and exploring within variation in addition to use oil production value as an instrument for royalty revenue. Finally, we look at a different time period and analyze what happened in each political mandate, which allows us to understand short and medium-term effects of royalty shocks.

The remainder of the paper is organized as follows. Section 2 describes the institutional background. Section 3 explains the methodology and section 4 describes the data used. Section 5 presents the empirical findings and section 6 discusses the results. Finally, section 6 concludes the paper.

2 Institutional Background

Brazil has extracted oil since 1939, but oil production became important only in the mid-1970s, when oil fields in Campos Basin, on the coast of Rio de Janeiro, were discovered and the increase in international oil prices made offshore production viable.[5] The industry prospects improved during the 1980s when the first giant oil fields were found as shown in Figure 1.[6] An important industry upturn occurred in 1997, with the enactment of Law no. 9478, named the Oil Law, which phased out the state oil extraction monopoly.[7] Oil output increased and more than doubled between 1997 and 2008, reaching 663 million barrels in 2008. Figure 2 shows that offshore oil output drove this increase, by tripling from less than 200 million barrels a year in 1994 to 600 million barrels in 2008, while onshore output was stable around 65 million barrels a year in this period.

Ten states produce oil in Brazil but production is highly concentrated in Rio de Janeiro, which is responsible for 92% of offshore or 82% of Brazilian oil output. Looking within the states, 53 municipalities have onshore oil wells and 63 are classified as producing municipalities because they face offshore oil fields (see below for a formal description of "facing" municipalities). The industry which supports offshore activities is concentrated in one city, Macaé, which is located in the north of the state of Rio de Janeiro.[8]

Oil companies must pay up to 10 percent of output value in royalties to federal, state and local governments. The legislation that determines the value and the beneficiaries of royalty revenue was modified several times. Onshore royalties were introduced in 1953 and were paid to states and municipalities. Offshore royalties were created in 1969, but only benefited the federal government. In 1985, during the re-democratization period and following a political movement to decentralize

[5]The most notable oil fields discovered in mid-1970s were Garoupa (1974), Namorado (1975), Badejo (1975), Enchova (1976), Bonito (1977) e Pampo (1977). The first offshore well drilled in the country was in Sergipe in 1968. Bregman (2006)

[6]In 1984, Petrobras discovered Albacora, the first giant oil field in deep waters, which consolidated Campos Basin as the main production zone in the country.

[7]From 1953 to 1997, only Petrobras, the Brazilian state-company, produced oil in Brazil. The new rules exposed Petrobras to international competition but the company is still by far the largest player in Brazil's oil market.

[8]Macaé was selected by Petrobras in the 1970s as the base for offshore activities due to its geographic proximity to Campos Basin.

fiscal revenues, Law 7.453/85 was enacted and offshore royalties began to be paid to states, municipalities and the Navy.[9] In this decision, one key issue was to determine which municipalities were affected by offshore oil production. Politicians chose a geographic criteria and classified municipalities into four groups: producing municipalities, secondary zones, neighboring municipalities and non-affected municipalities. In 1986, Decree 93.189/86 classified as 'producing municipalities' those that lie in front of an oil well according to orthogonal and parallel lines to the Brazilian coast. These lines were not the object of political bargain since, by law, they were designed by the National Bureau of Statistics (IBGE) based on the geodesic lines orthogonal to the Brazilian coast which are used as reference in nautical letters. Figure 4 illustrates the criteria for the coast of Rio de Janeiro.[10]

The main modification in the oil royalty rule occurred with the enactment of Oil Law in 1997. This law increased royalty payments from 5 to 10 percent of the output value and indexed the reference price to the oil international price. In addition, the Law created special quotas ("participações especiais") or extra payments received from highly productive oil fields.[11] The second parcel of 5% of royalty payments followed a different rule than the previous one and benefited even more producing municipalities (see Annex for details).[12] The new legislation was followed by the upward trajectory of international prices and two large Brazilian Real devaluations. All these facts together induced an enormous increase in royalty payments from R$ 190 million in 1997 to R$ 10.9 billion in 2008.

Taken together, royalty payment rules imply that local governments are the main beneficiaries of oil windfall. In 2008, municipalities directly received 34 percent of royalty payments, followed by states, which received 30%, the Ministry of Science and Technology (16%), the Ministry of Navy (12%) and a special fund (8%).[13] This level of decentralization of natural resource compensation is not observed in other countries (Serra (2005)).

These rules also imply that geographic location is the main determinant of who receives what and how much of the oil windfall each municipality gets. The largest share of royalty revenue that goes to municipalities is paid to 'producing municipalities" because they are considered the ones most affected by oil production. In addition, the proximity to these municipalities determines the

[9]This Law only entered into effect in 1986, after being regulated by Law 7.525/86 and Decree 93.189/86. Law 7.453/85 was proposed by Senators Nelson Carneiro (PMDB - RJ) and Passos Pôrto (PDS - SE), whose aim was to introduce offshore royalties by following the same rule which was used for onshore royalties. For details on the political bargains made to approve Laws 7.453/85 and 7.525/86 see Serra (2005).

[10]There was another modification in the rule in 1989. Law 7.990/89 included municipalities with transportation facilities from and to oil sites in the list of benefited municipalities.

[11]The special quotas were paid for the first time in 2000 and about 30 municipalities received it in 2008.

[12]Serra(2005) argues that the new rule for royalty payments was not the object of much debate during the approval of the Oil Law because this Law was dealing with more important topic by that time, the phase-out of the state monopoly in oil production.

[13]Actually, the value received by local governments is even greater because they indirectly receive 80% of the special fund and 25% of the payments that go to state governments. This implies that municipalities receive 47.6 percent of royalty revenue. In our analysis, we only take into account the direct payments to municipalities.

status of 'neighboring cities". However, the amount paid to each municipality depends not only on geographic position, but also on population and the location of production plants, pipelines and transportation facilities (see Annex for details on the payment rule).

Every month an oil windfall is paid to the Brazilian Treasury, which in turn distributes it to the beneficiaries. Municipalities are free to allocate this income, with two restrictions. They cannot use this rent to hire public employees on a permanent basis, nor can they pay debts with it.[14] The Tribunal de Contas of each state (TCEs) is the institution in charge of auditing the allocation of royalty revenues. This windfall can be invested in different types of public goods and services. Local governments in Brazil are the main providers of basic education and basic health services. In addition, they are responsible for local transportation and infrastructure. Security, however, is supplied by state governments and few Brazilian municipalities have a local police.

The first political mandate under analysis, from 1997 to 2000, was marked not only by the extraordinary increase in royalty revenue but also by the Reelection amendment, which was enacted in June 1997 and allowed mayors to be reelected once. This period is of special interest because mostly of the revenue shock was arguably unanticipated and all the mayors could run for reelection.

Figure 3 presents a graph which illustrate the timing of the local elections, the reelection amendment and the enactment of Oil Law. We also show the evolution of royalty payments made to municipalities, which increased by twenty-seven-fold in real terms from R$ 167 million in 1997 to R$ 4.7 billion in 2008.

3 Empirical Strategy

Our main objective is to understand oil revenue impact on local economies. Specifically, we want to estimate:

$$y_{it} = \rho R_{it} + X_{it}\beta + c_i + \lambda_{st} + u_{it} \tag{1}$$

where y_{it} denotes municipality i outcome at year t (e.g. public employment and wages, educational and health supply measures), R_{it} indicates royalty value paid to municipality i at time t, X_{it} is a vector of municipality characteristics that vary over time such as population, c_i is a municipality fixed effect, λ_t is a state-year fixed effect and u_{it} is a random shock.

However, oil windfall is not exogenous to local economies because it depends on the geographic proximity to an oil field, population and the location of oil facilities. The main concern is related to the location of oil plants and facilities which may vary over time and are not perfectly observed by us. In order to deal with this potential problem, we follow Caselli & Michaels (2009) and apply an instrumental variable approach, using the following equation as a first stage equation:

$$R_{it} = \gamma_1 Z_{it} + X_{it}\gamma_2 + c_i + \lambda_{st} + \epsilon_{it} \tag{2}$$

[14]The only exception is a debt with the Federal Government, which can be paid with this income.

where Z_{it} denotes oil output and ϵ_{it} indicates non-observable characteristics that explain royalty payments, such as oil producing plants.

The validity of this approach depends on two main assumptions: (i) Z_{it} has a significant effect on R_{it} and (ii) the only impact of Z_{it} on Y_{it} is through R_{it} (the exclusion restriction). The first assumption is guaranteed by the royalty rule, which generates a strong first stage, as a fraction of oil output is paid in royalties to municipalities where drilling is done. In addition, the rule allocates offshore output among municipalities according to lines that lie parallel and orthogonal to the Brazilian coast, creating a geographic instrument. Figure 5 shows the map of the Brazilian coast with producing and non-producing municipalities and the location of oil fields. We believe that this figure makes explicit the fact that, conditional on being on the coast, the status of 'producing municipality' is quite random.

However, Figure 5 also highlights that benefited municipalities are not evenly distributed in Brazil, instead, they are mainly on the Brazilian coast. If coastal municipalities are systematically different from other Brazilian municipalities, and indeed they are, a simple comparison between benefited and non-benefited municipalities may have biases. To account for this problem, we restrict our analysis to coastal municipalities in coastal states. This provides a sample of 256 municipalities distributed among the states of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina e Rio Grande do Sul.[15] In addition, we exclude the top 1 percent of municipalities in royalty distribution in order to deal with outliers, which implies excluding three municipalities from the sample. As robustness checks, we replicate most of the results using an alternative sample which includes all the 3,56 municipalities from the fifteen coastal states.[16]

The second main assumption in the identification strategy (the exclusion restriction) requires that oil output does not generate any direct effect on outcome variables, for instance, through economic impacts or income effects. We believe that this is plausible because 90% of oil is produced offshore in Brazil and services and industrial plants that support offshore production are concentrated in one city (Macaé).[17] Although we cannot test this assumption, we provide evidence in the empirical results that oil production does not have any economic effect on local economies other than through the municipal budget.

The existence of term-limits in Brazil led us to use a different strategy when analyzing political outcomes. The fact that mayors cannot run for two subsequent reelections implies that reelection estimates are conditional on mayor being in the first-term. Hence, the sample of municipalities changes every election, which makes the within estimates hard to interpret. We, therefore, run the following equations to estimate royalty effect on political outcomes:

[15] Although the state of Amazonas also produces oil, we exclude it from the analysis because it only has onshore production. We don't include the North region coastal states because they are very different from the other regions and do not produce oil.

[16] We also exclude the three top beneficiaries from these alternative samples to guarantee comparability.

[17] In the empirical section, we run the regressions with and without Macaé and the results do not change.

$$y_{it} = \rho_t R_{it} + \alpha y_{it-4} + X_{it}\beta + \lambda_{st} + u_{it} \tag{3}$$

$$R_{it} = \gamma_1 Z_{it} + \alpha y_{it-4} + X_{it}\gamma_2 + \lambda_{st} + \epsilon_{it}$$

The main difference is that this strategy does not use municipal fixed effects but control for geographic characteristics such as latitude, longitude, altitude, distance to the state capital, dummy for state capital, log of population, population density and dummy for coastal municipality. We also control for the level of the dependent variable in the previous election (y_{it-4}) when possible, in order to account for pre-existent differences. We evaluate oil windfall impact in each election by running different regressions for each year.

Table 1 shows the first-stage regression for the two samples used in this work and for both panel and cross-section specifications. We show results for four different time periods that we explore across the analysis. We have a strong first stage relationship in all samples and specifications, with F-statistics that range from 44 to 401.

Our approach is different from the one used in Caselli & Michaels (2009) in several ways. First, we focus on offshore output variation by focusing on coastal municipalities. The next section presents summary statistics that show that this sample gives us a better control group than the one that uses all municipalities. Second, our analysis covers a different period. We explore annual variation of royalty payments between 1997 and 2008, the period when the oil boom is most remarkable. In addition, we are able to recover royalty payments and oil output series for 1996-1998, which allow us to understand royalty effects before the boom. In turn, Caselli & Michaels (2009) analyze mainly variation in outcomes between 1991 and 2000, having few variables whose values were gathered more recently. Third, our analysis of the impact of royalty revenue on public goods supply and municipal expenses explore a within-variation in addition to the IV strategy, leading to more clean estimates. Finally, our unit of analysis is the municipality rather than the AMC ('área minima de comparação). In Brazil, the fact that many municipalities split during the 1990s led to the creation of the AMC concept, which aggregates municipalities according to their original political borders and allows comparisons across decades. While this is an easy way to deal with municipal divisions, the results generated by this strategy do not have a clear economic interpretation. The main concern is related to public budget analysis and the size of municipal civil service. For instance, consider a municipality which was split in three during the 1990s. AMC measures compare the municipal budget of one municipality in 1991 with the sum of three municipal budgets in 2000. The problem is that all municipalities have a minimum structure and the sum of three budgets is probably larger than a hypothetical one that would include the three. We don't need to rely on AMC analysis because municipality divisions are not a concern in the sample and period under analysis (1997-2008),[18] which allow us to understand the impact of royalties on

[18] 23 among the 256 coastal municipalities were installed in 1997 and have their first election in 1996, so we have all outcome information for them. 36 municipalities in the states under analysis were created in 2001 but none is on

municipalities, which is the actual political division.

Finally, there is a possible concern related to the endogeneity of oil output Z_{it}. One may argue that municipalities can try to influence oil output from each oil field in order to influence the amount of royalties they receive. We believe that this possibility is highly unlikely in the Brazilian context. Production and investment are carried out by Petrobras and other multinational companies, respond to long-term decisions and involve budgets in the billions of dollars. It seems highly unlikely that tiny municipalities and local politicians can influence multinational companies' plans, and there is no anecdotal evidence in support of this idea. In the empirical section, we provide direct evidence that endogeneity of oil output due to local political influence is not a concern in the context under analysis.

4 Data

We use several data sources in this study. Agência Nacional de Petróleo (ANP) is the main source of information for the oil sector in Brazil and provides data on oil output, oil fields location and royalty payments to municipalities from 1999 to 2008. We complement this data with information on oil output from the Oil and Gas Journal (Oil & Special (1999)).[19] The December editions of this magazine report oil output per oil field in Brazil and other countries from 1991 to 1997. This allows us to construct the series of oil output and to recover royalty payments data for the 1990s. As a result, we have oil output and royalty payments series from 1995 to 2008, which let us understand how municipalities were affected by oil windfall before and after the boom in royalty payments promoted by the Oil Law. This is the first work that provides oil data at the municipal level for the 1990s. In the Annex we explain in details how we build oil production annual values, how we linke oil output to specific municipalities and how we recover royalty payments series. We double checked our calculation and we show that the 1994-1997 royalty series constructed based on Oil and Gas Journal data is almost equal to the one provided by ANP at the state level (correlation 0.9997).

Electoral information for 1996, 2000, 2004 and 2008 local elections comes from Tribunal Superior Eleitoral (TSE). We then construct measures of electoral competition and performance such as vote shares, effective number of political parties and margin of victory. In addition, TSE also provides us with a list of candidates and parties elected in 1992, which allows us to construct 1996 party reelection variable.[20]

In order to understand whether oil windfall improves municipal public services, we gather information on how municipalities spend their budget and on local public goods provision. Data

the coast.

[19] We are grateful to Gabriela Egler for showing us this data and making it available to us.

[20] We were able to get 1992 election results in order to construct 1996 party reelection for only a subset of states: PR, SP, RJ, BA, SE, AL, CE and part of RN.

on public finance, including revenues and expenses, are available from Brazil's National Treasury through the 'Finanças do Brasil' (FINBRA) database from 1997 to 2008. Educational outcomes are provided by Educational Census, carried out by Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP) from 1998 from 2010. The number of municipal health clinics and hospitals are available at DATASUS's site for 1999 and 2010. We use the 2000 and 2010 Population Census to get information on household infrastructure and population growth. We gather information on municipal public employees for the 1996-2008 period from the Social Security Registry of all formal workers in Brazil (RAIS), and collected by the Brazilian Ministry of Labor. We also use RAIS to obtain information on private employees, total payroll and number of firms per sector in order to estimate oil windfall effects on economic activity. This analysis is complemented with information on municipalities' GDP available from IBGE for 1999-2009 period.

The analysis to identify endogeneity issues is based on geocoded information regarding when and where oil fields were discovered in Brazil. We gather this data from ANP's Exploration and Production Database (Banco de Dados de Exploração e Produção de Petróleo - BDEP). Finally, we get complementary information to account for differences in municipal characteristics that may confound the results. Since oil output is concentrated in the Brazilian coast, we gather data on municipalities' geographic position to use as controls in the regressions that do not use municipal fixed effects. IPEA provides information on geographic characteristics such as latitude, longitude, altitude and distance to the state capital. We also use demographic characteristics such as percentage of urban households, infant mortality and percentage of illiterate population available from the 1991 and 2000 population census as controls in some regressions and to understand differences among municipalities before the oil boom. In addition, we use the IBGE inter-census population estimates to obtain yearly data on municipal population, which are used in all regressions. However, we did our own interpolation for 2001-2007 period based on the population growth rate between 2000 and 2008. The idea was to smooth the jump in population that some municipalities experience in 2008, when the 2007 Population Count results are recorded in the data. All monetary variables used throughout the analysis are deflated using IPCA index and represent real values on 2010 prices. In the annex, we provide the sources of all variables.

Finally, we collect several pieces of information to understand the mechanisms which explain reelection results. To gather information on voters' awareness about oil windfall, we performed a websearch on two newspapers to look for news about 'petroleo' (oil), 'royalties' and 'municipios' that were published in each year from 1998 to 2008. We performed the search for O Globo and Folha de São Paulo.[21] In order to shed light on law enforcement, we get information from Tribunal de Contas do Rio de Janeiro, which is the institution responsible for auditing royalty revenues allocated by Rio de Janeiro's municipalities. They provide us with information on which municipalities were audited between 2003 and 2008. The objective of the audits under analysis is to verify whether a

[21] These are the only two newspapers we were able to search by key word and data in the internet.

municipality has any irregularities with respect to municipal public employment.

Table 2 shows summary statistics for oil royalties and output in each election year. We observe that oil rents measure in per capita terms increase on average ten-fold between 1996 and 2008, while oil output per capita increased by five-fold in the same period. Oil municipalities located in the coast received on average R$ 88 per capita per year in 1996, which was equivalent to 8% of their municipal revenue. This revenue increased by ten-fold on average from 1996 to 2008, reaching R$ 760 per capita per year in 2008, or 16 percent of municipal revenue. [22] Non-oil producing municipalities also receive royalties because they are neighboring municipalities or have oil facilities. They also experienced high growth in royalty revenues but the amount they received is relatively quite small, reaching R$ 21 per capita or 1.6 percent of municipal revenues in 2008. For the sake of comparison, Table 2 also presents FPM transfers figures, which is the main Federal transfer to Brazilian municipalities. Although FPM transfers increased 26% in real terms from 1996 to 2008, this rate was much lower than the growth rate of oil windfall (764%). As a consequence, the rate between royalty and FPM transfers went from 0.37 to 1.86.

Table 3 compares municipalities in the coast of Brazil to all municipalities in the 15 states under analysis by showing socio-demographic and political characteristics in our baseline year (1997), which is just before the boom of oil royalties. We observe that coastal municipalities are on average more populated and developed. Coastal municipalities have a more educated population, are less poor, have a higher income per capita and have a higher share of households with electricity, suggesting that the sample selection is important in our analysis. In columns 3-6 we test whether royalty payments before the oil boom was correlated with municipal characteristics. We present the coefficients and standard errors of regressions of municipal characteristics on royalty payments per capita in 1997, controlling for state dummies to account for differences across states. Columns 3-4 shows results for the complete sample and indicate that royalty payments are correlated with several municipal characteristics, indicating that more developed municipalities receive more oil rents. However, when we compare just coastal municipalities (columns 5-6), we don't observe this pattern. But we still find that oil royalties per capita are correlated with population, urbanization, public revenue and number of employees per capita. More important, oil royalties are not correlated with political characteristics in 1996. The difference between the two samples in our baseline period provides support for the use of coastal municipalities as our main sample. In addition,Table 3 indicates that the analysis of royalty impact on public goods and services must take into account the variation of services rather than its level.

[22]For a comparison, oil royalties per capita were equivalent to 1 percent of Brazil's household per capita income in 1996 and to 8 percent in 2008.

5 Results

We begin the empirical analysis by doing two validation tests. We provide evidence that endogeneity in oil output is not a concern in the context under analysis. We present the timing of oil discoveries and the relation between having a oil field discovered in its boundaries and municipal political alignment. In addition, we show evidence that oil production does not have a positive effect on local economies rather than through the public sector, which support our empirical strategy.

We then investigate oil windfall effects on local politics. We show that there is a large incumbency advantage in the election that follows the oil windfall boom, but this effect disappears in the medium run. We analyze political competition and selection and show that oil royalties do not impact them. We follow by investigating how municipalities spend oil windfall. We show that municipalities report to increase all their expenses and promote large increase in public sector but we don't find any long-term improvements in terms of household infrastructure, health and educational services.

5.1 Validation Tests

5.1.1 Determinants of Oil Discovery and Production

As briefly discussed in the Empirical Strategy, there are few reasons to believe that local municipalities have the capacity to influence Petrobras and other multinational company plans on where and when to drill an oil field. Figure 1 shows that the largest oil fields in terms of 2008 oil output were discovered in the mid-1980s and in 1996. Therefore, for mayors to influence drilling locations in order to receive more royalties it would require that the same political groups had been in power in oil-rich municipalities for more than 10 years (from mid-1980s to 2000s) and that mayors from oil-rich areas could anticipate or influence the enactment of the Oil Law in 1997, which was responsible for the major increase in royalty revenue. Although both facts seems unlikely, Table 4 provides direct evidence that mayors indeed do not influence discoveries and output from oil fields. We explore the association between the timing of discoveries and initial production of new oil fields and municipalities political alignment. Each observation is one municipality. The sample covers the period from 1993 to 2008 and includes all Brazilian municipalities that have at least one oil field (onshore or offshore) discovered within its boundaries in any moment in time. In column 1, the dependent variable is equal to one if an oil field within a municipality's borders was discovered in the respective year, while in column 2 the dependent variable indicates whether oil began to be extracted in the respective year. The regressions include a dummy indicating whether the party in power in the municipality is from the same political coalition of the federal government, party dummies, year and city effects. We see that the fact that the party in power in the municipality is from the same federal government political coalition is not associated with the municipality having an oil field discovered within its borders or with the year oil field entered into production. In

addition, we see that few, if any, parties have a higher or lower probability than PT (the Workers Party, which governed the country from 2003 to 2010, and the omitted party in this regression) of influencing the timing of oil production. Finally, columns 3 and 4 look at the time gap between discovering the oil field and beginning its production and confirm that there is no indication of municipal political influence on oil production decisions.[23]

5.1.2 Impact on Economic Activity

One of the main hypotheses in our empirical strategy is that oil output does not affect municipal outcomes through other channels than the public budget. We believe that this assumption can be supported because 90% of oil produced in Brazil comes from offshore wells and most of municipalities which face oil fields does not suffer externalities from oil output. Table 5 presents evidence on that direction by showing oil output effects on different variables of economic activity. We explore long-term variation within oil-rich municipalities by regressing economic variables on oil output in 2008 and in 1998-1999 and controlling for municipal and state-year effects. All measures are in per capita terms. Panel A shows our preferred specification that includes coastal municipalities from the fifteen coastal states, while Panel B includes all municipalities from these states.

Columns 1-4 reveal that oil output does not affect the number of firms in any sector, while columns 5-6 indicate that oil output does not impact the number of private employees nor the private companies payroll. However, we find a positive impact on public payroll, reinforcing the idea that oil output effect occurs mainly through the public sector. Columns 8-9 show the effect of oil output on municipal GDP per capita. We see that oil production is associated with an increase in total GDP per capita (column 8). However, this result should be interpreted with caution. Municipal GDP in Brazil is not directly computed. The National Bureau of Statistics (IBGE) computes the state GDP and then divides each sector's GDP among municipalities according to reference variables (variáveis de rateio). The key issue in our analysis is that the reference variable used to divide mineral industry GDP is precisely the royalty rule. Hence, the estimated association between oil output and industry GDP is tautological. To assess whether oil output affects municipal economic activity, it is more informative to look at non-industry GDP, which we measured by subtracting industry GDP from total GDP. This variable indicates a negative effect of oil activity in the coastal sample, which is in accordance with the literature that points out that natural resource abundance crowds out other economic activities. The effect is relevant in economic terms, indicating an average decrease of 5.4 percent of the non-industrial GDP for each standard deviation increase in oil output. As an additional exercise, we checked that the results are robust to the presence of Macaé on the sample, the municipality that concentrates oil facilities for offshore production (results not shown and available upon request). All the results hold in both coastal and

[23]The sample used in columns 3 and 4 is smaller because regressions are conditioned on the municipality having an oil field discovered between 1993 and 2008

complete sample.

Our findings contradicts Caselli & Michaels (2009) results, which shows that oil windfall does not affect municipal non-industry GDP pc. The reason is that they explore cross-sectional variation in 2002 at AMC level, and the negative effect that we estimate just shows up when we explore the variation within municipalities.

5.2 How Oil Royalties Affect Local Politics?

We now turn to investigate the main question of this paper which is whether oil windfall help mayors to stay in power. We begin by analyzing the short-term effect, followed by the effect in 2008 election, ten years after the beginning of the oil boom.

5.2.1 Short-term effect: 2000 election

Table 6 assesses the effects of oil revenue on 2000 election. Panel A shows OLS results, while Panel B shows the effects when we instrument oil royalties by oil output.[24]. We observe that mayors from oil-rich municipalities are not more likely to run for office, but they experienced a large incumbency advantage relative to their peers in non-oil municipalities. The point estimates in IV regressions are substantially larger than OLS results indicating that oil royalty effect is primarily driven by oil producing municipalities. The IV results in column 2 and 3 indicates that a one-standard-deviation increase in royalty revenue increases mayor reelection chances by 16 percentage points (a 32 percent increase in the sample mean) and party reelection by 26 percentage points, which represents a striking 71 percent increase. Note that column 3 takes into account the possibility that oil-rich municipalities have different initial levels of incumbency advantage by controlling for party reelection in 1996.[25]

Theoretical studies point out that resource abundance can also affect political competition. Caselli & Cunningham (2009) argue that resource revenue can increase competition over power because the value of attaining office and capturing oil revenue increase to all individuals and this may affect the entry of challengers and the effort they put on the process. On the other hand, resource revenues also increase the value of staying in power and can give means for incumbents to influence elections. Potential opponents can estimate the advantage of the incumbent and refrain from running for office, reducing political competition. Therefore, the effects on political competition is a matter of empirical investigation.

We assess whether oil windfall affects political competition in columns 4-6. We use three

[24] All regressions use state fixed effects and municipal characteristics as controls (log of population, urbanization rate, population density, distance to the state capital, altitude, longitude, latitude, area, a dummy for whether the municipality is a state capital)

[25] The sample in column 3 is smaller due to data availability. We were able to get 1992 election results in order to construct 1996 party reelection for only a subset of states: PR, SP, RJ, BA, SE, AL, CE and part of RN. The results are very similar if we don't control for party reelection in 1996 and use all costal municipalities

measures of political competition: the number of candidates running for mayor, the number of effective candidates and the incumbent's margin of victory. While the first variable gives us an indication of pre-election competition, the other two variables show how competitive each election was by taking into account vote-shares. We follow the same specification as before and control for the level of dependent variable in 1996. Column 4 indicates that oil royalties do not change the number of candidates running for office. When we take into account vote-shares, we measure a sharp decrease in political competition, which reinforces the results that oil-rich mayors were highly powerful in 2000 and beat their competitors easily. A one-standard-deviation increase in oil royalties is associated with an average increase of 7.8 percentage points in the margin of victory, which represents an increase of 91 percent in the sample mean. The result based on the number of effective candidates also indicates a decrease in competition, though less intense (decrease of 5.8 percent).

Columns 7-9 look at political selection by analyzing changes in the opponents' average characteristics. The link between oil windfall and political selection can be considered under a citizen-candidate framework, where any citizen can enter the electoral race if the benefits of entry exceed the costs (Osborne & Slivinski (1996)). Oil revenues can induce the entry of citizens with high opportunity cost, since it may increase the rewards from office.[26] We try to assess this channel by considering the opponents' average education and previous experience. In columns 7 and 8, we regress opponents' average years of schooling and the percentage of candidates with college degree on royalty payments. We find no effects of oil windfall on opponents' education. Finally, column 9 shows royalty effect on the percentage of candidates that had a highly skilled occupation before running for mayor. We coded as highly-skilled any occupation that requires a college degree or is associated with civil service. We see that oil revenue is not associated with changes in this variable.

5.2.2 Medium-term effect: 2008 election

We now turn to investigate how oil windfall affected reelection probability in 2008.[27] As shown in Figure 3, the oil windfall has continued to increase along the decade but this increase was not unexpected as it was in the 1997-2000 term, when the enactment of the oil law promoted a discontinuous jump in oil revenues. In addition, several municipalities became oil producers in this period as new oil field entered production. In order to explore possible differences between new oil municipalities and relative old recipients, we run the regressions considering the variation in royalty

[26]These rewards from office are not necessary private rents and can include ego-rents and present and future financial compensations.

[27]We opt to not include in this paper the analysis of 2004 election because, as we just showed, most mayors from oil-rich municipalities were reelected in 2000, which implies that they faced term limits in 2004. Therefore, the analysis on reelection prospects in 2004 is severely affected by sample size and selection. Regression estimates indicate that one-standard-deviation of oil royalties is associated with an increase of 22 percent in mayor reelection probability in 2004. The result is noisier (point estimate=0.4939, s.e.=.3247) due to lack of power since only 24 oil-rich municipalities had first term mayors in 2004.

revenue between the beginning and the end of the political term (2005-2008) and the average level in this period. We follow the same specification as Table 6 and use the value of the dependent variable in 2000 as control. Table 7 shows the results. We observe, that despite increasing oil rents, mayors from oil-rich municipalities were not reappointed to office with higher probability than their peers in non-oil places. This is true when we consider both the municipalities with high level of oil revenue (Panel A) and the ones which experienced high increases (Panel B). Column 3, Panel B, indicates that parties are less likely to remain in power in 2008 in municipalities which experienced a large increase in oil windfall. This result probably indicates that strong mayors run for reelection under a different political affiliation than the one under which they got into power. Column 4 evaluates whether any former mayor who were in power in 1996, 2000 or 2004 have a higher chance to be elected in oil-rich municipalities and indicates that oil royalties do not increase continuation in power.

Table 8 analyzes political competition and selection in 2008. We evaluate political competition with the variables previously analyzed plus campaign spending and a indicator variable for whether the former mayor run again. We don't find any significant effect but for campaign spending which decreases by 53 percent for each standard deviation increase in royalties. In column 6, we assess whether mayors from oil-rich municipalities face a higher probability of having their candidature suspended (temporarily or definitely). The idea is to understand whether mayors from oil-rich municipalities do not win with a higher probability because they face charges of political irregularity. There is no indication that this is the case. Finally, columns 7-10 evaluates oil windfall effect on candidates' characteristics and median wealth. The results again do not indicate that oil royalties affect political selection.

Overall, Tables 6 and 8 indicate that political competition and selection cannot explain changes in incumbency advantage. We next evaluate the behavior of those in power by analyzing how mayors allocate oil windfall.

5.3 How Municipalities Allocate Royalty Revenue?

5.3.1 Municipal Budget

We begin to evaluate oil revenue allocation by looking at municipal budget. We first look at municipal revenue. The idea is to analyze how royalty rents affect public coffers and whether it affects other unrelated revenues. Table 9 indicates that oil royalty effect on components of municipal revenue measured in R$ per capita. The results are from panel-IV regressions that cover the period from 1997 to 2008 period and use municipal and state-year effects as controls. In column 1 we see that each Real per capita received as royalty payment generates 1.04 Reais in total revenue. This increase of 104 percent in total revenue occurs either because oil activity generate additional transfers from the state and federal governments that we don't measure here (see footnote 13) and/or because oil rents affect other revenues. Indeed, column 2 indicates that oil revenue is also

associated with an increase tax revenue, which increases by R$ 0.01 per capita for each standard-deviation increase in oil windfall, which represents a 4 percent increase in this revenue.[28] This result indicates that one of the problems of resource abundance pointed out by the literature - the reduction in the incentive to tax - is not present in the Brazilian context.

Columns 3 and 4 look at the effects of royalty revenues on two other federal transfers. FPM stands for "Fundo de Participação dos Municipios" and it is the most important transfer to municipalities in Brazil, while FUNDEF is the acronym for Fundo de Desenvolvimento da Educação Fundamental (Basic Education Development Fund) and is a fund to finance education.[29] The idea is to understand whether the federal government tries to offset royalty payment by reducing other transfers. Columns 3 and 4 indicate that this does not occur since oil windfall is not associated with changes in both transfers.

Table 10 investigates how municipalities report to allocate oil revenue. In this exercise, we explore yearly variation from 1997 to 2008 to identify which expenses respond more to variation in oil revenue. Each column presents the coefficients from panel IV regressions of different types of expenses on royalty payments instrumented by oil output and controlled for municipal fixed effects and log of population. We do this analysis for the whole sample in Panel A, and then split the sample between the three political terms under investigation in order to identify different patterns across terms. Column 1 shows that for every Real received, 53 cents are allocated in current expenses,[30] while 21 cents are used for investments and 1 cent for debt amortization, but this last effect is not statistically different from zero. From the 53 cents used for current expenses, 15 cents or 28 percent are allocated to payroll and other direct labor costs, and 19 cents are spent with other types of labor and service hiring (see columns 2 and 3). These results indicate that oil-rich municipalities apply equivalent amount of resources on payroll and on "other labor and service contracts", which include consulting services, outsourced services and labor hired on a temporarily basis. We interpret this result as a reflection of law restrictions for allocation of royalty revenues, which do not allow municipalities to use royalty revenue to hire public employees on a permanent basis. A way to circumvent this restriction is to hire people through other means. When we disaggregate "other labor and service contracts" by its components,[31] we see that the bulk of this expense is used to pay for outsourced services provided by companies (results not shown and available under request). This budget line can include several expenses, including two famous expenses in oil-rich municipalities: free live concerts and labor hiring through NGOs. The media usually cite both expenses in scandals related to the use of public funds in oil-rich municipalities

[28] The two main taxes under municipal authority are the property tax (IPTU) and a service tax (ISSQN).

[29] FUNDEF is composed by municipal, state and federal contributions whose resources are redistributed to municipalities according to the number of school enrollments to finance education expenses. In 2007, FUNDEF was replaced by FUNDEB.

[30] These include all direct and indirect labor cost, interest payments and other current expenses

[31] Consulting services, outsourced services and labor hired on a temporarily basis (locação de mão-de-obra + contrato por tempo determinado).

and they have been object of police investigation.[32] In terms of relative increase, oil rents increase mainly expenses in investment, which increase by 48 percent, followed by other labor and service contracts (17% increase). Analyses not shown evaluate the impact of oil windfall on each expense as a share of total revenue. We observe that oil revenues do not affect much the composition of public budget. Payroll expenses were slightly reduced as a proportion of total budget while investments suffered a small percentage increase.

Columns 6 to 10 offer another way to look at budget allocation by examining the destination of expenses. We observe that local governments report spending similar amounts in all areas, with the exception of transportation. Housing and urbanization receive 17 cents of every Real received as royalty payments, followed by administration and planning (16 cents) , health and sanitation (15 cents), education and culture (15 cents) and transportation (3 percent but not statistically different from zero). This implies that the areas that receive the largest improvements are housing and urbanization (27 percent increase in expenses for each standard-deviation increase in royalty revenue), followed by administration and planning (18%), health and sanitation (16%) and education and culture (15%). As a share of total expenses, results not shown indicate that education and health expenses are slightly reduced, while housing and urbanization expenditures marginally increase.

Panels B-D repeat the same analysis by political term. We observe that from 1997-2000, municipalities use oil money to increase mainly investment (46 cents of each Real received or 48% increase form each standard deviation of oil rents), and the areas that are reported to receive these funds are health, and housing and planning. In 2001-2004, when most mayors in oil -rich places are in their second term in office, oil rents is associated with increases in payroll expenses rather than investment. Health and education areas are the main destination of oil revenue. In 2005-2008, we observe a change in pattern and increases in all current expenses and areas (but administration and planning). Investments increase by 70% for each standard deviation of oil royalties, and housing and urbanization received an important share of these investment (+ 33%).

Although this analysis so far offers insight into how municipalities apply oil windfall, we cannot use it as strong evidence of public goods provision. We have two main concerns with these data. First, the simple report that municipalities spend resources on a service does not necessary imply that this service is indeed delivered. Our second concern is related to the fact that data on municipal public finance are self-declared by municipalities to the Brazilian National Treasury and some municipalities do not report their finances every year. Campos dos Goytacazes, the largest recipient of royalty revenues in absolute terms, for instance, only disclosed information on its public expenses

[32] In 2008, the federal police arrested 14 people in Campos dos Goytacazes charged with fraud in public procurement of hire outsourced services. In particular, two companies received about R$ 15 million to organize live concerts in the city with non-famous singers. In addition, Campos dos Goytacazes' mayor between 2005 and 2008 is charged of using NGOs and Foundations to divert more than R$ 200 million by hiring 16,000 outsourced employees. See `http://oglobo.globo.com/pais/mat/2008/05/30/ministerio_publico_federal_pede_justica_afastamento_dos_17_vereadores_de_campos-546596081.asp`

on 2000 and 2006. If oil benefited municipalities have a higher probability of not disclosing their public accounts, this can limit the capacity of these data to inform how municipalities are investing royalty revenues. Indeed, a regression of the probability of declaring FINBRA on a dummy on whether the municipality is an oil producing site (onshore or offshore) shows that producers's municipalities have a 4.5 percentage point lower probability of disclosing their public accounts (results not shown).[33]

With these caveats in mind, we turn to look to de facto public good provision.

5.3.2 Public Employment

Table 10 shows that the payroll is a major destination of public expenses, which led us to directly evaluate public employment growth. Figure 6 shows the evolution of the median number of municipal employees per 1000 habitants in producing and non-producing municipalities in the Brazilian coast from 1997 to 2008. We see that although the median levels in the two groups of municipalities are quite similar in 1997 and 1998, they began to diverge in 1999, exactly when municipalities were most affected by the the large boost in royalty payments caused by the Oil Law.[34] Both groups increased substantially the number of public employees, but producing municipalities began to increase municipal public employment earlier and did it at a faster pace.

Table 11 examines whether the largest increases in municipal public employment occurrs in municipalities benefited by the highest increases in royalty payments. Panel A shows the results of IV regressions covering 1997-2008 period and use log of population, municipality and state-year effects as controls. In column 1, the dependent variable is the number of municipal employees per 1,000 habitants on September 30th. We use the employment level on September 30th because this is the record available closest to the election, which takes place every four years in the first weekend of October.[35] Column 1 shows that for each R$ 1,000 per capita received, municipalities hire more 5.93 public employees per 1,000 habitants. This result is highly statistically significant (standard error=0.94) and quite important in economic terms. It implies that municipalities hired more 2.2 employees per 1000 habitants for every standard-deviation increase in royalty revenues, which is equivalent to an annual average growth of 7.4 percent in the number of public employees.

[33] This result is not robust to the inclusion of municipal fixed effects.

[34] Although Oil Law was enacted in June 1997, decree 2.705/98 which detailed the rules for paying the new parcel was just enacted in August 1998. The incremental part of royalty payments was paid for the first time in October 1998 because royalties are due two months after production. This information was provided by ANP technicians.

[35] The RAIS database includes the information on the employment level on December 31st but also discloses monthly hirings and firings. We calculate the level on September 30th as EmploymentLevel9/30 = EmploymentLevel12/31 - (HiringOctNovDec - FiringOctNovDec). In addition, we did a correction in this measure to account for huge variations in reported employment levels in certain years. Since we believe that these drastic variations are misreports, we replaced by missing any record that reports an annual decrease of more than 75% in the number of employees followed by an increase of more than 200% in the following year. As a result, we lose 68 observations out of 2823 in the sample that includes only coastal municipalities. We performed this correction because we don't want artificial jumps in employment level to affect within-estimates. However, the result is robust to the use of corrected or uncorrected measure.

Alternatively, this means that oil-rich municipalities on average multiplied the number of employees by 150 percent in the twelve years under analysis.

Note that the Law forbids municipalities to use royalty income to hire employees on a permanent basis. However, it is widely believed that municipalities use royalty revenues to hire employees.[36] In practice, municipalities have several options for hiring more employees: they can reallocate expenses in order to use the regular budget to pay for hirings, they can bring in temporarily employees or they can hire people indirectly, by establishing contracts with companies which hire people in their place (see footnote 32 on corruption scandals related to this last point). Since the data on Ministry of Labor only consider direct employees, these results should be viewed as a lower bound for the effects on royalties on public employment.

Column 2 in Table 11 shows the results of a regression which assesses whether oil windfall affected municipal public sector wages between 1999 and 2008.[37] In order to account for differences in price levels among municipalities, we use the ratio between the average wage in public sector and the average wage in the private sector as measure. The average of this variable is 1.18 in our sample for the period from 1999 to 2008, indicating that public employees earn on average 18 percent more than private sector employees.[38] Column 2 shows that oil windfall raises the relative public-private wage, which increases by 0.04 for each standard deviation increase in oil royalties, which is equivalent to an annual average growth of 3.5 percent.

In column 3 to 4 we shed light on the composition of the payroll increase. Columns 3 and 4 divide the number of employees between those with and without tenure. Column 3 indicates that the effect on the number of employees with tenure is small and not statistically different from zero. Column 4 shows that most of new employees (78% percent) were hired on a temporary-basis and don't have tenure. A one-standard-deviation increase in royalty payments is associated with the hiring of more 1.8 employees without tenure per 1000 habitants, which represents an average annual increase of 17 percent. Both results are consistent with the fact that, by law, municipalities cannot use oil windfall to hire employees on a permanent basis.

Panels B-C repeat the same analysis by political term in order to identify when most of the expansion of the public sector occurs. We observe that between 1997 and 2000, oil-rich municipalities do not increase the public sector, but change its composition, replacing non-tenured employees by tenured ones. The increase in municipal sector occurrs mainly during 2001-2004 political term, when one-standard-deviation of oil royalties is associated with 3.9 employees per 1000 habitants per year, which is equivalent to a 13 percent average annual growth. We observe that municipalities hire new employees in a temporary basis and public employees receive a substantial wage increase.

[36] See, for instance, an article at Estado de São Paulo: "Lucro com petróleo banca farra de contratacões em municípios" (Oil revenues support excessive employment in municipalities), at `http://www.estadao.com.br/estadaodehoje/20080414/not_imp156256,0.php`

[37] This measure is not available for 1997 and 1998.

[38] The relative wage suffered a huge increase in the period under analysis. In 1999, the first year in our sample, the relative wage in Brazil was 0.98. In 2008, this ratio jumped to 1.35.

The relative wage increase by 0.09 for each standard deviation increase in oil royalties, which means that public employees get an increase of 9 percent higher than their peers in the private sector. In the 2005-2008, mayors stop to hire employees but raise the relative wage by 0.03 for each standard deviation of oil royalties.

In sum, the results presented on Table 11 indicate that oil windfall is associated with a huge expansion in the public sector and that the majority of new employees don't have tenure and are hired between 2001 and 2004.

5.3.3 Public Service Supply

The analysis of municipal budget indicates that municipalities report significant increases in investments, specially into housing and urban infrastructure. Table 13 analyzes whether royalty rents were translated in better household infrastructure, measured by the proportion of households with access to electricity, piped water, sewage and trash collection. We regress differences in the level of these variables between 2000 and 2010 Census on differences in oil royalties and control for state-year effects and log of population. We opt to show four different specifications (OLS and IV for coastal and complete samples) because results are sensible to the specification and to provide compelling evidence that oil royalties generate limited improvements in household infrastructure. Panel A shows that there are no improvements in electricity and sewage coverage. We find a modest improvement in the share of households with piped water in the IV specifications, but weakly significant in the coastal sample (p-value=0.16) and small in economic terms (6.6 % increase for each standard deviation of oil royalties). The point estimates for trash collection are also positive but too noise to claim that there is a statistically significant effect (point-estimate=9.09, s.e.=7.14).

One explanation for this lack of improvement are migration flows. If population and the number of households increase in these municipalities, administrators may be only able to increase infrastructure to maintain its current coverage. In order to evaluate it, Panel B looks at population and household growth. We follow the same specification as above. We observe that in all specifications but our preferred one, there is an indication that oil royalties are associated with population and household growth. The IV results with complete sample indicate an one-standard-deviation increase in oil royalties raise the population by 6.5 percent and the number of households by 5.5 percent. However, our preferred specification (IV and coastal sample) does not indicate any statistical or economic effect. We believe that this specification is specially more accurate to evaluate effects on population. First, royalty revenue varies with population (see rule in Institutional Framework section), which compromises the OLS analysis. Second, coastal municipalities have traditionally a higher population growth in Brazil, which make us doubt that oil royalties rather than sample selection is driven the result in the complete sample. Even if one believe that Panel B provides indication that oil royalties generated population growth, we don't believe that this provides an excuse for lack of improvement in infrastructure since the oil money was high while the population

growth was not.

We continue to investigate improvements in public goods by looking at education and health supply in Panel C and D. We again explore long-term differences by comparing the supply of these services in 2010 and the beginning of oil boom (1998 for education and 1999 for health) in order to allow time for investments to occur and show up in the data. Panel C looks at 12 indicators of school supply which include enrollment, number of schools, number of teachers, measured in terms of young population and the share of schools with computer lab, science lab and free meal. Oil royalties are not associated with improvements in any of these indicators in our preferred specification. The results for the complete sample indicate increases only in the number of teachers and educational employees, which is in line with total employment growth figures. Our results are in accordance with Caselli & Michaels (2009) paper, which finds that the only effect of oil windfall on education outcomes is through the increase in the number of teachers. We use a different database and find a similar result.

Panel D analyzes improvements in the number of health clinics and hospitals administered by local governments,[39] and on health professionals (all of them normalized by population), and indicates that municipalities do not use oil royalties to improve health services.

Overall, Table 13 provides evidence that municipalities do not use oil royalties to provide major improvements in public services.

6 Discussion: Why There is an Incumbency Advantage Only in the Short Run?

Our results indicate that municipalities use oil windfall to enlarge the public sector. This increase in municipal employment is not only important in economic terms but is also the only effect on public goods provision that we estimate. In addition, the pattern of this increase points out that mayors stop to hire more people in the last political term under analysis, promoting just an increase of 2 percent in wages. Therefore, our results suggest that as long as incumbents provide new jobs, they can get reelected but once they stop doing so, they are ousted from power. This evidence raises two questions that we discuss in this section: (i) why voters reward increases in public employment and (ii) why mayors stop to hire people.

6.1 Why voters reward increases in public employment?

Voters' preferences

We can think in two models that rationalize why voters rewards an enlargement of the public

[39] We add two databases to construct number of clinics and hospital series. Data for 1999 is from Cadastros Extintos do SUS, while data for 2010 was gathered from CNES database. Results for number of hospitals should be interpreted with caution because it is not clear that this variable is comparable in both series.

sector. The first one is related to preferences for public jobs due to higher expected utility. Consider the simple specification where voter's utility is given by $u_{it} = p_t w_t + v(g_t) - e_i$, and w_t is the public wage, which he receives with probability p_t (the probability of being a public employee in t), g_t is a public good and e_i is the effort to work in the public sector. As long as $p_t w_t - e_i > v(g_t)$, voters prefer public employment than public goods. However, budget constraints usually limits mayors' ability to provide high $p_t w_t$. This relates to Collier (2007) point that "patronage politics can be a more cost-effective use of public money to attract votes than the provision of public goods, yet it is too expensive to be feasible". Therefore, we could see more patronage practices in resource-rich economies just because resource wealth provides funds to bribe voters.

Voters who don't work in the public sector may reward increases in total employment because this increases p_t. In turn, a public employee utility depends on w_t and on whether he has tenure ($p_t = 1$) or not ($p_t < 1$). Our results indicate that in 1997-2000 mayors increase voters expected utility by increasing the number of employees with tenure ($p_t = 1$), which increases the present value of public employment. In contrast, oil-rich municipalities promote a large expansion in non-tenured jobs in 2001-2004. This change in strategy may reflect law enforcement since municipalities cannot use oil money to hire people in a permanent basis, and/or be a consequence in the change in political environment. In 2001-2004 most mayors in oil-rich municipalities were in their second-term. Facing mayor term limits, political parties may need to bribe even more supporters to be able to elect an unknown candidate and remain in power. According to Robinson & Verdier (2003) model, non-tenured employment and the threat of firing are crucial to guarantee that voters credibly support incumbent politicians.

This story is also consistent with the idea that oil fuels patronage, although we cannot support it without direct evidence that mayors give public jobs only to political supporters.

Information

A second model that rationalize our results is a information one, where voters do not perfectly assess the amount that municipalities receive as oil royalties. Voters can only observe the amount of public goods provided and they know that this depends on the total revenue and on the incumbent's ability, which is not observed. Therefore, oil windfall allows the incumbent to signal a higher ability and voters respond by reappointing the mayor for office. This incumbency advantage can persist as long as voters interpret public employment as a signal of mayor's ability and are sufficiently unaware about the royalty revenue. Once voters become more informed, the difficulty in signaling higher ability reduces the incumbency advantage as well as the incentive to provide more public goods, and mayors end up diverting more funds.

To support this information story we need to provide evidence that voters are not fully informed about oil windfall, but their awareness has increased throughout the years. Although we don't have any objective measure of voters' information about oil windfall that varies over time, alternative

evidence suggest that this has happened. The asymmetric information about oil royalty distribution is justified by the characteristics of Brazilian oil production and royalty distribution rule. The lion's share of oil production in Brazil is located offshore and the inland basis is concentrated in one municipality (Macaé). Therefore, voters would be unaware of this oil windfall unless this revenue is made public by the media, politicians or informed citizens. Even more difficult for voters to assess is the exact amount received. Royalty payments depend on the international oil prices, the exchange rate, the production and quality levels of each oil well and their proximity to oil fields. Therefore, royalty revenue varies a great deal across municipalities and over the years and voters need to update their information frequently. Although they can do that by assessing the ANP website, there is evidence that, in the first years of oil boom (at least), the awareness level was quite low. A survey carried out on September 2002 in Campos dos Goytacazes, the largest beneficiary of royalty revenues, indicates that 58 percent of the respondents were not familiar with the term royalties.[40] For those who knew the meaning of royalties, 56 percent pointed out that they didn't know how the revenue was invested.

However, we believe that voters' awareness has increased along the years with the increase in oil windfall. In municipalities where this money represents a key part of the total budget, informed citizens, the media, political challengers and think tanks improved their technologies to disclose information to the average citizen. Local initiatives to disclose information on royalty values have come out since 2004, at least in the most benefited municipalities. The InfoRoyalties website was created in June 2004 by a local research center in order to deliver information on royalty payments and their use. Regional blogs have been posted in order to freely discuss local politics and public budget.[41]

In addition, in 2007, a particular event increased the information provided regarding royalty payments. In November, Petrobras announced the discovery of Tupi, a giant oil field equal to all Norway's reserves. As noted by Economist (2007), Tupi was the world's second largest strike in 20 years. Two other announcements followed Tupi in early 2008, and the Federal government launched a huge propaganda campaign about what were termed 'pre-sal discoveries', which promised to put Brazil among the five largest oil producers in the World. The promise of a huge windfall spurred politicians to debate the royalty rule, which until then was considered undebatable by the Federal government.[42] A special concern is to increase the number of beneficiary states and municipalities, since the current rule determines that the state of Rio de Janeiro and its municipalities received 43 percent of all oil royalty payments in 2008. In order to follow and stimulate this discussion, newspapers have produced many articles about royalty payments, their beneficiaries and their use. Figure 7 shows the number of articles with the words 'petróleo" (oil), 'royalties" and 'municípios"

[40]Survey of 1,400 respondents detailed at UCAM, Petroleo, Royalties e Regiao, Boletim, Ano 1, Numero 1, Setembro/2003.

[41]Roberto Moraes blog is a case in point. Posted for the first time in August 2004, it has drawn more than 1.4 million readers since then and had an active role in the 2004 and 2008 election debate.

[42]See `http://oglobo.globo.com/pais/noblat/post.asp?cod_post=80899`

(municipalities) published by year since 1998 by Folha de São Paulo and O Globo, two Brazilian major newspapers.[43] We see that the average number of articles were about ten until 2006. In 2007, the year of the first major discovery announcement, the number tripled to 30 and in 2008, an election year, 100 news articles were published about the topic. We believe that this graph indicates that voters receive more information in 2008 than in previous elections.

However, to provide compelling evidence for an information story, we would need to provide direct evidence that voters respond to information and/or they reward large increases in public goods. We tested heterogeneous effect by municipal characteristics in order to understand whether more sophisticated voters (e.g. more educated) are more able to evaluate incumbents' ability but we failed to find any evidence in that direction. We also didn't find any support for the idea that voters reward the incumbent when mayors promote higher than median improvements in public services. Therefore, we don't believe that we have enough evidence to support an information story.

6.2 Why mayors stop to increase the public sector?

A intuitive explanation for why mayors stop to enlarge the public sector is constraints on its level. If there is a limit on how many people municipalities can hire, mayors must change their strategy when they reach this cap, which hurts his electoral chances. Indeed, there are several laws in Brazil that limit mayors ability to keep hiring people. First, 'Lei de Responsabilidade Fiscal' determines that municipal and state governments cannot spend more than 60 percent of the net current revenue on payroll.[44] Second, the royalty law does not allow the use of royalty revenues to hire employees on a permanent basis. Finally, the government can hire new employees on a temporary basis just to perform very special duties, such as to combat epidemics and carry out the census.[45] Therefore, the fact that we find that public employment does not increase between 2005 and 2008 can be a result of law enforcement.

We analyze this issue by gathering information on which municipalities were audited by Tribunal de Contas of Rio de Janeiro state from 2003 and 2008. The audits under analysis had the specific aim of investigating public employment irregularities. In Table 14, we regress the number of employees per capita on royalty revenues (both are measured as two-year average), a dummy variable indicating whether the municipality was audited in the current or previous year and an interaction variable of auditing dummy and the average value of royalties received on the current and previous year. We also include the geographic controls and instrument royalty value and the interaction variable by oil output and oil output interacted with the auditing dummy. We observe that in 2004, an increase in royalty revenues is associated with a large increase in public employment but we don't find any differential effect for municipalities which were audited in 2003

[43] Information for O Globo is only available from 2003 onwards. We are still trying to obtain the same information from other newspapers from the beneficiary states.

[44] Lei Complementar n 101, 4 de maio de 2000.

[45] Lei n 8.745, 9 de dezembro de 1993

and/or 2004. However, in 2008, the interaction variable has a negative and significant effect of similar magnitude of royalty effect. This implies that the audit process was effective in 2008 in restraining public employment increases, since municipalities that received royalties and were audited in 2007 and/or 2008 did not increase the number of employees, while the other non-audited oil-rich municipalities enlarged the public sector in that year. Therefore, Table 14 provides indication that public employment ceased to increase due to constraints on the executive branch, and this caused the loss in incumbency advantage in 2008.

Finally, the information story sketched above may explain why municipal public sector cease to increase. As explained, the increase in information can reduces incumbents' incentives to signal ability, shifting incumbents' trade-off towards private rents. Unfortunately, the lack of data on diversion of public funds or voters' information don't let us test this model.

7 Conclusions

In this paper we empirically assess the political mechanisms which explain how natural resource booms affect economic development. We do that by studying the recent boom of oil production in Brazil and the distribution of oil royalties to municipalities. We first investigate how royalty payments affect local politics. We provide evidence that royalty payments create a large incumbency advantage in the election that follows oil windfall boom. We estimate that a one-standard-deviation increase in royalty value raises reelection chances by 16 percentage points in 2000 (an increase of 32 percent in reelection chance). However, we show that this effect disappears in the medium run, by estimating no incumbency advantage in 2008. We also show that the the behavior of those who are in power needs to explain the incumbency advantage estimated for 2000 since oil revenues do not impact political selection and pre-election competition.

We then analyze how municipalities spend oil windfall. Municipalities use oil windfall to increase the public sector but does not promote large improvements in household infrastructure and health and education supply. The only impacts on these two areas that we find is on the number of educational professionals. Our estimates indicate an annual average growth of 7.4 percent in the total number of public employees, which imply that oil-rich municipalities on average multiplied the number of employees by 150 percent in the twelve years under analysis. We also show that oil production does not have any economic effect on local economies rather than through the municipal budget.

We follow by discussing why voters reelect the incumbents only after the beginning of oil boom. We show that changes in composition of public employment and the evidence that municipalities increase the number of public employees mainly in 2001-2004 political term support the idea that voters reward the enlargement of the public sector in the ballot box. However, to claim that oil fuels patronage, we would need evidence that mayors distribute employment only to their supporters.

This paper contributes to the literature by testing for the first time the political economy

impacts of resource booms on a democratic context and by exploring how the effects vary in the short and medium-run. In addition, this study is an empirical test to several papers. Our findings support some of the theoretical mechanisms present by the literature but contradicts others. We find support for the idea that natural resources increase public employment as suggested by Collier (2007). We don't find evidence that resource abundance increases competition over power as stated by Caselli & Cunningham (2009) nor that it reduces the incentive to tax as proposed by Collier (2007). Our results also do not support a resource curse story since living standards did not deteriorate.

Taken together, our results indicate that oil does not make leaders unaccountable, and provide suggestive evidence that constraints on the executive branch restrained the the irresponsible use of oil revenues. These results point out that a democratic system is crucial to avoid the negative effects of resource abundance but also indicates that the institutions in place are not sufficient to transform natural resource wealth into economic development.

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Annex

A Royalty Rule

Oil producers in Brazil must pay 10 percent of the production value as royalties to different government bodies. The rule to distribute oil royalties is determined by two main pieces of legislation and depends on whether the oil is produced onshore or offshore.

5 percent parcel

Law 7.990/89 and Decree 01/91 determine the distribution of the first 5 percent of royalty payments. For onshore production, royalty distribution is straightforward: municipalities where the well is located receive 20% of royalty payments.

The distribution of royalties from offshore production follows a more complex rule. Municipalities affected by oil output receive 30 percent of total royalty payments from offshore wells. The production of the whole state is added up and divided among municipalities which are classified into three categories: (A) main production zone, (B) secondary production zone and (C) neighboring municipalities.

The main production zone comprehends municipalities which are in front of oil wells or which have in their territory three or more oil plants. The criteria to determine which municipality is 'facing' each oil well are based on parallel and orthogonal lines extracted from nautical letters. Main producing zone municipalities receive together 60% of royalty payments due to municipalities. The distribution of royalty payments within this group follows a population size rule. The National Bureau of Statistics (IBGE) is responsible to disclose municipality population every year, which is used to define the participation coefficient for each population range. This participation coefficient aims to attribute greater shares for larger municipalities but do not follow a linear rule. The law also guarantees that municipalities which concentrate production facilities should receive at least one third of the share distributed to municipalities in the main production zone. Hence, the share that each municipality in the main zone receive depends on its location, population and oil producing plants and the ones from its neighbors.

The secondary production zone receives 20% of royalty payments due to municipalities and is composed by municipalities which are crossed by pipelines. The neighboring municipalities receives the remaining 10% of municipal share. A municipality is classified in this group if it borders the main producing zone or if it is from the same mesoregion of main production zone municipalities. The mesoregion is a geographic classification established by IBGE and is not related to royalty payments or oil output. The distribution within these zones also takes into account the population size rule.

Therefore, the share of royalties that municipality i receives from offshore production is :

$$royalties_i = \tag{4}$$

$$municshare_{Ais} * 0.6 * 0.3 * 0.05 * OutputState \ if \ i \in A = MainProductionZone$$

$$municshare_{Bis} * 0.2 * 0.3 * 0.05 * OutputState \ if \ i \in B = SecondProductionZone$$

$$municshare_{Cis} * 0.1 * 0.3 * 0.05 * OutputState \ if \ i \in C = NeighbMunicipalities$$

where $municshare_{jis},\ j \in \{A, B, C\}$ is the municipal share of municipality i from state s. This share depends on municipality population and the number and population of other municipalities in the same group at the same state such that $\sum_i municshare_{jis} = 1$ for each state.

The royalty rule also guarantees 10% of royalty payments to municipalities which have facilities to support transportation to and from oil sites. This share is equally distributed among all the municipalities in Brazil who have this kind of facility, but it considers in different groups municipalities with facilities which support onshore fields and the ones that support offshore fields.

Second 5 percent parcel

The Oil Law (9.478/97) enacted in 1997 and regulated by Decree 2.705/98 increased royalty payments from 5% to up to 10% but determined different criteria to distribute the second parcel of royalty payments.[46]

In relation to onshore royalties, few changes were introduced. Municipalities where the oil field is located receives 15% of its royalty payments (0.15 x 0.05 x OutputField).[47]

In turn, the rule to distribute royalties from offshore fields was dramatically simplified. 22 percent of the second parcel of royalty payments from offshore production is paid to municipalities located in front of the field. The criteria to determine which municipality is 'facing' each field are also based on the same parallel and orthogonal lines to the Brazilian coast. A combination of both lines creates the 'facing quotas', which are the percentage of each oil field located in front a each municipality. Hence, the amount that each coastal municipality receives from offshore production is equal to (FacingQuota x 0.22 x 0.05 x OutputField).

Finally, the second parcel of royalty rule also distributes 7.5% of royalty payments to municipalities which have facilities to support transportation to and from oil sites. But in this case, the distribution within this group considers the amount of oil transported by each facility.

B Oil Data

B.1 Oil output

The Brazilian Oil National Agency (ANP) is the main source of information on oil sector in Brazil. Since August 1998, it discloses monthly data on oil and gas production and prices by oil field. This

[46] The size of the second parcel varies with exploration risk involved in the oil field under contract and range from 1 to 5 percent.

[47] The change of nomenclature from well to field is not accidentally. Law 9.478/97 use the field as a reference rather than the well

information allows us to calculate oil output from 8/1998 to 12/2009 for each oil field by using the formula Output = OilPrice x OilProduction + GasPrice x GasProduction.

Data from the 1991 to 1997 were gathered at the December editions of Oil and Gas Journal. From 1991 to 1997, the magazine reported the average number of barrels of oil produced daily by each oil field. We measure the annual production by multiplying the average daily production by 365. However, this Journal does not provide information on prices, which are necessary to calculate production value. We rely on ANP (2001a) to calculate implicit prices by using the information on total royalty payments and total production. The price per barrel was obtained by using the formula: price=royalties /(0.05 x OutputBarrels). We did not compute prices from 1991 to 1993 since this was a high inflation period, what dramatically challenge the calculation of monetary values. We are confident about using this average price per year for the whole country because oil price was controlled by the state and did not fluctuate with exchange rate and international price before Oil Law was enacted in 1997. A final calculation was necessary to obtain 1998 annual production values since Oil and Gas Journal did not disclose information per oil field for that year. We rely on ANP information from August to December (the first ones available) to calculate 1998 production value as 12/5 x (OutputAugDec).

The next step was to associate oil fields with municipalities in order to obtain production values per municipality. We localized the onshore fields by using GIS information provided by ANP's Exploration and Production Database (Banco de Dados de Exploracão e Producão - BDEP). An onshore oil field is assigned to one municipality if its boundaries falls within a municipality border. In the case of oil fields whose boundaries cover more than one municipality, we distribute the production by considering the percentage of the area of the oil field located on the municipality. In the case of offshore production, we assigned oil fields to each municipality by using the list of facing quotas disclosed by ANP.The facing quotas are monthly disclosed by ANP at `http://www.anp.gov.br/?pg=14431` under the name 'Confrontação Month Year.pdf'.

We should note that we were not able to find the location of all oil fields listed on Oil and Gas Journal on DBEP or ANP database. The fields we didn't localize are responsible for less than 1 percent of total production in a given year and could not have their production assigned to a specific municipality only to the state.[48]

In order to double check our calculation, we added municipal oil output by state and year and compared these number to the ones disclosed at ANP (2001a). The series from 1994 to 1997 constructed based on data provided by Oil and Gas Journal are almost the same to the one informed by ANP at state level (correlation 0.9997), which support the quality of the data provided by the Journal. For the period from 1998 to 2008, our series also match almost perfect to the one disclosed

[48]The production of all non-localized fields represents 0.17 percent of total production in 1994, 0.83% in 1995, 0.67% in 1996, 0.15% in 1997. In most of the cases, they are small oil fields which should have been phased-out due to low production. The largest producing fields not identified are fields which are by the time in their early phases of production and therefore hadn't had a name but rather a code. We weren't able to match these codes with the new names.

by ANP (2001a).

B.2 Royalty payments

Data on royalty payments made to each municipality are disclosed monthly by ANP from 1999 to 2008 at `http://www.anp.gov.br/?pg=9080`. Data from 1994 to 1998 were calculated by us by following in detail the rule described in ANP (2001b) and relying on the information on production value per municipality (calculated as described above using data from Oil and Gas Journal).

Note that from 1994 to 1997, only the first 5% parcel of royalties was paid. The second parcel of royalties began to be paid on October 1998.[49] Hence, the main task to compute royalty payments for this period is to replicate the first parcel rule. We describe that first.

The computation of onshore oil royalties is the easiest part. By using GIS database provided by BDEP, we could match municipal borders with oil field borders and attribute to each municipality 0.2 x 0.05 x ShareFieldMunicipality x OutputField.[50].

For offshore oil royalties, the task is more cumbersome. In order to calculate royalties from 1994 to 1998, we need not only the information on producing municipalities but also the list of municipalities which have three or more oil plants (classified as being part of main producing zone), the ones crossed by pipelines (secondary zone), the neighboring municipalities and the ones from the same mesoregion to a municipality in the main producing zone.

Since no list was found for the 1990s, we rely on ANP (2001b) which provide information for 2000 and assume that the same municipalities were affected by oil output in the 1990s. According to ANP (2001b), eight municipalities are classified in the primary zone in 2000 because they have three or more producing plants. They are: São Sebastião do Passé (BA), Paracuru (CE), São Mateus (ES),Macaé (RJ), Guamaré (RN), Itajaí (SC), Aracaju (SE) e Cubatão (SP). We compose the list of main producing zone municipalities by listing these municipalities and the the ones facing oil fields under production during the 1990s, which are determined in accordance to 'facing quotas' list[51] Royalty payments to each municipality within this group were calculated using equation 4, taking into account that Macaé (RJ) and Cubatão (SP) concentrated oil facilities and deserves at least 33 percent of royalty payments to main producing zone in their respective states.

ANP (2001b) also reports that there were ten municipalities in 2000 crossed by pipelines which

[49] Although Oil Law was enacted in June 1997, decree 2.705/98 which detailed the rules for paying the second parcel was just enacted in August 1998. The second parcel of royalty payments was paid for the first time in October because royalties are due two months after production. This information was provided by ANP technicians.

[50] This calculation requires a simplification because the law determines the payment according to oil well rather than the field. For fields entirely within one municipality border, that is not a problem. For fields which extend from more than one municipality, one may think the use of ShareFieldMunicipality as assessing the probability that the well is located within the municipal border.

[51] Note again that the law states that distribution should follow well location rather than the field, which is the unit of analysis in our dataset. We don't believe, however, that this is a major limitation since we can think about the use of these 'facing quotas' as assessing the probability that the well is located in front a specific municipality, which is equal to the share of that field in front of the municipality.

compose the secondary zone: Fortaleza (CE), Cachoeiras de Macacu (RJ), Duque de Caxias (RJ), Guapimirim (RJ), Mage (RJ), Rio de Janeiro (RJ), Silva Jardim (RJ), Praia Grande (SP), São Paulo (SP), São Vicente (SP). The distribution of royalties to these municipalities also follows the population size rule[52] and equation (4).

The list of neighboring municipalities is determined by using mesoregion codes provided by IBGE. Based on this list, we distribute royalty payments within this group taking into account the population size rule and equation (4). Note that municipalities can receive royalties for more than one reason. For instance, a municipality can receive royalties because it has transportation facilities and because it is a neighboring municipality. Hence, we calculate all these quotas independently for each municipality and each year and then add them up.

Finally, we need to determine the list of municipalities with facilities which support transportation from and to oil sites. This again was extracted from ANP (2001b). In 2002, 57 municipalities had facilities which support onshore production and each of them receive (1/57)*0.1*0.05.ProductionValueOnshoreBrazil. In turn, 15 municipalities have transportation facilities to and from offshore site and each receive (1/15)*0.1*0.05.ProductionValueOffshoreBrazil (see ANP (2001b) for the list of municipalities).

After concluding the computation of the first parcel of royalties, we still need to input the second parcel of royalty payments for 1998. Onshore producing municipalities received additional 0.15 x 0.05 x ShareFieldMunicipality x 3/12 x ProductionValueField1998, while offshore producing municipalities received 0.22 x 0.05 x ShareFieldMunicipality x 3/12 x ProductionValueField1998, where 3/12 stands for three months in that year. We were not able to compute royalties relative to the second parcel for municipalities with transportation facilities. We didn't find information on the volume handled by each facility, which would be necessary to distribute royalties. We don't believe this is a major problem because we are losing just three months of payments.

B.3 Other data

Other variables used in this paper were gathered from different sources as following described.

Electoral information. We use Tribunal Superior Eleitoral (TSE) microdata for 1996, 2000, 2004 and 2008 local elections that is provided by TSE under request. TSE also sent us a list of candidates and parties elected in 1992, which allows us to construct 1996 party reelection variable.

Municipal finance. Data on public finance, including revenues and expenses, are available from Brazil's National Treasury through 'Finanças do Brasil' (FINBRA) database from 1997 to 2008 at `http://www.tesouro.fazenda.gov.br`. Some municipalities do not declare FINBRA every year and sometimes do not provide all the information requested. We use only data from municipalities which report most of revenues and expenses but we do not perform any correction for the years that municipalities did not declare. Hence, our analysis of municipal finance is based on an unbalanced

[52]The population size rule can be found at ANP (2001b).

panel.

Public employees. Data on the number of municipal public employees, their composition and wages were gathered from Registro Anual de Informaes Sociais (RAIS), a database that comprises all formal workers in Brazil. The Brazilian Ministry of Labor (MTE) collects that information and disclose it in Cd-Roms, which are available upon request.

Economic activity. RAIS provides information on private employees, total payroll and number of firms per sector. Municipal GDP is available from IBGE for 1999-2007 period at `http://www.ibge.gov.br/home/estatistica/economia/pibmunicipios/2006/default.shtm`.

Educational data. Educational outcomes are provided by Instituto Nacional de Estudos e Pesquisas Educacionais Ansio Teixeira (INEP) at `http://www.inep.gov.br` from 1996 to 2006.

Health supply. The number of municipal health clinics and hospitals are available at DATASUS's site (See `http://www.datasus.gov.br`). Cadastros Extintos do SUS discloses information for 1998-2002 period, while Cadastro Nacional de Estabelecimentos de Saude (CNES) publish data for 2006-2008. We named health clinics the sum of 'unidades basicas de saude' and 'postos de saude'. Hospital units include 'Ambulatório de Unidade Hospitalar Geral' and 'Ambulatrio de Unidade Hospitalar Especializada' in CNES database and 'Hospital Dia', 'Hospital Geral' and 'Hospital Especializado' in Cadastros Extintos do SUS database. We considered only health units managed by the local government.

Geographic characteristics. We gathered data on municipalities' geographic characteristics such as latitude, longitude, altitude and distance to the state capital at IPEADATA site (`http://www.ipeadata.gov.br`). IPEA also provides 1991 and 2000 population census variables such as population density, percentage of urban households and average years of schooling.

Population estimates. Inter-census population estimates are available at `http://www2.datasus.gov.br/DATASUS/index.php?area=0206`.

Table 1: First-stage

	Panel 1997 to 2008	Panel 1999 and 2008	Cross-section 2000	Cross-section 2008
	(1)	(2)	(3)	(4)
Panel A -Coastal sample				
Oil output pc	0.023	0.028	0.028	0.028
	[0.003]***	[0.002]***	[0.004]***	[0.002]***
Observations	2,781	505	253	253
R-squared	0.587	0.885	0.484	0.678
Municipalities	253	253		
F test	62.10	224.2	44.71	137.9
Panel B - Complete sample				
Oil output pc	0.024	0.029	0.024	0.027
	[0.003]***	[0.001]***	[0.003]***	[0.002]***
Observations	41,313	7,510	3,756	3,756
R-squared	0.512	0.821	0.482	0.643
Municipalities	3,756	3,756		
F test	75.72	401.4	58.59	149.7

Notes: The results presented in columns 1-2 are from panel regressions and include log of population and municipal and state-year effects as controls. Columns 3-4 show results for OLS regressions which include log of population and geographic characteristics as controls. Panel A includes coastal municipalities from the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). Panel B include all municipalities from these states. Oil output data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. Robust standard errors are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 2: Royalty Summary Statistics

	N	1996	2000	2004	2008	Mean	Growth 1996-2008
Royalties pc							
Coastal municipalities	256	0.024	0.100	0.182	0.204	0.127	750%
		(0.081)	(0.431)	(0.625)	(0.668)	(0.511)	
Oil	63	0.088	0.359	0.696	0.760	0.471	764%
		(0.147)	(0.810)	(1.154)	(1.220)	(0.962)	
Non-oil	193	0.003	0.015	0.028	0.037	0.021	1133%
		(0.015)	(0.072)	(0.105)	(0.135)	(0.094)	
All municipalities	3,798	0.003	0.010	0.018	0.020	0.013	567%
		(0.023)	(0.118)	(0.174)	(0.187)	(0.141)	
Oil output pc							
Coastal municipalities	256	0.780	2.788	4.074	4.539	3.045	482%
All municipalities	3798	0.074	0.256	0.372	0.411	0.278	455%
Royalties/Total revenue							
Coastal municipalities	256	0.028	0.051	0.077	0.078	0.058	179%
Oil	63	0.081	0.141	0.214	0.217	0.162	168%
Non-oil	193	0.006	0.012	0.020	0.026	0.016	333%
All municipalities	3,798	0.004	0.008	0.011	0.012	0.009	200%
FPM pc							
Coastal municipalities	256	0.219	0.210	0.230	0.268	0.232	22%
Oil	63	0.235	0.232	0.252	0.296	0.253	26%
Non-oil	193	0.214	0.203	0.223	0.260	0.225	21%
All municipalities	3,798	0.330	0.338	0.378	0.443	0.372	34%

Notes: This table reports the number of municipalities, average royalty payments per capita, royalty standard deviation, oil output per capita, share of oil royalties on municipal revenue and FPM transfers in election years. Data refer to municipalities from the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS).

Table 3: Municipal Characteristics

Sample:	Complete mean	Coast mean	Complete coef	Complete se	Coast coef	Coast se
	(1)	(2)	(3)	(4)	(5)	(6)
Characteristics in 1991						
Number of municipalities	3759	256	3,756		253	
% urban population	0.48	0.63	0.62	[0.18]***	0.44	[0.20]**
Average years of schooling	3.03	3.47	1.09	[0.64]*	-0.68	[1.20]
% illiterate (pop > 25 years)	37	36	-15.96	[6.76]**	-0.85	[11.01]
Household income per capita	123	135	32.12	[38.86]	-35.15	[61.27]
Poverty rate	58.87	56.54	-18.89	[9.93]*	-2.76	[11.84]
Gini index	0.52	0.52	-0.01	[0.04]	-0.01	[0.05]
Human Development Index	0.61	0.61	0.08	[0.04]**	0.00	[0.06]
Infant mortality	70.42	77.36	-8.86	[13.60]	-13.64	[16.20]
% households w/ electricity	71.97	78.74	51.04	[12.48]***	6.84	[14.00]
% households w/ piped water	54.7	54.1	3.51	[12.02]	-14.98	[15.12]
Characteristics in 1997						
Population	38,720	124,575	-2.09	[0.81]**	-3.94	[1.14]***
Municipal employees (1000 hab)	23	20	36.21	[16.60]**	43.26	[13.21]***
Total revenue pc (R$ 1000)	0.755	0.786	2.32	[0.35]***	2.46	[0.66]***
FPM transfers pc (R$ 1000)	0.33	0.22	0.74	[0.16]***	0.96	[0.11]***
% education expenses on total budget	0.27	0.25	-0.07	[0.05]	0.05	[0.07]
% health expenses on total budget	0.15	0.14	-0.08	[0.06]	-0.07	[0.07]
Politics in 1996						
Party reelection	0.22	0.21	0.14	[0.51]	0.29	[0.74]
Effective number of candidates	2.21	2.42	0.09	[0.43]	-0.38	[0.58]
Margin of victory	0.17	0.16	-0.10	[0.15]	-0.14	[0.15]
% candidates college degree	0.36	0.37	-0.35	[0.25]	-0.18	[0.29]
% candidates in high occupation	0.3	0.28	-0.33	[0.24]	-0.28	[0.27]
% male candidates	0.4	0.6	0.27	[0.17]	0.19	[0.25]
Geographic characteristics						
Latitude	-16.9	-14.7	1.81	[0.93]*	2.01	[0.88]**
Longitude	45	41.5	-2.53	[1.11]**	0.82	[0.70]
Altitude	374	21	-909.10	[176.61]***	-34.81	[35.55]
Distance to state capital	244	111	-90.63	[110.17]	181.55	[84.57]**

Notes: This table presents a comparison of the mean socio-demographic, political and geographic characteristics of all municipalities and coastal municipalities from the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). Columns 1-2 shows the average of the variables listed in the lines in each sample. Columns 3-4 show the coefficient and standard error of a cross-section regression of the listed variable on oil royalties and state dummies in 1997 for the complete sample. Columns 5-6 repeat the same exercise of columns 3-4 for the coastal sample. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 4: Political Alignment and Timing of Oil Field Discoveries and Initial Output

	Year of discovery	Year of initial output	Gap between initial output and discovery (days)	Gap between initial output and discovery (years)
	(1)	(2)	(3)	(4)
Municipality aligned with federal government	-0.010	0.002	82.3	0.14
	(0.014)	(0.017)	(403.0)	(1.00)
Party: PRB	-0.001	-0.087		
	(0.043)	(0.042)**		
Party: PDS/PP/PPB	-0.027	-0.008	-49.2	0.20
	(0.031)	(0.034)	(549.3)	(1.36)
Party: PDT	-0.017	-0.055	706.2	2.07
	(0.036)	(0.037)	(504.6)	(1.23)*
Party: PTB	-0.017	-0.043	59.8	0.48
	(0.040)	(0.033)	(475.6)	(1.16)
Party: PMDB	-0.033	-0.045	133.9	0.96
	(0.034)	(0.033)	(442.7)	(1.08)
Party: PL/PR	-0.025	-0.010	266.0	0.99
	(0.033)	(0.044)	(488.3)	(1.11)
Party: PPS	0.031	0.045	420.3	1.03
	(0.063)	(0.050)	(475.8)	(1.29)
Party: PFL/DEM	-0.008	-0.009	-5.8	0.22
	(0.033)	(0.031)	(468.8)	(1.13)
Party: PMN	0.102	-0.006	532.3	1.53
	(0.102)	(0.062)	(453.3)	(1.22)
Party: PRN	0.235	-0.018	-475.3	-1.25
	(0.186)	(0.038)	(508.6)	(1.32)
Party: PSB	-0.064	-0.046	-684.5	-1.55
	(0.039)	(0.039)	(547.6)	(1.37)
Party: PSD	0.007	0.006	-52.5	0.25
	(0.056)	(0.039)	(508.6)	(1.32)
Party: PV	-0.049	-0.190		
	(0.032)	(0.034)***		
Party: PSDB	-0.002	-0.012	-260.4	-0.44
	(0.030)	(0.031)	(470.0)	(1.19)
Party: PT do B	-0.041	-0.075		
	(0.032)	(0.042)*		
Observations	2155	2155	69	69
R^2	0.042	0.038		
Municipalities	133	133	43	43

Notes: This table reports regression coefficients of the timing of oil field discoveries and initial production on municipal political alignment. In column 1, the dependent variable is equal to one if an oil field within municipality borders was discovered in the respective year, while in column 2 the dependent variable indicates whether oil began to be extracted on the respective year. Columns 3 and 4 dependent variables are the time gap in days and years, respectively, between discover the oil field and beginning its production. All regressions cover the period 1993-2008 and include a dummy indicating whether the party in power in the municipality is from the same political coalition of the federal government, party dummies, and year effects. Columns 1 and 2 also include municipal fixed effects. The omitted party is PT, the Workers Party and the one which run the federal government between 2003 and 2010. In columns 1 and 2, the sample comprises all Brazilian municipalities who had at least one oil producing field within their borders (onshore or offshore) between 1993 and 2008. Regressions present in columns 3 and 4 include only municipalities who had an oil field discovered within their borders in the respective year between 1993 and 2008. Robust standard errors clustered at the municipality are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 5: Oil Output Impact on Economic Activity

	Number of firms pc								
	Total	Manufacturing	Trade	Services	Number of private employees pc	Private payroll pc	Public payroll pc	GDP pc	Non-industrial GDP pc
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A - Coastal sample									
Oil output pc	2.503	0.075	0.990	0.884	-0.174	-0.206	0.313	0.423	-0.037
	(1.952)	(0.136)	(0.748)	(1.240)	(0.131)	(0.184)	(0.076)***	(0.042)***	(0.014)**
	506	506	506	506	506	506	506	506	506
	253	253	253	253	253	253	253	253	253
Panel B - Complete sample									
Oil output pc	2.164	-0.030	0.714	1.460	0.067	0.222	0.419	0.472	-0.016
	(2.059)	(0.118)	(0.713)	(1.321)	(0.108)	(0.214)	(0.099)***	(0.041)***	(0.009)*
Observations	7,512	7,512	7,512	7,512	7,512	7,512	7,512	7,512	7,512
R-squared	0.650	0.368	0.742	0.466	0.125	0.130	0.697	0.297	0.325
Municipalities	3,756	3,756	3,756	3,756	3,756	3,756	3,756	3,756	3,756

Notes: The results presented are from panel regressions of the variable indicated in the column on oil output and include log of population and municipal and state-year effects as controls. The sample covers 2008 and a baseline year (1997 in columns 1-4 and 7, and 1999 in columns 5-6 and 8-9). Panel A includes coastal municipalities from the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). Panel B include all municipalities from these states. Oil output data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. Robust standard errors are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 6: Election 2000

	Mayor run for reelection	Mayor reelected	Party reelected	Number of candidates	Effective s number of candidates	Incumbent vote-share	Opponents' average schooling	% opponents' with college degree	% opponents' with high-skilled occupation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A - OLS									
Oil royalties	0.223	0.824	1.268	-0.127	-0.542	0.071	1.534	-0.113	-0.112
(Mean 1997-2000)	[0.213]	[0.285]***	[0.425]***	[0.641]	[0.283]*	[0.184]	[1.419]	[0.146]	[0.180]
Lag Y (1996)			0.091	0.203	0.183	0.377			
			[0.103]	[0.105]*	[0.082]**	[0.165]**			
Panel B - IV									
Oil royalties	0.315	1.385	2.195	-0.594	-1.054	0.574	-1.698	-0.278	-0.465
(Mean 1997-2000)	[0.351]	[0.431]***	[0.508]***	[1.153]	[0.498]**	[0.270]**	[3.079]	[0.299]	[0.309]
Lag Y (1996)			0.071	0.202	0.180	0.395			
			[0.102]	[0.105]*	[0.082]**	[0.176]**			
% variation (IV)	4.4%	31.8%	71.2%	-2.2%	-5.8%	90.6%	-1.5%	-6.8%	-11.9%
Y mean	0.805	0.488	0.364	3.486	2.308	0.0862	12.97	0.461	0.439
SE royalties	0.112	0.112	0.118	0.128	0.128	0.136	0.112	0.112	0.112
Municipalities	251	252	118	185	185	149	250	251	250
Geographic characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Coast	Coast	Coast	Coast	Coast	Coast	Coast	Coast	Coast

Notes: This table reports the effects of royalty payments on political outcomes in 2000 election. The sample includes coastal municipalities from the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). Regressions exclude the municipalities on the top 1% of royalty distribution. The sample in column 3 is smaller because there is information on 1996 party reelection only for the following states: PR, SP, RJ, BA, SE, AL, CE and part of RN. All regressions control for state fixed effects and municipal characteristics (population, urbanization rate, population density, distance to the state capital, altitude, longitude, latitude, area, a dummy for whether the municipality is a state capital). In Panel B, we use oil output as an instrument for royalty value. We use the average value of royalty rents and oil output between 1997 and 2000. Both are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. Robust standard errors are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 7: Reelection 2008

	Mayor run for reelection	Mayor reelected	Party reelected	Any former mayor reelected
	(1)	(2)	(3)	(4)
Panel A - OLS				
Oil royalties	0.146	0.072	0.010	0.036
(Mean 2005-2008)	[0.167]	[0.186]	[0.082]	[0.105]
Lag Y (2000)	-0.062	0.037	0.080	
	[0.084]	[0.083]	[0.063]	
Panel B - IV				
Oil royalties	-0.013	0.297	-0.488	0.133
(Δ 2004-2008)	[0.302]	[0.354]	[0.150]***	[0.275]
Lag Y (2000)	-0.052	0.049	0.058	
	[0.082]	[0.079]	[0.064]	
Y mean	0.766	0.497	0.336	0.506
SE royalties	0.451	0.451	0.483	0.483
Municipalities	197	197	253	253

Notes: This table reports the effects of royalty payments on political outcomes in 2008 election. The sample includes coastal municipalities from the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). Regressions exclude the municipalities on the top 1% of royalty distribution. All regressions use oil output as an instrument for royalty value and control for population, state fixed effects and municipal characteristics (population, urbanization rate, population density, distance to the state capital, altitude, longitude, latitude, area, a dummy for whether the municipality is a state capital). Columns 1-2 consider only municipalities where the mayor is in his first term. All regressions control for the dependent variable level in 2000 election. Panel A uses the average value of royalty rents and oil output between 2005 and 2008, while Panel B uses the variation between 2004 and 2008. All oil royalty and output variables are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. Robust standard errors are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 8: Political Competition in 2008

	Number of candidates	Effective number of candidates	Incumbent vote-share	Campaign spending per voter (log)	Former mayor run	Mayor's candidature suspended	Opponents' average schooling	% opponents' with college degree	% opponents' with high-skilled occupation	Candidates' median wealth (log)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A - IV										
Oil royalties	0.354	-0.039	-0.017	-0.156	0.099	-0.004	0.217	0.028	0.020	-0.209
(Mean 2005-2008)	[0.228]	[0.089]	[0.128]	[0.322]	[0.113]	[0.074]	[0.328]	[0.042]	[0.052]	[0.161]
Lag Y (2000)	0.227	0.094	-0.126				0.056	0.185	-0.016	
	[0.076]***	[0.062]	[0.150]				[0.064]	[0.061]***	[0.065]	
Panel B - IV										
Oil royalties	1.288	0.078	0.013	-1.105	0.323	-0.122	0.757	0.021	0.155	-0.339
(Δ 2004-2008)	[0.970]	[0.389]	[0.106]	[0.485]**	[0.314]	[0.193]	[1.144]	[0.160]	[0.134]	[0.379]
Lag Y (2000)	0.228	0.101	-0.096				0.067	0.195	0.009	
	[0.080]***	[0.063]	[0.151]				[0.065]	[0.061]***	[0.064]	
Y mean	3.665	2.286	0.103	1.129	0.514	0.237	13.56	0.517	0.519	12.74
SE royalties	0.485	0.485	0.520	0.483	0.483	0.483	0.486	0.485	0.486	0.484
Municipalities	248	248	116	253	253	253	249	250	249	252

This table reports the effects of royalty payments on political outcomes in 2008 election. The sample includes coastal municipalities from the fifteen coastal states (MA PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). Regressions exclude the municipalities on the top 1% of royalty distribution. All regressions use oi output as an instrument for royalty value and control for population, state fixed effects and municipal characteristics (population, urbanization rate, population density distance to the state capital, altitude, longitude, latitude, area, a dummy for whether the municipality is a state capital). Columns 1-3 and 7-9 control for the dependen variable level in 2000 election. Panel A uses the average value of royalty rents and oil output between 2005 and 2008, while Panel B uses the variation between 2004 and 2008. All oil royalty and output variables are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. Robust standard errors are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 9: Municipal Revenue

	Total revenue pc	Tax revenue pc	FPM transfers pc	FUNDEF transfers pc
	(1)	(2)	(3)	(4)
Panel A - 1997-2008				
Oil royalties	1.04	0.02	0.00	-0.01
(current year)	[0.03]***	[0.01]*	[0.00]	[0.01]
Y mean	1.225	0.210	0.244	0.161
SE royalties	0.373	0.374	0.373	0.400
Observations	2,694	2,679	2,694	2,310
Municipalities	253	253	253	253

Notes: This table reports the effects of royalty payments on public revenues in municipalities located on the coast of the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). These regressions exclude the municipalities on the top 1% of royalty distribution and include only municipalities reporting most revenues and expenses. In all regressions, royalty value is instrumented by oil output and population, and use state-year and municipal effects as controls. All regressions cover 1997-2008 period. Tthe dependent variables are measured in R$ 1000 per capita. Royalty data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. In column 3, FPM stands for Fundo de Participação dos Municipios . FPM is the most important transfer to municipalities in Brazil. FUNDEF in column 4 is the acronym for Fundo de Desenvolvimento da Educação Fundamental (Basic Education Development Fund) and is composed by municipal, state and federal contributions, whose resources are redistributed to municipalities according to the number of school enrollments to finance education expenses. In 2007, FUNDEF was replaced by FUNDEB. Robust standard errors clustered at municipal level are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 10: Municipal Expenses

	Current expenses pc	Payroll pc	Other labor and service pc	Invest-ment pc	Debt amortization pc	Administration and planning	Education and culture pc pc	Health and sanitation pc	Housing and urbanization pc	Transport-ation pc
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A - 1997-2008										
Oil royalties	0.53	0.15	0.19	0.21	0.01	0.16	0.15	0.15	0.17	0.03
(current year)	[0.11]***	[0.03]***	[0.04]***	[0.03]***	[0.01]	[0.04]***	[0.02]***	[0.04]***	[0.03]***	[0.03]
% variation	14.2%	9.7%	17.0%	47.6%	9.2%	18.4%	14.9%	16.0%	27.1%	33.6%
Y mean	135.1	56.11	50.30	15.98	4.125	31.40	36.53	33.88	22.70	3.228
SE royalties	0.362	0.362	0.450	0.362	0.378	0.362	0.362	0.362	0.362	0.362
Observations	2,589	2,588	1,513	2,589	2,358	2,589	2,589	2,589	2,589	2,589
Municipalities	253	253	248	253	253	253	253	253	253	253
Panel B - 1997-2000										
Oil royalties	0.55	0.19		0.46	0.02	0.05	0.10	0.21	0.41	0.05
(current year)	[0.18]***	[0.10]*		[0.10]***	[0.02]	[0.12]	[0.07]	[0.08]***	[0.12]***	[0.05]
% increase	7.1%	6.0%		48.3%	5.0%	2.5%	5.3%	12.9%	29.7%	17.0%
Y mean	102.7	41.85		12.57	5.965	26.01	24.84	21.50	18.25	3.885
Royal sd	0.132	0.132		0.132	0.149	0.132	0.132	0.132	0.132	0.132
Observations	809	809		809	540	809	809	809	809	809
Municipalities	231	231		231	185	231	231	231	231	231
Panel C - 2001-2004										
Oil royalties	0.53	0.19	0.14	0.13	0.01	0.09	0.10	0.09	0.19	0.02
(current year)	[0.16]***	[0.07]***	[0.09]	[0.12]	[0.02]	[0.14]	[0.04]***	[0.04]**	[0.19]	[0.04]
% variation	13.2%	11.0%	11.4%	26.3%	11.5%	9.5%	9.0%	8.7%	27.6%	20.8%
Y mean	127.1	54.39	42.53	15.62	2.736	30.01	35.29	32.66	21.77	3.032
SE royalties	0.316	0.316	0.347	0.316	0.316	0.316	0.316	0.316	0.316	0.316
Observations	874	874	618	874	874	874	874	874	874	874
Municipalities	242	242	225	242	242	242	242	242	242	242
Panel D - 2005-2008										
Oil royalties	0.21	0.05	0.11	0.27	0.01	-0.02	0.13	0.10	0.18	0.03
(current year)	[0.03]***	[0.02]***	[0.03]***	[0.02]***	[0.00]	[0.05]	[0.01]***	[0.01]***	[0.05]***	[0.03]
% variation	6.2%	3.6%	10.1%	70.7%	12.0%	-2.7%	13.7%	11.0%	33.1%	54.7%
Y mean	173.6	71.23	55.94	19.55	4.274	37.85	48.74	46.71	27.82	2.810
SE royalties	0.512	0.512	0.512	0.512	0.512	0.512	0.512	0.512	0.512	0.512
Observations	871	869	871	871	871	871	871	871	871	871
Municipalities	239	238	239	239	239	239	239	239	239	239

Notes: This table reports the effects of royalty payments on public expenses in municipalities located on the coast of the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). These regressions exclude the municipalities on the top 1% of royalty distribution and include only municipalities reporting most revenues and expenses. In all regressions, royalty value is instrumented by oil output and population, and use state-year and municipal effects as controls. All regressions cover 1997-2008 period.The dependent variables are measured in R$ 1000 per capita. Current expenses include all direct and indirect labor cost, interest payments and other current expenses. Payroll (column 2) and other labor and service contracts (column 3) are subdivisions of current expenses (column 1). Royalty data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. Robust standard errors are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 11: Public Employment

	Number of employees	Relative wage (public/private)	Tenured employees	Non-tenured employees
	(1)	(2)	(3)	(4)
Panel A - 1997-2008				
Oil royalties pc	5.93	0.10	1.29	4.65
	[0.94]***	[0.03]***	[1.09]	[1.06]***
Y mean	30.05	1.185	19.50	10.53
Royal sd	0.378	0.409	0.378	0.378
Observations	2,823	2,414	2,823	2,823
Municipalities	253	251	253	253
Panel B - 1997-2000				
Oil royalties pc	-1.68	-0.01	13.46	-14.99
	[3.50]	[0.38]	[4.81]***	[4.02]***
Y mean	21.58	1.019	13.42	8.081
SE royalties	0.143	0.177	0.143	0.143
Observations	854	438	854	854
Municipalities	234	219	234	234
Panel C - 2001-2004				
Oil royalties pc	11.37	0.27	-4.57	15.94
	[2.97]***	[0.11]**	[3.78]	[3.99]***
Y mean	28.83	1.143	19.72	9.107
Royal sd	0.339	0.338	0.339	0.339
Observations	966	972	966	966
Municipalities	249	246	249	249
Panel D - 2005-2008				
Oil royalties pc	-0.97	0.06	-0.24	-0.73
	[1.20]	[0.03]**	[1.83]	[1.77]
Y mean	38.54	1.303	24.52	14.02
Royal sd	0.520	0.527	0.520	0.520
Observations	994	987	994	994
Municipalities	252	249	252	252

Notes: This table reports the effects of royalty payments on municipal public employment in municipalities located on the coast of the fifteen coastal states (MA, PI, CE, RN, PB, PE, AL, SE, BA, ES, RJ, SP, PR, SC and RS). These regressions exclude the municipalities on the top 1% of royalty distribution. In all regressions, royalty value is instrumented by oil output and population, state-year and municipal effects are used as controls. All employment variables are measured in per 1000 habitants. Columns 1, 3 and 4 cover 1997-2008 period and regression in column 2 includes 1999-2008 years. The number of employees in column 1, 3 and 4 relates to all employees hired by the local municipality on September 30th. The relative public-private wage is the ratio between public and private sector wages. Columns 3 and 4 are subdivisions of column 1. Royalty payments are the value received in the contemporaneous year, are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. Robust standard errors are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 12: Provision of Public Services

Sample	Coast OLS	Coast IV	Complete OLS	Complete IV
	(1)	(2)	(3)	(4)
Panel A. Household infrastructure (2000 -2010)				
Electricity	-0.463	-0.094	-3.100	-4.042
	[2.725]	[4.918]	[2.060]	[4.205]
Piped water	1.457	11.074	2.578	10.718
	[4.365]	[7.958]	[2.918]	[5.963]*
Sewage	3.122	-16.558	-3.242	-11.124
	[7.872]	[16.592]	[5.347]	[12.411]
Trash collection	-3.898	9.090	3.640	5.990
	[3.796]	[7.138]	[2.575]	[5.363]
Observations	506	506	7,550	7,550
Municipalities	253	253	3,794	3,794
Panel B. Education Supply (1998-2010)				
Enrollment pc	49.071	-7.197	62.505	27.706
	[25.880]*	[39.322]	[22.405]***	[33.790]
Schools pc	0.456	-0.177	0.851	0.670
	[0.267]*	[0.407]	[0.379]**	[0.572]
Kindergarden pc	0.277	-0.148	0.235	-0.121
	[1.447]	[2.177]	[1.747]	[2.634]
Teacher pc	11.885	8.646	12.864	15.334
	[6.126]*	[9.221]	[5.390]**	[8.126]*
School employees pc	13.170	6.941	14.856	9.918
	[3.977]***	[6.014]	[2.892]***	[4.363]**
Teacher-pupil ratio	0.936	0.264	0.680	0.420
	[1.209]	[1.820]	[1.792]	[2.611]
% computer	6.456	-2.203	5.004	-0.612
	[2.723]**	[4.184]	[0.824]***	[1.209]
% internet	-0.042	-0.066	-0.006	0.047
	[0.051]	[0.077]	[0.039]	[0.059]
Science lab	0.015	0.032	0.013	0.029
	[0.014]	[0.020]	[0.018]	[0.026]
Computer lab	-0.021	-0.028	0.007	0.012
	[0.041]	[0.061]	[0.035]	[0.053]
Library	0.016	-0.030	0.007	-0.013
	[0.036]	[0.054]	[0.042]	[0.063]
Free meal	0.063	0.084	0.025	0.053
	[0.038]	[0.058]	[0.037]	[0.056]
Observations	505	505	7,514	7,514
Municipalities	253	253	3,793	3,793

Table 13: Provision of Public Services (continuing...)

Sample	Coast OLS	Coast IV	Complete OLS	Complete IV
	(1)	(2)	(3)	(4)
Panel C. Health Supply (1999-2010)				
Health clinics pc	-2.944	-6.863	-5.208	-14.072
	[8.074]	[12.711]	[7.504]	[11.509]
Hospitals pc	0.693	0.686	0.736	1.153
	[0.567]	[0.892]	[1.005]	[1.542]
Doctors pc	0.440	0.825	0.250	0.562
	[0.475]	[0.746]	[0.351]	[0.562]
Observations	501	501	7,219	7,219
Municipalities	252	252	3,784	3,784
Panel D. Population and Household Income (2000 -2010)				
Population (log)	0.162	-0.019	0.224	0.221
	[0.051]***	[0.172]	[0.028]***	[0.061]***
Households	0.142	0.097	0.224	0.187
	[0.059]**	[0.193]	[0.034]***	[0.074]**
Income pc (log)	-0.001	0.138	0.07	0.203
	[0.052]	[0.095]	[0.035]**	[0.071]***
Observations	506	506	7,550	7,550
Municipalities	253	253	3,794	3,794

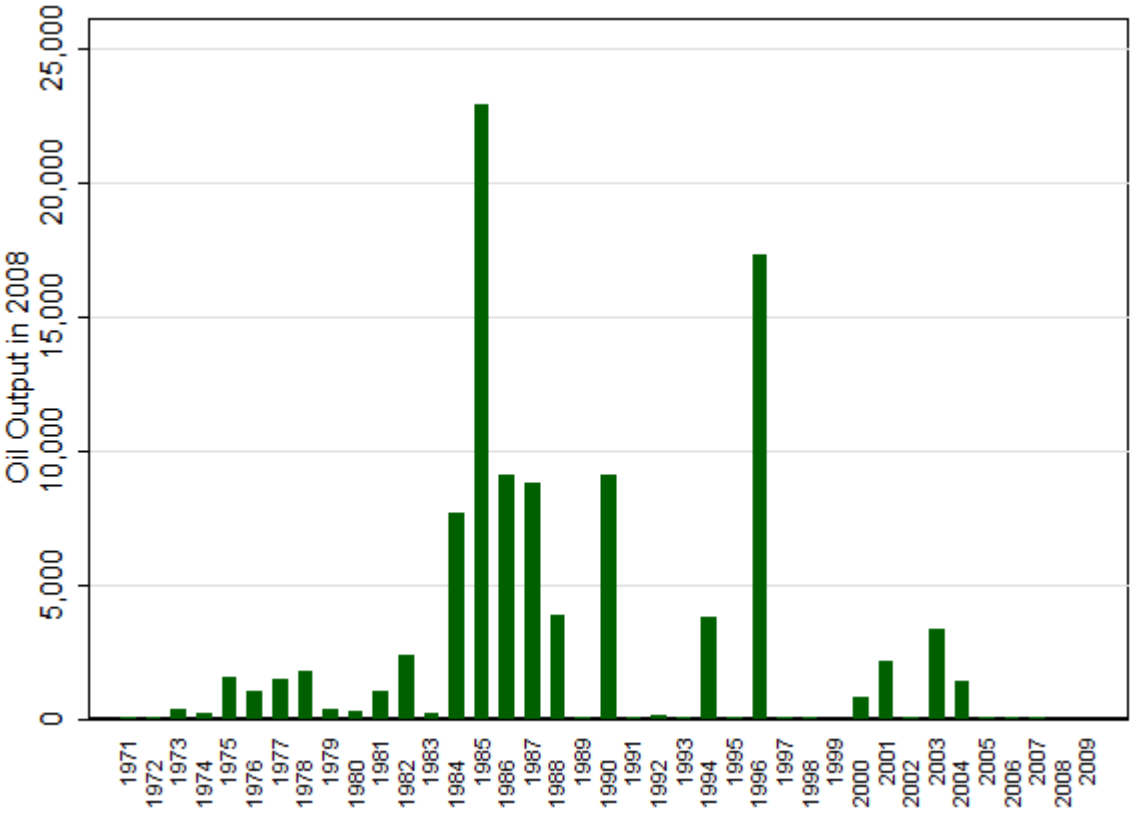
Notes: Each entry shows the estimate of oil royalty value impact on the variable indicated in the line. Columns 1 and 3 indicate the results of an OLS regression and columns 2 and 4 of a IV regression. The sample consist of observations for coastal municipalities in the 15 coastal states (columns 1-2) and for all municipalities from these states (columns 3-4). The regressions estimate long-term changes between 1998-2000 and 2010, with the base line year varying by panel. Oil royalties per capita indicate the mean of royalties per capita from 1999 to 2000 and from 2009 to 2010. All regressions control for log of population, year, state-year and municipal effects. Regressions exclude the three top beneficiaries in each base and end year (1% of royalty distribution in coastal sample). Robust standard errors are displayed in brackets. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 14: Auditing

	2004	2008
	(1)	(2)
Oil royalties pc * Audit	-8.94	-15.01
	[12.83]	[4.84]***
Oil royalties pc	17.22	16.94
	[9.08]*	[3.98]***
Audit	0.53	19.09
	[3.87]	[4.71]***
Observations	88	88
R-squared	0.68	0.76
Y mean	43.60	49.40
Audit mean	0.352	0.227
SE royalties	0.570	0.698

Notes: This table reports the effects of royalty payments and audits on municipal public employment. The dependent variable is the mean of total number of public employees per 1000 habitants on September 30th in 2003-2004 (column 1) and in 2007-2008 (column 2). Audit is a dummy variable indicating whether the municipality was audited by TCE-RJ in the current and/or previous year. These regressions use as controls municipal characteristics: population, urbanization rate, population density, distance to the state capital, altitude, longitude, latitude, area, a dummy for whether the municipality is a state capital. We instrument royalty value and the interaction variable by oil output and oil output interacted with the auditing dummy. Royalty payments and oil output are the average value received in the contemporaneous and previous year, are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2010 values. The sample includes only Rio de Janeiro municipalities. Robust standard errors are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Figure 1: Oil Field Output in 2008 by Year of Field Discovery



Notes: This graph shows the distribution of 2008 oil output based on the year that the oil field was discovered (indicated on the x-axis). Oil output is measured in R$ million.

Figure 2: Oil Production 1994-2008

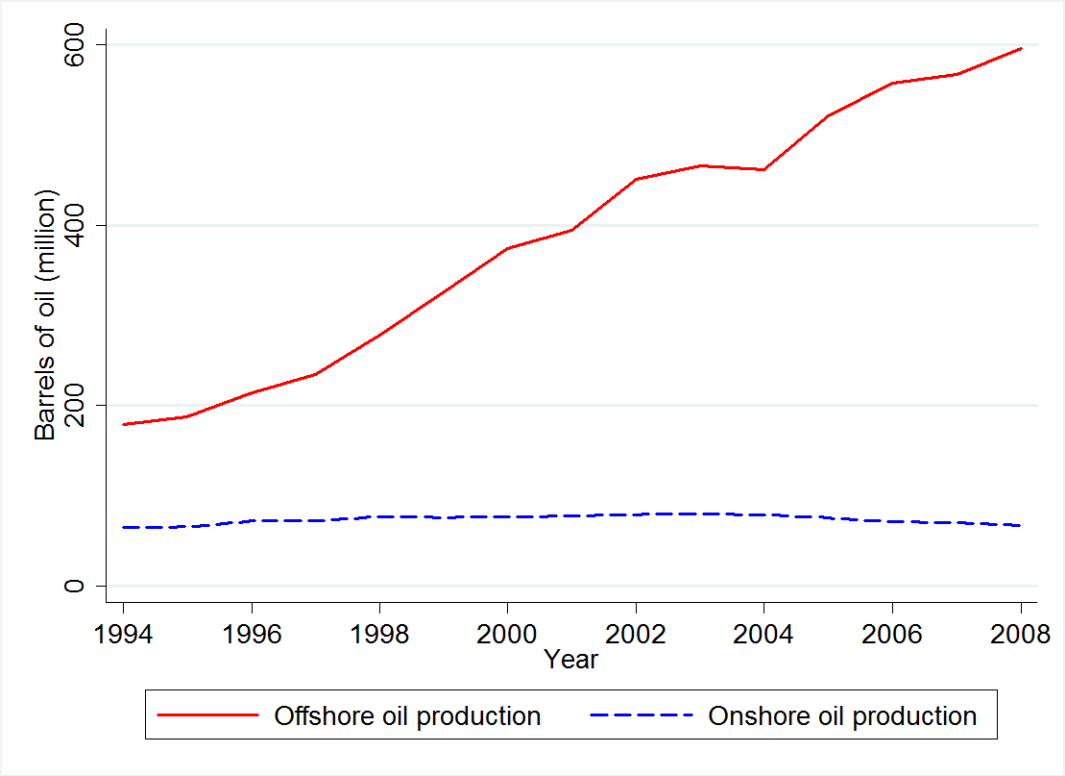
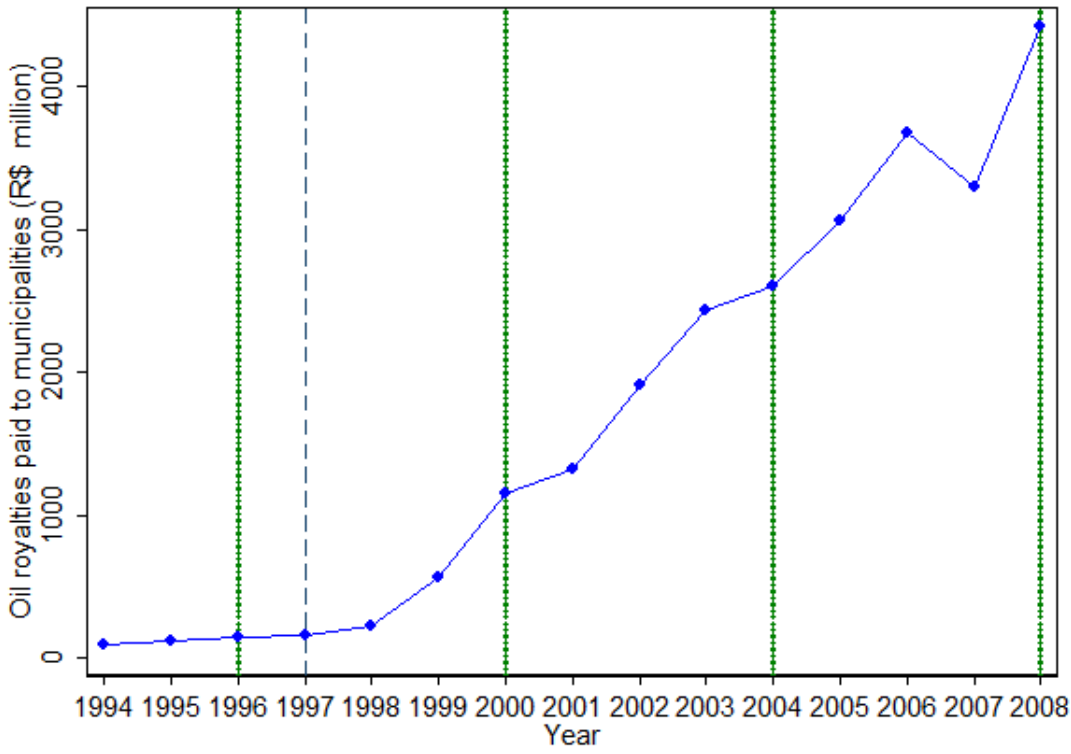
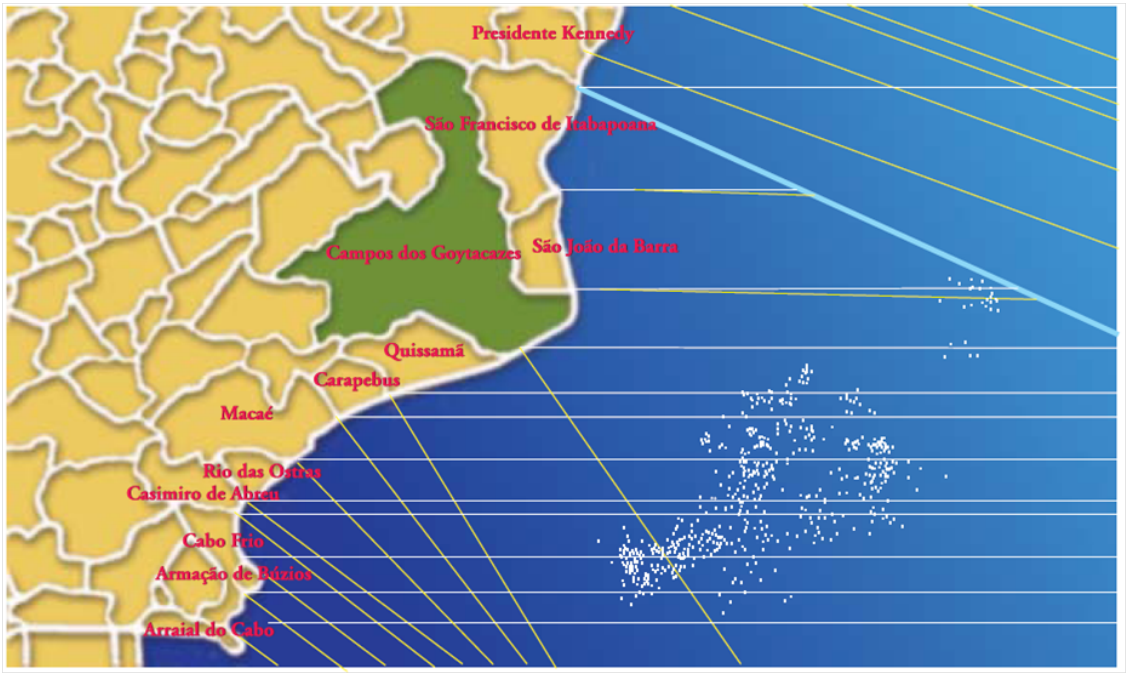


Figure 3: Royalty Payments to Brazilian Municipalities 1994-2008



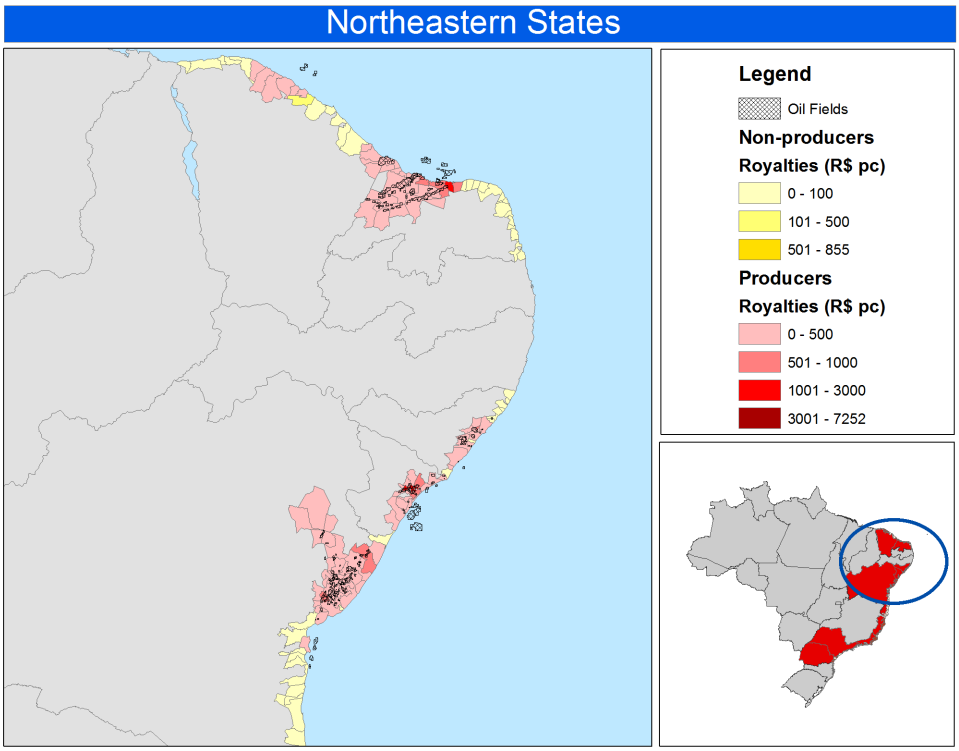
Notes:
This figure show the evolution of royalty payments to municipalities from 1994 to 2008. Royalty payment unit is R$ million and corresponds to 2008 real value. The solid vertical lines indicate municipal election years. The dash vertical line indicates the year of enactment of Oil Law.

Figure 4: Orthogonal and Parallel Lines on Rio de Janeiro Coast



Notes: This figure shows the orthogonal and parallel lines that lies on the coast of the state of Rio de Janeiro. These lines are the criteria used to determine which municipalities face oil fields. The dots indicate oil wells. Source: ANP (2001b). Guia dos Royalties de Petróleo e do Gás Natural.

Figure 5: Location of Producing and Non-producing Municipalities



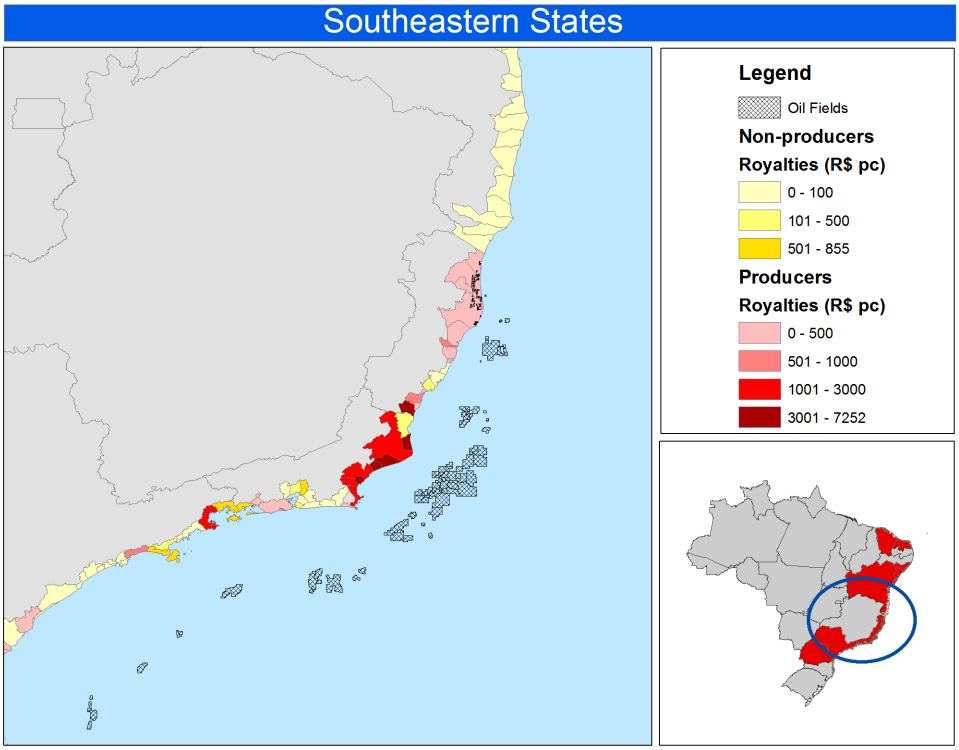
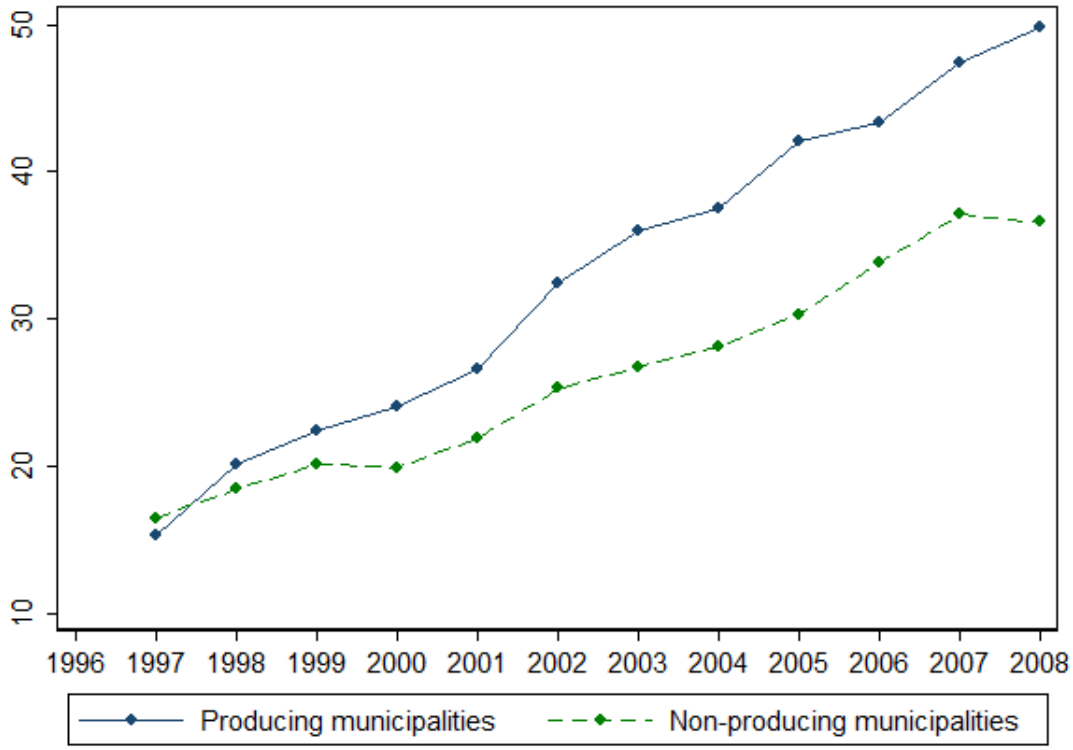
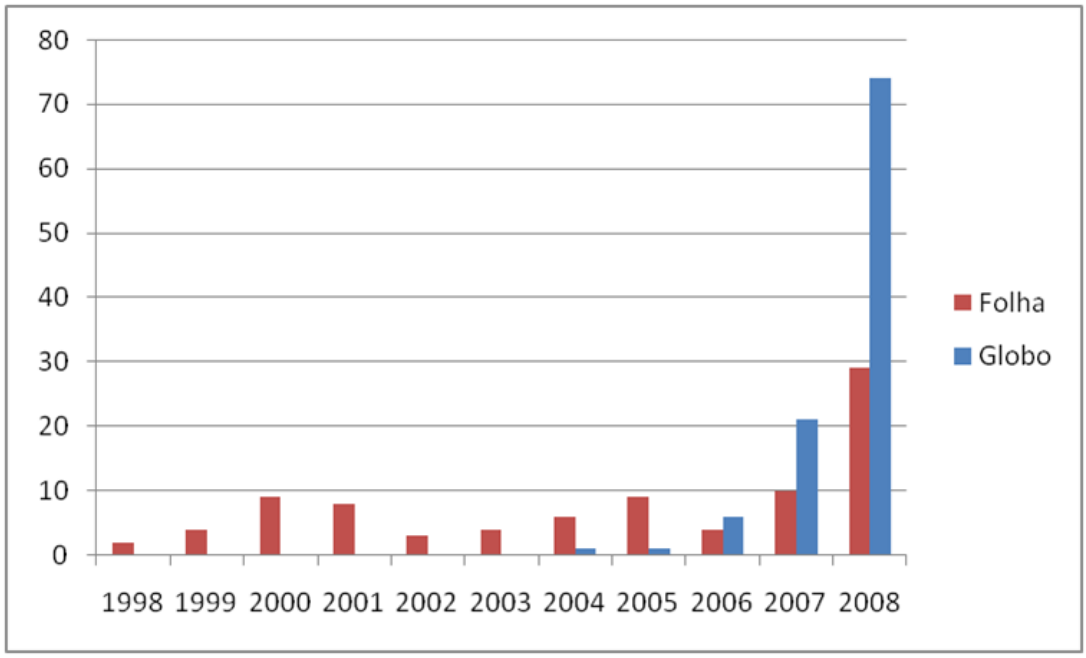


Figure 6: Municipal Employees in Oil Producing and Non-producing Municipalities 1997-2008



Notes:
This figure shows the median number of municipal employees per 1000 habitants on September 30th between 1997 and 2008 for two group of municipalities. Producing municipalities are municipalities on the coast of the fifteen coastal states under analysis that have oil extracted from an oil field within their borders in the reference year. Non-producing municipalities are the other municipalities on the coast of these fifteen states (those which do not produce oil).

Figure 7: Newspaper Coverage



Notes: This figure shows the number of articles with the words 'petróleo" (oil), 'royalties" and 'municípios" (municipalities) published by year by Folha de São Paulo (since 1998) and O Globo (since 2003).