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

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This version: October 2010
First draft: May 2009

**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 large oil royalty payments made to municipalities. We explore a fixed geographic rule which determine who receive oil royalties and investigate how incumbents spend oil windfall and the impact of these rents on local elections. We show that royalty payments create a large incumbency advantage in the two elections that follow oil windfall boom, but this effect disappears in the medium-run. Oil windfall is associated with a large increase in the number of employees, but we don't find any significant impacts on education or in health supply. We also exploit the mechanisms through which mayors are able to remain in power only in the short-term. Our results are consistent with a learning story, in which voters are initially unaware about the huge increase in royalty rents. These rents were used to create more public jobs, which was interpreted by voters as a signal of incumbent's ability. Oil rents continued to increase along the years but were not translated into improvements in living standards, which lead voters to oust the incumbent. Thus, our results indicate that oil does not make leaders unaccountable and that a democratic system is crucial to avoid the negative effects of resource abundance. We show that elections, media presence and constraints on executive are institutions which play a role in restraining the irresponsible use of oil rents.

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

*We are grateful to Juliano Assunção, Filipe Campante, Stephan Coate, Roberto Moraes, Rohini Pande, Rodrigo Serra, Rodrigo Soares, James Snyder, Denise Terra and seminar participants at Harvard Development Lunch, MIT Political Economy Breakfast, IPEA and LACEA for helpful discussions and suggestions. I thank Nicole Saba for excellent research assistance. Joana Monteiro gratefully acknowledges the hospitality of Center for International Development at Harvard University and the financial support from Corporación Andina de Fomento (CAF) and CAPES.

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# 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 and 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 and Wantchekon [2004]; Ross [2001], Tsui [2010]). 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 and 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 provide evidence that royalty payments create a large incumbency advantage in the short-run. In 2000, the first election after the boom and when all mayors could run for reelection, an one-standard-deviation increase in royalty value increase reelection chances by 14 percentage

[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".

points, which implies a increase of 29 percent in reelection chance. However, this effect disappears in the medium-run since there is no incumbency advantage in 2008. Oil windfall does not impact political competition and selection which imply that the estimated increase in the likelihood to stay in power should be explained by the behavior of incumbent politicians. We then investigate how municipalities spend oil windfall. We show that municipalities report to have increased all their expenses and did not change much their budget composition. Oil windfall is associated with a large increase in the number of employees, which particular increased from 1999 to 2006. We don't find any significant impacts on education nor in health supply. We also exploit the mechanisms through which mayors are able to remain in power in the short-term. Increases in tenured employment in the two years before the election are specially important to explain reelection in 2000. However, increase in employment is not associated with higher reelection chance in 2004, while it reduces mayor reelection probability in 2008. We also provide evidence that awareness level about oil windfall increased along the years and that mayors from municipalities with local media presence have more difficult to get reelected in 2008.

Altogether, these results do not indicate that oil makes leaders unaccountable. Although oil windfall creates a large incumbency advantage in the two elections after the boom, voters reward incumbents by reappointing them to office as long as they are not completely informed of the size of the extraordinary revenue and see increases in public employment as an indication that municipality may improve. In the medium-run, as information about the resources increases and a larger public sector does not translate in more public goods and services, citizens oust the incumbent and select new candidates. Thus, our results indicate that a democratic system is crucial to avoid the negative effects of resource abundance and that institutions such as elections, media presence and constraints on executive play an important role in restraining the irresponsible use of oil rents.

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 and 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 can affect politicians incentives in a democratic context. Caselli and 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]

[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 and Francois [2000]; Lane and Tornell [1996]; Tornell and 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

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. 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 election outcomes, but, contrary to us, find an impoverish in the pool of candidates.[4] Litschig and 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

lack of human capital accumulation reduces long-run growth.

[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, while in our model there is an incumbency advantage because voters are unable to assess royalty value.

education and income per capita without causing ill effects on industrialization or inequality. More related to this study is Caselli and 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, no significant improvements in living standards, leading them to conclude that most of oil royalties received by municipalities go missing. This work differs from Caselli and Michaels [2009], however, on 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 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 three political mandates, 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. Finally, section 6 concludes the paper.

## 2 Institutional Framework

Brazil has extracted oil since 1939, but oil production became important only in the mid 1970s, when oil fields in Campos Basin, on Rio de Janeiro coast, were discovered and the increase in oil international prices made offshore production viable.[5] The industry prospects improved during the 1980s when the first giant oil fields were found.[6] But the industry major upturn occurred in 1997, with the enactment of Law no. 9478, coined as the Oil Law, which phased-out the state oil extraction monopoly.[7] Competition helped oil production to increase and more than double between 1997 and 2008, reaching 663 million barrels in 2008. Figure 1 shows that offshore 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 production or 82% of Brazilian production. Looking within the states, 53 municipalities have onshore oil wells and 73 are classified as producing municipalities because they face offshore oil fields (see below for a formal description of "facing" municipalities). The industry which support offshore activities is concentrated in one city, Macaé, which is located

[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.

in the north of Rio de Janeiro state.[8]

Oil producers must pay up to 10 percent of production value as 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 fiscal revenues, Law 7.453/85 was enacted and offshore royalties became 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 in four groups: producing municipalities, secondary zone, neighboring municipalities and non-affected ones. In 1986, Decree 93.189/86 classified as producing municipalities the ones which are in front of an oil well according to orthogonal and parallel lines to the Brazilian coast extracted from nautical letters. Figure 2 illustrates the criteria for Rio de Janeiro coast. In 1989, Law 7.990/89 included municipalities with transportation facilities from and to oil sites in the list of benefited municipalities.

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

Taking together, royalty payment rules imply that local governments are the main beneficiaries of oil windfall. In 2008, municipalities received directly 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%).[12] This level of decentralization of natural resource compensation

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

[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 to onshore royalties. For details on the political bargain to approve Laws 7.453/85 and 7.525/86 see Serra [2005]

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

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

[12]Actually, the value received by local governments is even greater because they receive indirectly 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.

is not observed in other countries (Serra, 2005).

These rules also imply that geographic location is the main determinant of who receives and how much each municipality gets of oil windfall. The largest share of royalty revenue that goes to municipalities are paid to 'producing municipalities" because they are considered the ones most affected by oil production. In addition, the proximity to these municipalities determine the 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 oil windfall is paid to the Brazilian Treasury, which in turn distribute to the beneficiaries. Municipalities are free to allocate this income except by two restrictions. They cannot use this rent to hire public employees in a permanent basis, nor can pay debts with it.[13] The Tribunal de Contas of each state (TCEs) are the institutions in charge of auditing the allocation of royalty rents. 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, in particular its effect on political outcomes. Specifically, we want to estimate:

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

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, $\lambda_t$ is a year fixed-effect and $u_{it}$ is a random shock.

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

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 to us. In order to deal with this potential problem, we follow Caselli and Michaels [2009] and apply an instrumental variable approach, using the following equation as first-stage:

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

where $Z_{it}$ denotes oil production value and $\epsilon_{it}$ indicates non-observable characteristics which 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 since a fraction of oil output is paid as royalties to municipalities where drilling is done. In addition, the rule allocates offshore production among municipalities according to parallel and orthogonal lines to the Brazilian coast, creating a geographic instrument. Figure 4 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 4 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 restrain our analysis to coastal municipalities from producing states. This gives a sample of 159 municipalities distributed among the states of Ceará, Rio Grande do Norte, Alagoas, Sergipe, Bahia, Espírito Santo, Rio de Janeiro, São Paulo e Paraná.[14] We also exclude the top 1 percent municipalities in royalty distribution in order to deal with outliers, which implies excluding two municipalities from the sample (Quissamã and Rio das Ostras).[15] As robustness checks, we replicate most of the results in annex using two alternative samples and show that our findings are in most cases not sensitive to sample selection. We use a full-sample that include all the 2,157 municipalities from the nine producing coastal states and in a third sample we restrain our analysis to the 124 onshore and offshore producing municipalities.[16]

[14] Although Amazonas state also produce oil, we exclude it from the analysis because it has only onshore production and is highly different from the other states. Santa Catarina also produce oil but its production is small, intermittent and attributed to just two municipalities, what led us to exclude it from the sample.

[15] Some results are quite sensitive to the exclusion of these two cities because they are huge outliers. Quissamã received 86% more royalty payments than the third municipality in the rank and 160% more than the fifth municipality, while Rio das Ostras earned 64% more than the third municipality and 128% more than the fifth in the rank on highest benefited municipalities.

[16] We also exclude Quissamã and Rio das Ostras from these alternative samples to guarantee comparability.

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

Therefore, our main empirical specification employs a panel IV strategy, described by equations (1) and (2). Table 1 shows the first-stage regression for the three samples used in this work. The F-statistics is greater than 230 for all samples confirming that we have a quite strong first-stage.

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:

$$y_{it} = \rho_t R_{it} + X_{it}\beta + \lambda_t + u_{it} \tag{3}$$

$$R_{it} = \gamma_1 Z_{it} + X_{it}\gamma_2 + \lambda_t + \epsilon_{it}$$

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, population, population density and dummy for coastal municipality. We also let the coefficient of royalty payments, $\rho$, vary per election in order to understand oil windfall impact in each election.

Our approach is different from the one used in Caselli and Michaels [2009] in several ways. First, we focus on offshore production variation by looking only at 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 cover a different period. We explore annual variation of royalty payments between 1997 and 2008, the period when the oil boom was most remarkable. In addition, we were able to construct royalty payments and oil production series for 1996-1998, which allow us to understand royalty effects before the boom. The fact that we cover three political mandates also permit us to understand short and medium-term effects. In turn, Caselli and Michaels [2009] analyze variation on outcome data mainly from 1991 and 2000, having few outcomes whose values are 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 ('area minima de comparação). In Brazil, the fact that many municipalities

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

split during the 1990s led the creation of 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 measure 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] what allow us to understand royalty impact 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 Brazilian context. Production and investment are carried-out by Petrobras and other multinational companies, respond to long-term decisions and involve billionaire budgets. It seems highly improbable and there is no anecdotal evidence which support the idea that tiny municipalities and local politicians can influence multinational companies' plans. Table 2 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. In column 1, the dependent variable is equal to one if an oil field within municipality border was discovered in the respective year, while in column 2 the dependent variable indicates whether oil began to be extracted on the respective year. The regressions cover 1993-2008 period 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, 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 enters into production. In addition, we see that few, if any, parties have a higher or lower probability than PT (the party of Lula, who 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 discover the oil field and beginning its production and confirms that there is no indication of municipal political influence on oil production decisions.

[18] Ten among the 159 coastal municipalities were installed in 1997 and have their first election in 1996, so we have all outcome information for them. Six municipalities in the states under analysis were created in 2001 but just one, Jequiá da Praia in Alagoas, is on the coast. This municipality is not included in the sample.

# 4 Data

We use several data sources in this study. Agencia 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 Oil and Gas Journal (Oil and 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 allow us to construct 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 Oil Law. This is the first work that provide oil data for the 1990s. In Annex we explain in detail how we build oil production annual values, how we link oil output to specific municipalities and how we recover royalty payments series. We double check our calculation and 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 provide 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 living standards, we gathered information on how municipalities spend their budget and on local public goods provision. 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. Educational outcomes are provided by Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP) from 1996 to 2006. The number of municipal health clinics and hospitals are available at DATASUS's site for 1998-2002 and 2006-2008 periods. Information on municipal public employees for 1996-2008 period was gathered from the Social Security Registry of all formal workers in Brazil (RAIS), 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 also complemented with information on municipalities' GDP available from IBGE for 1999-2007 period.

In order to understand the mechanisms which explain reelection results, we explore additional data. To gather information on voters' awareness about oil windfall we perform a search on two newspapers to look for the number of news about 'petroleo' (oil), 'royalties' and 'municipios' that

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

[20] There is no available information for 1996 election in Espírito Santo state and most of Rio Grande do Norte municipalities.

were published in each year from 1998 to 2008. We performed that search for O Globo and Folha de São Paulo.[21] In addition, we got information on local media presence from Donos da Midia, a NGO who built a database which contain the names of all radio, televisions and newspapers which disclose local content. Donos da Midia database contain information for 2,686 Brazilian municipalities, which include 77 municipalities (out of 157) from our main sample. This data is for 2007. In order to shed light on law enforcement, we got information from Tribunal de Contas do Rio de Janeiro, which is the institution responsible for auditing royalty rents allocation 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 the municipality perform any irregularity with respect to municipal public employment.

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 gathered 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 population illiterate available from 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.

All monetary variables used throughout the analysis have been deflated using IPCA index and represent real values on 2008 prices. In annex, we provide the sources of all variables.

Table 3 shows summary statistics for royalty payments in each political mandate. There were 103 producing municipalities in 1997 and this number increased to 123 in 2008 as new oil fields entered into production. These municipalities received on average R$ 133 per capita per year in 1997-2000 electoral mandate, which was equivalent to 9% of their municipal revenue. Royalty payments increased more than three-fold on average in the period under analysis, reaching R$ 478 per capita per year in 2005-2008 period or 15 percent of municipal revenue. Producing municipalities are concentrated on the Brazilian coast, which is the location of 58 percent (71 out of 123) producing municipalities. This group receives larger royalty payments (R$ 697 per capita per year in 2005-2008) because they face highly productive offshore oil fields. There are more 2,000 municipalities in the nine producing states and some of them also receive royalties because they are neighboring municipalities or have oil facilities. However, the amount received by this group is quite small, being about R$ 10 per capita per year or 0.6 percent of municipal revenues in 2005-2008 period.

Table 4 provides information on how producing and non-producing municipalities differ in terms of municipal characteristics. Columns (1) and (2) show that producing municipalities had worse economic indicators than non-producing municipalities in 1991. Producing municipalities had a

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

higher percentage of urban population, larger illiterate population, lower household income per capita, higher poverty rate, lower human development index, higher infant mortality and lower percentage of households with water pipes. The evolution of these variables between 1991 and 2000 show that they follow more or less the same trends, but producing municipalities experienced a larger population growth and a lower reduction in mortality rates. We also see striking differences between political characteristics in 1996 and geographic characteristics. There are more producing municipalities close to the sea, to the equator, to state capitals and in low altitudes, which reflect the fact that most of producing municipalities are on the Brazilian coast.

These differences led us to concentrate our analysis on municipalities on the Brazilian coast. Columns (4) and (5) compare average characteristics from producing and non-producing coastal municipalities. Most of the differences previously observed disappear. These two groups of municipalities were very similar in 1991, with the only exception that producing municipalities were slightly more unequal. These municipalities also followed a similar trend between 1991 and 2000. The only difference found is that producing municipalities had more progress in reducing poverty and experienced a lower increase in income inequality. Table 4 also shows that political and geographic characteristics are not statistically different between producing and non-producing municipalities on the coast. The similarity of observable characteristics between coastal municipalities that produce and do not produce oil make us confident about using coastal municipalities as our main sample.

# 5 Empirical Results

We begin the empirical analysis by showing evidence that oil production does not have any economic effect on local economies rather than through the municipal budget. We then turn to the main objective of this paper which is the oil windfall effects on local politics. We provide evidence that royalty payments create an incumbency advantage in the two elections that follows oil windfall boom. However, we show that this effect disappear in the medium-run. We also show that there is no royalty effect on pre-election competition or political selection. We then investigate how oil windfall is being spent and show that municipalities report to have increase all their expenses. Oil windfall is associated with a large increase in the number of non-tenured employees, which particular increased from 1999 to 2006. No significant impacts on education nor on health supply were found. The analysis if followed by an investigation of the mechanisms which can explain reelection outcomes. We show that patronage and information explain part of the story but oil windfall does not affect political competition and selection.

### 5.1 Impact on Economic Activity

One of the main hypothesis 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 is from offshore wells and most of municipalities which face oil fields does not suffer any externality from oil output. Table 5 presents some evidence on that direction by showing oil output effects on population and different variables of economic activity. The results presented in columns 1-11 are from panel regressions that include municipal and year effects as controls. With exception of column 1, all measures are in per capita terms. We present the results for three samples. Panel A include all municipalities from the nine producing states. Panel B shows our preferred specification that includes coastal municipalities from nine producing states, while panel C sample is composed by only oil producing municipalities.

Table 5 shows that oil output is associated with population changes in the sample which include all municipalities from producing states. However, this result is not robust to the use of other samples which do not show any impact of oil windfall on population. This difference among samples probably reflect the fact that oil producing municipalities are concentrated on the Brazilian coast, which historically have larger population growth, and reinforce the importance of focusing on coastal municipalities sample. Columns 2-6 reveal that oil output does not affect the number of firms on benefited municipalities. Columns 7-9 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. Finally, columns 10-11 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. However, these results should be interpreted with caution. Municipal GDP in Brazil is not directly computed. The National Bureau of Statistics (IBGE) compute the state GDP and then divide each sectoral GDP among municipalities according to reference variables (variáveis de rateio). The key issue to our analysis is that the reference variable to divide mineral industry GDP is precisely the royalty rule. Hence, the estimated association between oil production and industry GDP is tautological. To assess whether oil production is affecting municipal economic activity, it is more informative to look at non-industry GDP that we measured by subtracting industry GDP from total GDP. Column 11 indicates that there is no effect on this variable. Table 5 also shows that the results are robust to alternative samples. As 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).

Our results complement Caselli and Michaels [2009] paper which has previously shown that oil windfall does not affect municipal non-industry GDP pc. We extend this evidence by showing that oil windfall does not affect other variables of economic activity such as number of firms, private payroll and number of private employees.

### 5.2 Reelection Effects

We now turn to understand the effects of oil revenue on election outcomes. Table 6 presents these results. Our sample is composed by 157 municipalities located on the coast of the nine oil producing states. In columns 1-3 the dependent variable is an indicator variable equal to one if the incumbent mayor was reelected. We consider only municipalities where the mayor is in the first-term and, hence, can run for reelection.[22] In all regressions, we let royalty coefficient vary per election. The specification presented in column 1 accounts for year effects, state fixed effects and municipal characteristics.[23] Column 1 shows that an one-standard-deviation increase in oil windfall is associated with 9 percentage points increase in reelection probability in 2000 and to 19 percentage points in 2004. However, it is hard to support these estimates as the causal effect of royalty payments on reelection probability since a share of royalty payments is distributed by taking into account municipal characteristics. In column 2, we use the same controls but explore only the variation in royalty payments caused by variation in oil output. This is our preferred specification for this exercise since term-limits make the sample of municipalities vary every election, which makes the within estimates hard to interpret. We estimate a larger significant effect for 2000, which indicates that an one-standard-deviation increase in royalty value increase reelection chances by 14 percentage points, which implies a increase of 29 percent in reelection chance. In 2004, royalty effect is also large: an one-standard-deviation increase in oil windfall raises reelection chance in 18 percentage points, which represents a 37 percent increase in reelection probability. Just to make sure that the results are not driven by municipal unobserved characteristics, column 3 includes municipal fixed effects as controls (rather than geographic characteristics) in addition to year effects and population. This exercise led to particular large estimates in 2000 and 2004, and again none in 2008. Column 3 shows that incumbent mayors from municipalities which received large payments in 2000 or 2004 have their reelection probability increased, respectively, by 19 and 31 percentage points in 2000 and 2004 elections. These estimates imply that mayors from oil rich municipalities saw their reelection chance increases by 37 percent in 2000 and 65 percent in 2004. It worth mention that most of the mayors from oil-rich municipalities was reelected in 2000, hence these strong results for 2004 indicate that the few that run for reelection in 2004 were reelected with probability of 80 percent.

In columns 4-6 of Table 6 we repeat these econometric exercises but use as dependent variable a dummy indicating whether the political party was reelected. Note that mayors can run for reelection under a different political affiliation that the one they got into power, so party estimates can be an underestimate (overestimate) of mayors incumbency advantage in case that mayors are more (less) associated than parties with possible benefits of royalty rents. In addition to check the robustness of our results, the use of party reelection allows us to incorporate 1996 election in

[22] Note that in 2000 all mayors were in the first-term since this was the first election that reelection was allowed.

[23] Municipality characteristics are population, urbanization rate, population density, distance to the state capital, altitude, longitude, latitude, area, a dummy for whether the municipality is a state capital

the analysis and understand what was happening in these municipalities before the oil windfall boom. In this exercise, municipalities are on the sample no matter whether the mayor is in the first or second-term.[24] [25] The results using party reelection as dependent variable reassures that oil windfall is creating an incumbency advantage. The estimates follow the same pattern that we found for mayor reelection. No matter the econometric specification, we estimate important effects in 2000 and 2004. The comparison between econometric specifications shows that point estimates increase when we instrument royalty revenue by oil output but the results do not change much when we include municipal fixed-effects (column 6). The estimated coefficients presented in column 5 indicate that an one-standard-deviation increase in royalty payments raises reelection chance in 21 percentage points in 2000 and in 14 percentage points in 2004. This implies that on average party reelection probability increased by 55 percent in oil rich municipality in 2000 and 50 percent in 2004. We also find no effects for party reelection in 1996, when most of the municipalities already received royalties but in much lower levels. This result is very important because it supports the idea that local politics were affected only when royalty value reached a substantial amount, what happened from 1999 onwards, and confirm that our analysis cover the period when most effects occurred.

In Annex Table 1, we show that these findings are robust to alternative samples. No matter whether we consider all the 2,151 municipalities from the nine producing states or the 124 onshore and offshore producing municipalities, we estimate that both mayor and party reelection increase in 2000 and 2004 but not in 1996 and 2008 elections.[26]

Overall, the results show that oil windfall creates a large incumbency advantage in 2000 and 2004 elections but this effect disappears in 2008, ten years after the beginning of royalty payment boom. The comparison between 2000 and 2004 effects also deserves some comments. While royalty effects on mayor reelection is statistically the same in 2000 and 2004 elections, the effect on party reelection is smaller in 2004.[27] This difference is explained by the fact that most mayors in oil rich municipalities faced term-limits and could not run for reelection. The results show that the

[24]The sample is composed by 590 municipalities rather than 628 (157 x 4 elections) because there is no available information on 1996 election for Espírito Santo state and for most of Rio Grande do Norte municipalities.

[25]For municipalities created between 1993 and 2001, we use information on the party in power on the origin municipality to construct party reelection.

[26]In addition, we use the share of royalty payments in total municipal revenue as alternative measure of royalty payments. We estimate that an increase in oil windfall that is equivalent to 10 percent of municipal revenue raises mayor reelection probability in 26 percentage points in 2000 and in 22 percentage points in 2004 (results not shown and available upon request).These estimates are from a regression which uses oil production value per capita as an instrument for the share of royalty payments in total municipal revenue and use municipality dummies, year dummies and population as controls. The sample comprises the 157 coastal municipalities from producing states. We should note that oil production value (neither in level nor in per capita term) is not a good instrument for the share of royalty payments in total municipal revenue in a regression that that let the royalty coefficient vary per election. In this case, we cannot reject the null hypothesis that oil production is a weak instrument for royalty payments.

[27]We cannot reject the null hypothesis that 2000 and 2004 royalty effects on mayor reelection are the same. This is true no matter each of the three samples we use. In a regression that uses party reelection as an outcome variable, 2000 and 2004 royalty effects are significantly different at 98 confidence level for coastal municipalities sample and at 94 percent for the producing sample and 97 confidence level for the full sample.

candidate selected by the party to run for mayor didn't have the same advantage as the former mayors. Although these results may also indicate that lame duck mayors weren't able to elect their successor, we cannot guarantee this based on these results since they could support a candidate under another political affiliation.[28]

### 5.2.1 Political Competition and Selection

Theoretically, resource rents can have both a positive and negative effect on political competition. On the one hand, Caselli and Cunningham [2009] argue that resource revenue can increase competition over power because the value of attaining office and capturing oil rents increases to all individuals and this may affect the entry of challengers and the effort they put on the process. On the other hand, resource rents also increase the value to stay in power and can give means to incumbents influence elections. Potential opponents can estimate the advantage of the incumbent and refrain to run for office, reducing political competition. In our context, this channel may explain our reelection results if we estimate a reduction in political competition in 2000 and 2004 and/or an increase in 2008.

We assess whether oil windfall affects political competition in Table 7. We use three 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 us how competitive was each election by taking into account the vote-shares. We regress each dependent variable on royalty payments per capita, population and year effects. In other to compare to our reelection results, we consider in all regressions only municipalities where the mayor is in the first-term and let the royalty coefficient vary per election in order to understand what happened in each election.

The point estimates indicate that oil rents reduced political competition in 2000 and 2004 (-0.39 and -0.11), but the effect is too noisy and cannot be distinguished from zero (standard error equal to 0.36 and 0.24, respectively). Column 2 shows that oil windfall is associated with a reduction of the effective number of political candidates in 2000 and 2004 elections. An one-standard-deviation increase in royalty rents decreases the effective number of candidates in 4 percent in 2000 and in 8 percent in 2004. No effect was found for 2008. Column 3 indicates that royalty payments dramatically increase the incumbent's margin of victory in 2000. An one-standard-deviation increase in royalty payments raised the incumbent's margin of victory in 5 points in 2000, which implies a increase of 71%. Overall, the results shown in columns 1-3 indicate that there is a negative association between oil rents and post-election political competition in 2000 and 2004 and

[28] We tried to gather information on the candidate that each lame duck mayor supported in 2004 election but we couldn't find it for an enough number of municipalities. However, by performing this task, we got to know some examples of mayors who moved to another party in 2004 and support a candidate under another political affiliation than the one he ran the 2000 election. Hence, we don't believe that we can use the candidate from the former political party as a proxy for lame duck mayor political support.

no effect in 2008. The fact that we don't find effects on pre-election competition indicates that the political competition channel cannot explain why mayors experienced an incumbency advantage in 2000 and 2004 election.

Columns 4-6 look at political selection by analyzing changes in opponent's characteristics. The link between oil windfall and political selection can be thought under a citizen-candidate framework, where any citizen can enter the electoral race if the benefits of entry exceed the costs. Oil rents can induce the entry of citizens with high opportunity coast since it may increase the rewards from office.[29] We try to assess this channel by considering the opponents' education and previous experience. In columns 4 and 5 , we regress opponents' average years of schooling and the percentage of candidates with college degree on royalty payments using the same econometric specification used in columns 1-3. We find no effects of oil windfall on opponents' education in all the three elections under analysis. Finally, column 6 shows royalty effect on the percentage of candidates that have a high skilled occupation before running for mayor. We coded as high-skilled any occupation that requires a college degree or is associated with civil service. We see that oil rents is not associated with changes in this variable.

Overall, Table 7 indicates that political competition and selection were not affected by oil windfall, which imply that the incumbency advantage estimated for 2000 and 2004 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.

### 5.3 Municipal Budget

Table 8 shows how oil windfall impacts municipal revenue. The results are from panel-IV regressions which cover 1997-2008 period and use municipal and year effects as controls. This analysis includes only municipalities which report most of revenues and expenses, which results in a smaller sample than in other exercises. In column A we see that each Real per capita received as royalty payment generates 1.13 Reais in total revenue. Column 2 indicates that an increase in tax revenue can explain approximately half of this 0.13 additional cents.[30] An one-standard-deviation increase in oil windfall is associated with an increase in R$ 0.03 per capita in tax revenue, which represents a 14 percent increase in this revenue. 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. Panel B shows that this increase in tax revenue was only sufficient to keep the share of tax revenue on total budget. The other remaining cents (0.07 out of 0.13) of additional impact on total revenue should be a result of the additional transfers that oil-producing municipalities receive from the state government, which by law should redistribute 25 percent of its royalty revenue to municipalities (see note 12).

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

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

Columns 3 and 4 look at the effects of royalty rents 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.[31] 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 on both transfers. Naturally, we estimate a reduction of both transfers as a share of total budget since they do not increase while the total budget is boosted by royalty rents.

Table 9 turns to investigate how municipalities report to allocate royalty revenue. Each column presents the coefficients from panel IV regressions of different types of expenses on royalty payments instrumented by oil production value. It shows that for every Real received, 63 cents are allocated in current expenses,[32] while 23 cents are used for investments and 1 cent for debt amortization, but this last effect is not statistically different from zero. From the 63 cents used for current expenses, 19 cents or 30 percent is allocated to payroll and other direct labor costs, and 20 cents are spent with other types of labor and service hiring (see columns 3 and 4). This indicates that oil-rich municipalities apply the same amount of resources on "other labor and service contracts", which include consulting services, outsourced services and labor hired on a temporarily basis than on payroll. We interpret this result as a reflection of law restrictions to the use of royalty rents, 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,[33] we see that the bulk of this expense is used to pay for outsourced services provided by companies. This budget line can include several expenses, including two famous expenses in oil-rich municipalities: free live concerts and labor hiring through NGOs. Both expenses are usually cited in scandals on the use of public funds on oil-rich municipalities and have been object of police investigation.[34]

Panel B shows the impact of oil windfall on each expense as a share of total revenue. We see that oil rents does 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 7 to 11 offer another way to look at budget allocation by examining the destination

[31] 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.

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

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

[34] In 2008, the federal police arrested 14 people in Campos dos Goytacazes charged of fraud on public procurement to 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 $http://oglobo.globo.com/pais/mat/2008/05/30/ministerio_publico_federal_pede_justica_afastamento_dos_17_vereadores_de_campos-546596081.asp$

of expenses. We observe that local governments report to spend similar amounts in all areas, with exception of transportation. Expenses with administration and planning are the main destination of oil revenues, receiving 21 cents of every Real received as royalty payments, followed by housing and urbanization (18 cents), health and sanitation (17 cents), educational and culture (16 cents) and transportation (2 percent but not statistically different from zero). This implies that the areas that receive the largest improvements are housing and urbanization (41 percent increase in expenses for each standard-deviation increase in royalty rents), followed by administration and planning (33%), health and sanitation (30%) and educational and culture (19%). As a share total of expenses, Panel B indicates that education and health expenses were slightly reduced, while housing and urbanization increased a little.

Although this analysis so far offers insight on 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 the municipality spent resources with some expense does not necessary imply that such service has been delivered in an efficient way. 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.[35] Campos dos Goytacazes, the largest recipient of royalty rents in absolute terms, for instance, only disclosed information on its public expenses on 2000 and 2006.[36] This can limit the capacity of these data to inform how municipalities are investing royalty rents if oil benefited municipalities have a higher probability of not disclosing their public accounts. 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 municipalities have a 4.5 percentage points lower probability of disclosing their public accounts (results not shown).[37]

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

## 5.4 Public Goods and Service Provision

### 5.4.1 Public Employment

A major destination of public expenses is the payroll. In order to shed light on public employment trends, Figure 5 shows the evolution of the median number of municipal employees in coastal producing and non-producing municipalities from 1996 to 2008. We see that although the median levels in the two groups of municipalities are quite similar in 1996 and 1997, they began to diverge in 1998, exactly when municipalities were affected by the the large boost in royalty payments caused

[35] Caselli and Michaels (2009) use 2001 values to impute the missing observations for 2000 in order to not lose many municipalities. We do not perform any imputation. We don't need it because we use several years of data and we don't think this is appropriate because municipalities can allocate their budget in different ways from one year to another.

[36] The only record for "other labor and service contracts" is from 2006. In this year, this municipality spent R 387 million with these contracts, which corresponds to 31 percent of its total expenses or 122 percent of its payroll.

[37] This result is not robust to the inclusion of municipalities fixed-effects.

by the Oil Law. Both groups increased substantially the number of public employees, but producing municipalities began earlier to increase municipal public employment and did it in a higher pace.

Table 10 examines whether the largest increases in municipal public employment occurred in municipalities benefited by the highest increases in royalty payments. It shows the results of IV regressions which cover 1997-2008 period and use population, municipal and 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 that is closest to election, which takes place every four years in the first weekend of October.[38] Column 1 shows that for each R$ 1,000 per capita received, municipalities hire more 7.24 public employees per 1,000 habitants. This result is highly statistically significant (standard error=1.44) and quite important in economic terms. It implies that municipalities hired more 3.4 employees per 1000 habitants for every standard-deviation increase in royalty rents, which is equivalent to a annual average growth of 10 percent in the number of public employees. Alternatively, this means that oil-rich municipalities on average multiplied the number of employees by more than two-fold in the twelve years under analysis. In Annex Table 2, we show that this estimate is robust to alternative measures of public employees, to different samples and to the inclusion of outliers. In particular, the estimate for royalty impact on municipal employment is quite similar if we use 'Perfil dos Municípios Brasileiros: Gestão Pública" database, which is a survey carried out by IBGE that investigates various aspects of the public administration, such as budgetary and planning procedures, and the number of public employees.[39]

Note that municipalities are forbidden to use royalty income to hire employees in a permanent basis. However, it is widely believed in Brazil that a large share of royalty rents was used to hire employees.[40] In practice, municipalities have several options to hire 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 note (5.3) 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 hiring.

[38]RAIS database inform employment level on December 31st but also disclose 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 to huge variations in reported employment levels in some years. Since we believe that these drastically variations are misreports, we replaced by missing any record which reports a annually decrease of more than 75% in the number of employees followed by an increase of more than 200% in the following year. By doing that, we loose 60 observations among 1864 in the sample that include only coastal municipalities. We performed this correction because we didn't want that artificial jumps in employment level affected within-estimates. However, the result is robust to the use of corrected or uncorrected measure.

[39]This research was carried out in 1999, 2001, 2002, 2004, 2005, 2006 and 2008.

[40]See, for instance, an article at Estado de São Paulo: "Lucro com petróleo banca farra de contratacões em municípios" (Oil rents support excessive employment in municipalities), at *http* : *//www.estadao.com.br/estadaodehoje/*20080414/*not*$_i$*mp*156256, 0.*php*

Column 2 in Table 10 shows the results of a regression which assess whether oil windfall has affected municipal public sector wages between 1999 and 2008.[41] In order to account for differences in price levels among municipalities, we use as measure the ratio between the average wage in public sector and the average rate in the private sector. The average of this variable is 1.17 in Brazil for 1999-2008 period, indicating that public employees earn on average 17 percent more than private sector employees.[42] Column 2 shows that the oil windfall raises public-private relative wage, which increases by 0.06 for each R$ 1000 per capita received. However, this estimate is quite noisy (standard error=0.06) and is not statistically different from zero.

In column 3 to 8 we shed light on the composition and quality of the payroll increase. In column 3, we show the results of a regression which estimate the impact of oil royalties on the number of public employees on December 31st. This result is quite similar to the one presented in column 1 and indicates that an one-standard-deviation increase in oil windfall raises public employment in 3 employees per 1000 habitants, which represents an average annual growth of 9.5%. This increase is a little smaller than the one presented in column 1 because municipalities usually fire some employees on the last month of the political mandate. Although we prefer the measure on September 30th, we report the estimates on December 31st to be used as a reference for columns 4-8 because we are able to decompose the number of employees between categories only for this date. Columns 4 and 5 divide the number of employees between the ones with and without tenure. Column 5 shows that most of new employees (86% percent) were hired in a temporarily-basis and don't have tenure. An one-standard-deviation increase in royalty payments is associated with the hiring of more 2.6 employees without tenure per 1000 habitants, which represents an average annual increase of 24 percent. Column 4 shows that the effect on the number of employees with tenure is small and not statistically different from zero. Both results are consistent with the fact that, by law, municipalities cannot use oil windfall to hire employees in a permanent basis.

Column 6 shows the results of a regression which use the percentage of public employees with a college degree as dependent variable. The point estimate is negative and indicate that in oil-rich municipalities, an one-standard-deviation increase in royalty rents promoted a decrease of 1 percentage point in the percentage of public employees with a college degree. However, this estimate can only be distinguished from zero at 13 percent confidence level. In order to understand the significance of this result, it worth mention that the public sector in all Brazilian municipalities suffered a boost in the period under analysis. Between 1999 and 2008, municipal employment in per capita terms increased 64 percent (from 22 to 36 employees per 1000 habitants). There was also a major improvement in the average educational level: the percentage of employees with college degree changed from 7 percent to 25 percent. What our results indicate, therefore, is that oil-rich municipalities experienced a even starker growth in public sector and that, although they also

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

[42] 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 0.95. In 2008, this ratio jumped to 1.35.

improved the educational level of its employees, they did that in a reduced level than other Brazilian municipalities. We cannot tell whether this difference is a consequence of intentional decisions of public authorities to hire low educated people or whether it is a consequence of a supply constraint in the number of habitants with college degree in oil-rich municipalities.[43]

Finally, columns 7 and 8 investigate whether the oil windfall was used to increase the number of professionals in education and health services, which are the two main services provided by municipalities in Brazil. We see that oil windfall is associated with both an increase in the number of teachers and in the number of health professionals. Municipalities hire more 0.4 teachers and 0.3 health professionals per 1000 habitants for every standard-deviation increase in royalty payments. This represents a particular boost in health supply, since these estimates imply an annual increase of 22 percent in the number of health professionals and of 5 percent in the number of educational professionals. These estimates also indicate that among the new public employees, 14% were hired to provide educational services and 11% to supply health services. Considering that, on average, 25% of municipal employees in Brazil are related to education supply and 5 percent provide health services, these results indicate that a considerable number of health professionals were hired. However, we cannot determine the functions of the other 75% of new hired employees, which probably are being hired to administrative and bureaucratic services.[44] Unfortunately, there is no way to assess if these services have been improved.

In sum, the results present on Table 10 indicate that oil windfall is associated with a huge expansion in the public sector. We also see that most of the new employees don't have tenure and that part of the increase was used to hire new health and educational professionals.

### 5.4.2 Education and Health Supply

Table 11 looks at the impact of oil windfall on education outcomes. On Panel A, we regress school enrollment, three indicators of education supply (number of school per habitants between 5 and 19 years old, percentage of teachers with college degree and number of school hours per day) and two indicators of education performance (percentage of students with slow school progress and school dropout) on the 2-year lag of royalty revenue per capita. We use 2-year lag in order to account to the fact that some investments might take long to occur, but the results are the same no matter whether we use the contemporaneous value, one or two year lags. For most of the indicators, the period of analysis is from 1996 to 2006, but we analyze shorter periods for some outcomes due to data constraints. In all regressions, royalty value is instrumented by oil production value and

[43] A supply constrain may emerge in two cases. If fewer people in oil-rich municipalities have a college degree, local governments would not be able to hire enough high-skilled people. However, this seems not to be the case since educational level in oil-rich municipalities are higher than in non-recipients ones in year 2000 (4.31 years of schooling in comparison with 4.07). But even with better levels of education in oil-rich municipalities, a supply constraint would emerge if the additional public sector demand is more than the additional level of people with college degree.

[44] We can rule out the possibility that extra employees are being hired to promote security since this is a responsibility of state governments. Only the state capitals have a police force.

population, year and municipal dummies are used as controls. Panel A shows that oil windfall does not improve any of the education outcomes under analysis.

On Panel B, we also look at the effect of oil windfall on education outcomes but we use long-differences rather than annual values. The idea is to investigate whether oil windfall promotes educational improvements in the long-term. We see that royalty payments are not associated with improvements in education between 1996 and 2006. We actually estimate a negative effect of oil rents on hours of school per day, but this effect is quite small in economic terms: an one-standard-deviation increase in royalty rents reduce in 0.05 the number of hours of school per day, which represents a decrease of 1.3%. On panels C-E we analyze whether there were some improvements in one of the political mandates under analysis. In these exercises, we look at the longest difference within the political mandate that we have data availability. The only education outcome affected by oil windfall is the percentage of students with slow school progress, which was reduced between 1996 and 2000. An one-standard-deviation increase in royalty rents decrease the percentage of students with slow progress in 1.7 percentage points, which is equivalent to a 3 percent reduction.

Overall, Table 11 indicates that oil windfall has negligible effects on education outcomes. Our results are in accordance with Caselli and Michaels [2009] paper, which find 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 (see Table 11).

Turning to health outcomes, Table 12 looks at whether these larger expenses were transformed in more health supply. In this Table, we exclude the three largest beneficiaries of royalty rents.[45] In Panel A, we look at annual data from 1998 to 2008 and use the 2-year lag of royalty value to let time to investments take place. Panel A shows that oil windfall is not associated with increases in the number of health clinics or hospitals per 100,000 habitants. On panels B-D we analyze what happened in each political mandate by exploring the largest year intervals within a political mandate that data availability allow us. We see that no matter the period under analysis, oil windfall does not affect the supply of health clinics or hospitals.

Our results so far indicate that municipalities use oil windfall to increase the public sector but does not promote large improvements in health and education supply. The only impacts on these two areas that we find is on the number of health and educational professionals.

### 5.5 Why there is an incumbency advantage only in the short-run?

We now turn to understand the mechanisms which can explain reelection results. We analyze whether the increase in public employment and/or an information story can explain our results. We first analyze when the boost in public sector occurred and the composition of public employment and show that to employ more people was an effective way to get more votes in 2000 but it was

[45] A closer look at the data reveals that Quissamã and Carapebus promoted a substantial increase in the number o health clinics between 1998 and 2000. These municipalities are the first and third largest beneficiaries of royalty rents. Hence, their performance is sufficient to drive all the results.

not an efficient strategy since then. We then provide evidence on voters' awareness level about oil windfall along the years and on the role of local media in promoting political accountability.

### 5.5.1 Public employment

There are two main reasons why voters would reward an increase in municipal public employment. The first one is that voters appreciate the enlargement of the public sector. This can be true because voters believe that more employees is a precondition to improve public services such as health and education, or because they have ideological preferences for a larger state, or even because they assess a higher probability of being hired as a public employee. The second story is that public employment is an effective strategy to obtain political support as rationalized by Robinson and Verdier [2003] and Robinson et al. [2006] models. The argument in Robinson and Verdier [2003] is that offers of employment in the bureaucracy is a credible policy to obtain political support because optimal employment contract concede rents to workers due to moral hazard and employment in the bureaucracy is an attractive way for politicians to generate rents.[46] Although it is difficult to disentangle between these two stories, the analysis of composition of public employment can shed light on it. The clientelism story sketched in Robinson and Verdier [2003] is consistent with an increase in non-tenured employment since according to their model it is crucial for mayors to be able to fire workers, otherwise voters' promise of political support would not be credible. On the other hand, if voters appreciate the enlargement of the public sector they should reward the increase in total or tenured employment.

Table 13 analyzes whether voters reelect the incumbent because he creates more public jobs by exploring the timing of public employment increase. We also analyze the composition of this increase in order to understand which type of job is created and whether voters rewards any increase of public employment or just tenured employment. This help us to disentangle the two stories above. In panel A, we analyze the employment increase in the two last years of the political mandate. In particular, we regress the variation in employment level in the two years that precede the election to reelect or replace the mayor on the variation of royalty payments in the same period, on population changes and on year dummies.[47] We just consider the municipalities whose mayors were in the first-term to be able to understand electoral motivation. We see that employment increased mainly in the first two political mandates under analysis. However, there is a marked difference in employment composition between the two terms. Between 1998 and 2000, mayors from oil-rich municipalities increased the total number of employees but also changed it composition by

[46] There is a large number of papers which relate patronage and resource-rich economies. Collier [2007], for instance, points out 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.

[47] Municipal elections took place on the first weekend of October in 2000, 2004 and 1008. Therefore, columns 1-3 consider the variation in public employment between 9/30/2000 and 9/30/1998, columns 4-6 explore the variation between 9/30/2004 and on 9/30/2002, and columns 7-9 calculates de difference between 9/30/2008 and 9/30/2006.

exchanging non-tenured employees for tenured ones. The results indicate that total employment increased by 2.8 employees per 1000 habitants for every one-standard-deviation increase in royalty payments in 1998-2000 period (an increase of 13 percent). The increase in tenured employment was much larger: 5.2 employees per capita which is equivalent to an increase of 42 percent. As a result, the proportion of tenured employees increased by 10 percent for for every one-standard-deviation increase in royalty payments. In the 2002-2004, the composition changed toward more non-tenured employees, which constitute the majority of vacancies filled in this period. Columns 7-9 show no increase in both tenured and non-tenured employment in 2006-2008. These results confirm the trends we see on Figures 5a and 5b: total public employment in oil-rich municipalities began to increase in 1999 and followed an upward trend until 2006 and it stabilized in 2007 and 2008. In 1999 and 2000, there was a marked change in employment composition, when tenured employment suffered a huge boost and non-tenured jobs decreased. In 2001-2004, the increase in public employment was led by new non-tenured jobs.

Panel B from Table 13 investigates whether the municipalities which experienced the largest increases in the public sector were the ones whose voters reappointed the mayor for office with a higher probability. For each election year, we regress a variable indicating whether the mayor was reelected on the two-year variation of the total number of employees per capita (columns 1, 4 and 7), on the number of tenured employees per capita (columns 2, 5 and 6) and on the proportion of tenured employees (columns 3, 6 and 9). All employment measures are instrumented by the two-year variation of oil output. We observe that each employment per 1000 habitants created between 1998 and 2000 is associated to an increase of 6 percentage points in reelection probability, while one tenured employment increased reelection probability in 4 percentage points. There is no impact of the composition of public employees on reelection probability in 2000. We also see that more public employment is not associated with reelection in 2004. More interesting is the effect for 2008 which indicate that mayors who increased the number of tenured employees between 2006 and 2008 were in fact punished by voters. An additional public employee between 2006-2008 is associated with a decrease of 0.08 percentage points in reelection probability in 2008. These results indicate that employing more people was an effective strategy to attract votes in 2000 but not in 2004 and 2008.

In order to conclude this analysis, it is necessary to understand whether mayors did not hire more employees in the 2006-2008 because they changed their political strategy in anticipation of voters' behavior or because they were forbidden to do so. The royalty law does not allow the use of royalty rents to hire employees on a permanent basis. Therefore, the results present on Panel A of Table 13 can be a reflection of an increase in 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

rents, a dummy variable indicating whether the municipality was audited in the current or previous year and an interaction variable of auditing dummy and the amount of royalties received on that 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 rents is associated with a large increase in public employment but no differential effect is found for municipalities which were audited in 2003 and/or 2004. However, in 2008, the interaction variable has a negative and significant effect of similar magnitude of royalty effect. This imply that the audit process was effective in 2008 in restraining public employment increases since municipalities which received royalties and were audited in 2007 and/or 2008 did not increase the number employees, while the other non-audited oil-rich municipalities enlarged the public sector in that year.

Thus, the results present on this subsection indicate that mayors from oil-rich municipalities used royalty rents to hire tenured employees in the beginning of oil boom and then changed their strategy toward non-tenured employees. In 2008, at least in Rio de Janeiro, some municipalities were constrained to hire more public employees by Tribunal de Contas. These results also suggest that voters from oil-rich municipalities have become more demanding along the years and are no longer satisfied with increases in the public sector. Both the trends in public employment and its composition are consistent with the story that voters appreciate increases in public employment rather than with the clientelistic view that an employment is a type of private transfer to obtain political support. In addition, the result that in 2008 voters punished incumbents who continued to increase the public sector favors the story that voters reward public sector enlargement in 2000 because it was a signal of future improvements in public service. As years passed and municipalities did not experienced improvements in living standards, voters understood that this policy was not effective and ousted incumbents who continued to apply it.

### 5.5.2 Information

The fact that oil royalties create an incumbency advantage in the election after the boom and that this effect disappears along the years is also consistent with an information story. The idea is that voters are not fully informed about the amount of royalties received by the municipality where they live. This revenue enables the mayor to provide a higher level of public goods and since voters do not observe the size of the shock, they interpret any small increase in average public goods supply as higher political ability and reward the incumbent by reappointing him to office. However, as voters become aware about royalty payments, their demand for improvements increase and consequently the level of public goods supply that mayors need to provide to signal high ability. If mayors face a trade-off between divert money for his private use or provide public good and be reelected, the increase in voters awareness can turn the second strategy less attractive due to the increasing difficult in influencing election outcome. Therefore, changes in voters awareness would

decrease reelection probability and increase diversion of public funds.

To conciliate this story with the results presented, we need to provide evidence that voters' awareness increased along the years. In addition, we need to consider that voters interpret increases in public employment as a signal of incumbent's ability since this is the only royalty impact that we found in the data. In the previous section, we found evidence consistent with this second point. We now discuss in what extent voters' awareness have increased along years. Unfortunately, we don't have any objective measure of voters' information about oil windfall that varies over time but we try to circumvent this caveat with alternative evidence.

We believe that the characteristics of Brazilian oil production and royalty distribution rule challenge voters' assessment of royalty value. The lion's share of oil production in Brazil is located offshore and the inland basis is concentrated in one municipality (Macae).Therefore, voters would be unaware of this oil windfall unless this revenue is made public by the media, politicians or informed citizens. Even harder is to voters get informed about the exact amount received. Royalty payments depend on the oil international price, the exchange rate, production and quality levels of each oil well and the proximity to oil fields. Therefore, royalty revenue varies a lot across municipalities and along the years and voters need to update their information frequently. Although they can do that by assessing ANP website, there is evidence, that, at least in the first years of oil boom, awareness level was quite low. A survey carried out on September 2002 in Campos dos Goytacazes, the largest beneficiary of royalty rents, indicates that 58 percent of the respondents are not familiar with the term royalties.[48] For whom that mentioned to know the meaning of royalties, 56 percent pointed out that didn't know how the revenue was invested.

However, we believe that voters' awareness has increased along the years and with the increase in oil windfall. In municipalities where this money represents a key part of total budget, informed citizens, the media, political challengers and think-tanks improved their technologies to disclose information to the median citizen. Local initiatives to disclose information on royalty values have come out since 2004 at least in the largest 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.[49]

Two other facts suggest that voters awareness has increased along the years. One is related to voters and politicians capacity to predict royalty payments. Although most of the municipalities under analysis has produced oil since the mid-1980s, the stake that they get from this production increased dramatically with Oil Law in a way that was difficult to anticipate. Figure 6A shows the real and predict value of royalty payments for 1997-2000 period.[50] This figure shows that

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

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

[50]To predict 1997-2000 royalty payments, we use the royalty payments average annual growth rate from 1994 to 1996

the value received in 1999 and 2000 was much larger than what was possible to predict based on previous revenues. Therefore it was harder for both politicians and voters to estimate royalty rents. However, for 2001-2004 and 2005-2008 periods the previous revenue growth rate were a much better proxy of the following years trends (see Figures 6B and 6C).[51] What we want to emphasize with Figure 6 is that it became easier along the years to predict royalty payments.

In addition, in 2007, a particular event increased the information provided on royalty payments. On 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 strike in 20 years. Two other announcements followed Tupi in early 2008 and the Federal government made a huge propaganda of what was coined pre-sal discoveries, which promise to put Brazil among the five largest oil producers in the World. The promise of a huge windfall stimulated politicians to debate the royalty rule, which was until then considered undebatable by the Federal government.[52] A special concern is to increase the number of beneficiaries states and municipalities since the current rule determine that Rio de Janeiro state and its municipalities receives 43 percent of all oil royalty payments in 2008. In order to follow and stimulate this discussion, newspapers have produced several articles about royalty payments, their beneficiaries and their use. Figure 6 shows the number of articles published with the words 'petróleo" (oil), 'royalties" and 'municípios" (municipalities) published by year since 1998 by Folha de São Paulo and O Globo, two Brazilian major newspapers.[53] We see that the 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 were published about the topic. We believe that this graph indicates that more information was provided to voters in 2008 than in previous elections.

Another way to investigate whether information play a role in voters' decision is to explore variation in media coverage across municipalities. Table 15 shows the effect of the presence of media with local content on 2008 reelection outcome. We regress mayor reelection on royalty payments, a variable indicating whether the municipality has local media and an interaction variable of royalty payments and media dummy. We also include the geographic controls and instrument royalty value and the interaction variable by oil output and oil output interacted with media dummy. Along the columns, we vary the measure of media presence among local radio, television and newspaper.[54] These regressions only include the 77 municipalities (out of 157) for each the measures of media

and them apply this rate using the formula $PredictedRoyalties_{1997} = Royalties_{1996} * (1 + AverageGrowth1994-1996)$ and then $PredictedRoyalties_{t+1} = PredictedRoyalties_{t} * (1 + AverageGrowth1994-1996)$where $t = 1997, 1998, 1999$.

[51]We follow the same procedure described in footnote (50) to predict royalty payments for 2001-2004 using 1997-2000 average real growth rate and then to predict 2005-2008 payments based on 2001-2004 average real growth rate.

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

[53]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.

[54]In column 1, we use the number of local radio stations rather than an indicator variable for whether the municipality has a local station because almost all municipalities have at least one local radio.

presence are available. We observe that mayors from oil-rich municipalities have a lower probability of get reelected when there is a local TV or a local newspaper. Although we don't have information on the content disclosed by these medias, the fact that they are local imply that they have a higher probability of disclosing information on local issues than other state or national medias. The size of royalty payments on oil-rich municipalities budget and the threat of losing this revenue turn royalty rents into an important topic for discussion. Unfortunately, we just have data on local media presence for 2008, which does not allow us to understand how their impact changed over time which is crucial to understand the differential effect of royalty rents on 2000 and 2008 elections. However, Table 15 support the idea that information is crucial for political accountability is oil-rich municipalities.

# 6 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 provide evidence that royalty payments create an incumbency advantage in the two elections that follows oil windfall boom. We estimate that an one-standard-deviation increase in royalty value raises reelection chances by 14 percentage points in 2000 (an increase of 29 percent in reelection chance) and in 18 percentage points in 2004 (37 percent increase). However, we show that this effect disappears in the medium-run, by estimating no incumbency advantage in 2008. We also show that the incumbency advantage estimated for 2000 and 2004 should be explained by the behavior of who are in power since oil rents do not impact political competition or selection. We then investigate how municipalities spend oil windfall. Municipalities use oil windfall to increase the public sector but does not promote large improvements in health and education supply. The only impacts on these two areas that we find is on the number of health and educational professionals. Our estimates indicate an annual average growth of 10 percent in the total number of public employees, which imply that oil-rich municipalities on average multiplied the number of employees by more than two-fold 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 then investigate why voters reelected the incumbents only after the beginning of oil boom and then vote them out. We first analyze whether the enlargement of public sector can explain reelection results. In particular, we investigate when the boost in public sector occurred and whether the municipalities which experienced the larger increases in the public sector are the ones whose voters reappointed the mayor for office with a higher probability. We show that municipalities increased the number of public employees mainly in 1997-2000 and 2001-2004 political mandates but while the first increase was based on more tenured employees, the expansion of the municipal public sector relied on non-tenured jobs in the second political mandate. The efficacy of this

strategy as a way to obtain political support changed over time. While in 2000 voters rewarded the incumbents who created more jobs, in 2008 the mayors who increased tenured employment had a lower reelection probability.

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]. However, our results are not consistent with the mechanisms sketched in Robinson et al. [2006] model, in which politicians distribute public employment in exchange for political support. We don't find evidence that resource abundance increases competition over power as stated by Caselli and 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, although they indicate that Brazilian oil-rich municipalities lost a great opportunity to develop.

In addition to empirically test these papers, we contribute to the literature by comparing short and medium-term effects of oil windfall which are consistent with the following learning story. In 1997-2000 municipalities were surprised by a huge increase in royalty rents. These rents were used to create more public jobs and to substitute non-tenured employment for tenured ones. Voters interpreted public sector enlargement in 2000 as a signal of future improvements in public service provision and reappointed the mayors for office. Oil rents continued to increase along the years but were not translated into improvements in living standards, which led voters to understand that even mayors who promoted increases in public employment were not able politicians and to vote them down. We also show that two institutions were able to constrain the irresponsible use of oil rents. Audits restrained the increase in public employment and local media exerted a pressure on mayors from oil-rich municipalities, who had more difficult in getting reelected.

Thus, our results indicate that oil does not make leaders unaccountable and that a democratic system is crucial to avoid the negative effects of resource abundance. Elections, media presence and constraints on executive are institutions which play an important role in restraining the irresponsible use of oil rents.

## References


D. Acemoglu, J.A. Robinson, and T. Verdier. Kleptocracy and divide and rule: a theory of personal rule. *Journal of the European Economic Association*, 2:162–192, April-May 2004.

ANP. *Anuário Estatístico Brasileiro do Petróleo e do Gás Natural*. ANP, Rio de Janeiro, 2001a.

ANP. *Guia dos Royalties de Petróleo e do Gás Natural*. ANP, Rio de Janeiro, 2001b.

J. Baland and P. Francois. Rent-seeking and resource booms. *Journal of Development Economics*, 61:527–542, April 2000.

R. Barro. Determinants of democracy. *Journal of Political Economy*, 1999.

D. Bregman. Petrobrs e as atividades de explorao e produo no brasil: um breve histrico. In *I Conferência Internacional de História Econômica e III Encontro Nacional de Ps-Graduao em História Econômica. Campinas.*, 2006.

F. Brollo, T. Nannicini, R. Perotti, and G. Tabellini. The political resource curse. *NBER Working Paper No. 5705*, 2010.

F. Caselli. Power struggles and the natural resource curse. 2006.

F. Caselli and T. Cunningham. Leader behaviour and the natural resource curse. *Oxford Economic Papers*, 61:628650, October 2009.

F. Caselli and G. Michaels. Does oil improve living standards? evidence from brazil. *NBER Working Paper No. 15550*, 2009.

P. Collier. *The Bottom Billion - Why the Poorest Countries are Failing and What Can Be Done About It*. Oxford University Press, New York, 2007.

T. Dunning. *Crude Democracy: natural resource wealth and political regimes*. Cambridge University Press, New York, 2008.

The Economist. All this and oil too - god may indeed be brazilian after all. 2007.

T. Gylfason. Natural resources, education and economic development. *European Economic Review*, 45:847–859, May 2001.

S. Haber and V. Menaldo. Do natural resources fuel authoritarianism? a reappraisal of the resource curse. 2010.

N. Jensen and L. Wantchekon. Resource wealth and political regimes in africa. *Comparative Political Studies*, 2004.

P.R. Lane and A. Tornell. Rent-seeking and resource booms. *Journal of Economic Growth*, 1: 213–241, June 1996.

E.E. Leamer, H. Maul, S. Rodriguez, and P.K. Schott. Does natural resource abundance increase latin america inequality. *Journal of Development Economics*, 59:3–42, January 1999.

S. Litschig and K. Morrison. Government spending and re-election. 2010.

G. Michaels. The long term consequences of resource-based specialization. 2009.

Oil and Gas Journal Special. Worldwide production. pages 101–102, December 1999.

J.A. Robinson and T. Verdier. The political economy of clientelism. *unpublished*, 2003.

J.A. Robinson, R. Torvik, and T. Verdier. Political foundations of the resource curse. *Journal of Development Economics*, 2006.

M. Ross. The political economy of the resource curse. *World Politics*, 1999.

M. Ross. Does oil hinder democracy? *World Politics*, 2001.

M. Ross. Oil and democracy revisited. 2009.

R.V. Serra. *Contribuições para o Debate Acerca da Repartição dos Royalties Petrolíferos no Brasil*. PhD thesis, Instituto de Economia -UNICAMP, São Paulo, 2005.

A. Tornell and P.R. Lane. The voracity effect. *The American Economic Review*, 89:22–46, January 1999.

R. Torvik. Natural resources, rent-seeking and welfare. *Journal of Development Economics*, 67: 455–470, April 2002.

K.K. Tsui. More oil, less democracy: evidence from worldwide crude oil discoveries. *Economic Journal*, 2010.

P. Vicente. Does oil corrupt? evidence from a natural experiment in west africa. *Journal of Development Economics*, 2010.

J. Wolfers. Are voters rational? evidence from gubernatorial elections. *Stanford GSB Working Paper 1730*, 2007.

# 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 determines 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 production are benefited by 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 its 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 municipality 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 :

$$royalties_i = \begin{cases} municshare_{Ais} * 0.6 * 0.3 * 0.05 * OutputState \ if \ i \in A = MainProductionZone \\ municshare_{Bis} * 0.2 * 0.3 * 0.05 * OutputState \ if \ i \in B = SecondProductionZone \\ municshare_{Cis} * 0.1 * 0.3 * 0.05 * OutputState \ if \ i \in C = NeighbMunicipalities \end{cases} \tag{4}$$

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 increases the royalty payments from 5% to up to 10% but determine different criteria to distribute the second parcel of royalty payments.[55]

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).[56]

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 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.

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

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

# B 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 information allow us to calculate the production value 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 was 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 to municipalities in order to obtain production values per municipality. We localized the onshore fields by using GIS information provided by ANP's E&P 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 it was not possible 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.[57]

[57]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 producing 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

In order to double check our calculation, we summed 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 by ANP [2001a].

### B.2 Royalty payments

Data on royalty payments made to each municipality is disclosed monthly by ANP from 1999 to 2008 at http://www.anp.gov.br/?pg=9080. Data from 1994 to 1998 was 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.[58] 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 production royalties is the easiest part. By using GIS database provided by BDEP, we could match municipality borders with oil field borders and attribute to each municipality 0.2 x 0.05 x ShareFieldMunicipality x OutputField.[59].

For offshore production 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) and neighboring municipalities and the ones from the same mesoregion to a municipality in the main producing zone (neighboring municipalities).

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 were 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[60] The royalty payments to each municipality within this group was calculated using equation

new names.

[58]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.

[59]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 municipality border.

[60]Note again that the law states that distribution should follow well location rather than the field, which is the

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 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[61] and equation (4).

The list of neighboring municipalities was 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 them 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 have 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.

In order to estimate the effects of royalties on economic and political outcomes, we use a large number of data sources. The identity of municipalities that receive royalties, the value received and the eligibility status of each municipality is available from the National Oil Agency (ANP) from 1999 to 2008.[62] We extend this data in order to be able to include 1996 election in our analysis by

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.

[61]The population size rule can be found at ANP [2001b].

[62]The value of monetary transfers informed by ANP corresponds only to the direct transfers made by Brazil's Treasury to municipalities. Indirect payments related to state quotas and the division of "special fund" are paid to municipalities together with other state and federal transfers according to FPM and ICMS rules and are not reported by ANP.

using the information on total payments to local governments from 1995 to 1998 and the eligibility status in 1999 to estimate the value received by each municipality from 1995 to 1998.[63]

### 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 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 DATA-SUS'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 characteris-

[63] We did the following calculation. We first calculate the percentage value of 1996 total transfers to municipalities in relation to 1999 figures. We assess that in 1996 municipalities received altogether and in real terms 20.78 percent of what they received in 1999. We then input the 1996 royalty revenue of each municipality as the 20.78 percent of its 1999 royalty revenue. The same procedure was used for other years. This calculation is based on the hypothesis that the eligibility status between 1995 and 1998 was the same as in 1999.

tics 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 available and average years of schooling.

**Population estimates.** Inter-census population estimates are available at http://www2.datasus.gov.br/DATA

Table 1 – First-stage

| Dependent variable: | Royalty per capita | | |
|---|---|---|---|
| | All municipalities | Coastal municipalities | Producing municipalities |
| | (1) | (2) | (3) |
| Oil output per capita | 0.028 | 0.028 | 0.027 |
| | (0.002)*** | (0.002)*** | (0.002)*** |
| Observations | 25857 | 1882 | 1486 |
| R-squared | 0.602 | 0.686 | 0.678 |
| Municipalities | 2157 | 157 | 124 |
| F-stat | 252.7 | 234.0 | 241.9 |

Notes: The results presented on columns 1-3 are from regressions that cover 1997-2008 period and include municipal and year effects as controls. Column 1 includes all municipalities from the nine producing states. Column 2 includes coastal municipalities from nine producing states, while column 3 sample is composed by only oil producing municipalities (offshore and onshore). Royalty and oil output data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence. F-stat is the Kleibergen-Paap Wald rk F statistic for a weak instruments test.

Table 2 – 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 | -0.010 | 0.002 | 82.287 | 0.139 |
| with federal govern. | (0.014) | (0.017) | (403.005) | (1.001) |
| Party: PRB | -0.001 | -0.087 | | |
| | (0.043) | (0.042)** | | |
| Party: PDS/PP/PPB | -0.027 | -0.008 | -49.180 | 0.204 |
| | (0.031) | (0.034) | (549.321) | (1.362) |
| Party: PDT | -0.017 | -0.055 | 706.187 | 2.066 |
| | (0.036) | (0.037) | (504.605) | (1.226)* |
| Party: PTB | -0.017 | -0.043 | 59.828 | 0.480 |
| | (0.040) | (0.033) | (475.571) | (1.156) |
| Party: PMDB | -0.033 | -0.045 | 133.891 | 0.958 |
| | (0.034) | (0.033) | (442.734) | (1.078) |
| Party: PDC | -0.026 | 0.019 | 321.489 | 0.421 |
| | (0.034) | (0.050) | (360.096) | (0.902) |
| Party: PL/PR | -0.025 | -0.010 | 266.030 | 0.989 |
| | (0.033) | (0.044) | (488.346) | (1.109) |
| Party: PPS | 0.031 | 0.045 | 420.283 | 1.026 |
| | (0.063) | (0.050) | (475.802) | (1.291) |
| Party: PFL/DEM | -0.008 | -0.009 | -5.763 | 0.217 |
| | (0.033) | (0.031) | (468.849) | (1.129) |
| Party: PMN | 0.102 | -0.006 | 532.336 | 1.526 |
| | (0.102) | (0.062) | (453.294) | (1.219) |
| Party: PRN | 0.235 | -0.018 | -475.283 | -1.249 |
| | (0.186) | (0.038) | (508.646) | (1.320) |
| Party: PSB | -0.064 | -0.046 | -684.493 | -1.553 |
| | (0.039) | (0.039) | (547.628) | (1.372) |
| Party: PSD | 0.007 | 0.006 | -52.533 | 0.251 |
| | (0.056) | (0.039) | (508.646) | (1.320) |
| Party: PV | -0.049 | -0.190 | | |
| | (0.032) | (0.034)*** | | |
| Party: PSDB | -0.002 | -0.012 | -260.437 | -0.441 |
| | (0.030) | (0.031) | (470.004) | (1.191) |
| Party: Pc do B | -0.074 | -0.149 | | |
| | (0.065) | (0.048)*** | | |
| Observations | 2155 | 2155 | 69 | 69 |
| Municipalities | 133 | 133 | 43 | 43 |

Notes: This table report regressions 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 border 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 1993-2008 period 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, year effects. Columns 1 and 2 also include municipal fixed effects. The omitted party is PT, the labor party and the one who 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 its borders (onshore and offshore) between 1993 and 2008. Regressions present in columns 3 and 4 include only municipalities who had an oil field discovered within their border in the respective year between 1993 and 2008. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 3 – Royalty Summary Statistics

| | All producing municipalities | Producing municipalities on the coast | Non-producing municipalities |
|---|---|---|---|
| Number of municipalities | | | |
| 1996 | 103 | 56 | 2,050 |
| 2000 | 106 | 60 | 2,053 |
| 2004 | 106 | 60 | 2,053 |
| 2008 | 123 | 71 | 2,036 |
| Average royalties per capita (R$) | | | |
| 1997-2000 | 133 | 189 | 2 |
| 2001-2004 | 375 | 545 | 6 |
| 2005-2008 | 478 | 697 | 10 |
| Standard-deviation (R$) | | | |
| 1997-2000 | 346 | 451 | 22 |
| 2001-2004 | 838 | 1,070 | 44 |
| 2005-2008 | 1,026 | 1,300 | 61 |
| Royalties / Municipal revenue | | | |
| 1997-2000 | 9.0% | 10.9% | 0.2% |
| 2001-2004 | 15.4% | 18.0% | 0.4% |
| 2005-2008 | 14.6% | 18.0% | 0.6% |

Table 4 – Municipal Characteristics

| | All municipalities in producing states | | | Coastal municipalities in producing states | | |
|---|---|---|---|---|---|---|
| | Producers | Non-producers | Dif. | Producers | Non-producers | Dif. |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Number of municipalities** | 103 | 2050 | | 56 | 103 | |
| **Socio-demographic characteristics** | | | | | | |
| Level 1991 | | | | | | |
| Population | 68,214 | 37,138 | | 104,911 | 138,673 | |
| % urban population | 0.65 | 0.56 | *** | 0.68 | 0.63 | |
| Average years of schooling | 3.16 | 3.07 | | 3.49 | 3.35 | |
| % of illiterate (pop with > 25 years) | 0.41 | 0.37 | ** | 0.37 | 0.39 | |
| Household income per capita | 105 | 136 | *** | 125 | 137 | |
| Poverty rate | 65 | 55 | *** | 60 | 58 | |
| Gini index | 0.53 | 0.52 | * | 0.54 | 0.52 | ** |
| Human Development Index | 0.58 | 0.61 | *** | 0.60 | 0.60 | |
| Infant mortality | 0.09 | 0.07 | *** | 0.08 | 0.08 | |
| % of households with electricity | 0.81 | 0.77 | | 0.82 | 0.78 | |
| % of households with piped water | 0.48 | 0.59 | *** | 0.53 | 0.53 | |
| Variation between 1991-2000 | | | | | | |
| Population | 0.21 | 0.10 | *** | 0.28 | 0.29 | |
| % urban population | 0.15 | 0.21 | | 0.09 | 0.18 | |
| Average years of schooling | 0.43 | 0.43 | | 0.42 | 0.46 | |
| % of illiterate (pop with > 25 years) | -0.29 | -0.29 | | -0.31 | -0.32 | |
| Household income per capita | 0.34 | 0.38 | | 0.37 | 0.41 | |
| Poverty rate | -0.16 | -0.18 | | -0.19 | -0.14 | * |
| Gini index | 0.06 | 0.08 | | 0.06 | 0.12 | *** |
| Human Development Index | 0.17 | 0.15 | * | 0.16 | 0.18 | |
| Infant mortality | -0.31 | -0.37 | *** | -0.33 | -0.33 | |
| % of households with electricity | 0.19 | 0.26 | * | 0.21 | 0.20 | |
| % of households with water connection | 0.66 | 1.65 | | 0.67 | 0.79 | |
| Level 1997 | | | | | | |
| Number of public employees per 1000 habitants | 24.1 | 23.8 | | 21.0 | 20.7 | |
| Budget revenue net of royalties (R$ per capita) | 708 | 686 | | 831 | 689 | |
| % educational expenses on total budget | 0.27 | 0.27 | | 0.27 | 0.25 | |
| % health expenses on total budget | 0.15 | 0.17 | ** | 0.14 | 0.16 | |
| **Political characteristics (1996)** | | | | | | |
| Party reelection | 0.27 | 0.21 | | 0.27 | 0.18 | |
| Number of candidates | 3.81 | 2.99 | *** | 4.09 | 4.35 | |
| Effective number of candidates | 2.43 | 2.22 | *** | 2.45 | 2.42 | |
| Margin of victory | 0.14 | 0.17 | * | 0.14 | 0.18 | |
| Candidates's average years of schooling | 12.1 | 11.7 | | 11.9 | 11.8 | |
| % candidates with college degree | 0.37 | 0.37 | | 0.37 | 0.35 | |
| **Geographic Characteristics** | | | | | | |
| Latitude | -11.4 | -17.3 | *** | -13.0 | -14.8 | |
| Longitude | 38.5 | 44.7 | *** | 39.5 | 40.0 | |
| Altitude | 48.4 | 432.6 | *** | 22.3 | 20.2 | |
| Distance to state capital | 100.9 | 260.0 | *** | 105.5 | 119.2 | |

Notes: This table presents a comparison of the mean socio-demographic, political and geographic characteristics of oil producing and non-producing municipalities. Columns 1-2 compare all municipalities from the nine producing states under analysis (CE, RN, AL, SE, BA, ES, RJ, SP and PR) and columns 4-5 compare coastal municipalities from these states. Column 3 (6) indicates whether the difference between columns 1-2 (4-5) is significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 5 – Oil Output Impact on Economic Activity

| | Log population | Number of firms pc | | | | Number of private company employees pc | Public payroll pc | Private payroll pc | GDP pc | Non-industrial GDP pc |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Manufacturing | Trade | Services | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| **All municipalities in producing states** | | | | | | | | | | |
| Oil output pc | 0.0169 | 1.229 | -0.073 | -0.054 | 0.973 | 0.098 | 0.398 | 0.141 | 0.512 | -0.004 |
| | (0.00821)** | (1.510) | (0.079) | (0.519) | (1.032) | (0.114) | (0.108)*** | (0.135) | (0.034)*** | (0.007) |
| Observations | 25857 | 25857 | 25857 | 25857 | 25857 | 21556 | 21556 | 21556 | 19399 | 19399 |
| R-squared | 0.17 | 0.353 | 0.090 | 0.492 | 0.214 | 0.068 | 0.458 | 0.058 | 0.150 | 0.114 |
| Municipalities | 2157 | 2157 | 2157 | 2157 | 2157 | 2157 | 2157 | 2157 | 2157 | 2157 |
| **Coastal municipalities** | | | | | | | | | | |
| Oil output pc | 0.0009 | 2.452 | 0.124 | 1.049 | 0.969 | 0.161 | 0.279 | 0.212 | 0.502 | -0.008 |
| | (0.0056) | (1.741) | (0.099) | (0.639) | (1.117) | (0.130) | (0.074)*** | (0.151) | (0.036)*** | (0.010) |
| Observations | 1882 | 1882 | 1882 | 1882 | 1882 | 1569 | 1569 | 1569 | 1412 | 1412 |
| R-squared | 0.5 | 0.288 | 0.081 | 0.355 | 0.198 | 0.072 | 0.367 | 0.063 | 0.456 | 0.108 |
| Municipalities | 157 | 157 | 157 | 157 | 157 | 157 | 157 | 157 | 157 | 157 |
| **Producing municipalities** | | | | | | | | | | |
| Oil output pc | 0.0037 | 2.263 | 0.097 | 0.795 | 1.032 | 0.155 | 0.291 | 0.189 | 0.497 | -0.006 |
| | (0.0058) | (1.592) | (0.095) | (0.563) | (1.030) | (0.127) | (0.083)*** | (0.146) | (0.036)*** | (0.012) |
| Observations | 1486 | 1486 | 1486 | 1486 | 1486 | 1239 | 1239 | 1239 | 1115 | 1115 |
| R-squared | 0.51 | 0.359 | 0.151 | 0.398 | 0.172 | 0.128 | 0.402 | 0.091 | 0.523 | 0.107 |
| Municipalities | 124 | 124 | 124 | 124 | 124 | 124 | 124 | 124 | 124 | 124 |

Notes: Panel A regressions include all municipalities from the nine producing states. Panel B includes coastal municipalities from nine producing states., while panel C sample is composed by only oil producing municipalities. All regressions exclude the municipalities on the top 1% of royalty distribution (Quissama and Rio das Ostras). The results presented on columns 1-6 are from regressions that cover 1997-2008 period. Columns 7-9 include 1999-2008 years, while columns 10-11 cover 1999-2007 period. All regressions include municipal and year effects as controls. All measures are in per capita terms. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 6 – Reelection Effects

| | Mayor reelection | | | Party reelection | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Royalties pc 1996 | | | | 0.46 | 2.20 | 2.47 |
| | | | | (0.82) | (2.00) | (2.30) |
| Royalties pc 2000 | 0.34 | 0.53 | 0.68 | 0.43 | 0.75 | 0.79 |
| | (0.11)*** | (0.14)*** | (0.26)*** | (0.11)*** | (0.27)*** | (0.33)** |
| Royalties pc 2004 | 0.39 | 0.36 | 0.64 | 0.23 | 0.29 | 0.30 |
| | (0.12)*** | (0.13)*** | (0.17)*** | (0.09)*** | (0.15)* | (0.18)* |
| Royalties pc 2008 | 0.04 | 0.07 | 0.03 | -0.01 | 0.03 | 0.04 |
| | (0.07) | (0.08) | (0.12) | (0.04) | (0.07) | (0.09) |
| Instrumented? | No | Yes | Yes | No | Yes | Yes |
| City effects | No | No | Yes | No | No | Yes |
| Geographical characteristics | Yes | Yes | No | Yes | Yes | No |
| Year effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 353 | 353 | 352 | 590 | 590 | 590 |
| Municipalities | 157 | 157 | 156 | 157 | 157 | 157 |

Notes: This table reports the effects of royalty payments on mayor and party reelection in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). These regressions exclude the municipalities on the top 1% of royalty distribution (Quissama and Rio das Ostras). Royalties are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. Columns (1) and (4) controls for year effects, state fixed effects and municipality 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 (2) and (5) controls for year effects, municipal characteristics and state fixed effects and use oil output as an instrument for royalty payments. Columns (3) and (6) are also panel IV regressions which control for municipal effects, year effects and population. Columns (1) to (3) cover three municipal elections (2000, 2004 and 2008) and consider only municipalities where the mayor is in his first-term. Column (4) to (6) cover four municipal elections (1996, 2000, 2004 and 2008). There is no information on 1996 election for Espirito Santo state and for most of Rio Grande do Norte's municipalities. For municipalities created between 1993 and 2001, we use information on the party in power on the origin municipality to construct party reelection. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 7 – Political Competition and Selection

| | Competition | | | Opponents' characteristics | | |
|---|---|---|---|---|---|---|
| | Number of candidates | Effective number of candidates | Incumbent margin of victory | Years of schooling | College degree | High-skilled occupation |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Royalties pc 2000 | -0.39 | -0.31 | 0.19 | -0.49 | -0.03 | -0.11 |
| | (0.36) | (0.12)*** | (0.06)*** | (1.12) | (0.15) | (0.20) |
| Royalties pc 2004 | -0.11 | -0.37 | -0.07 | 0.40 | 0.06 | 0.01 |
| | (0.24) | (0.15)** | (0.05) | (0.73) | (0.08) | (0.08) |
| Royalties pc 2008 | 0.33 | -0.03 | 0.01 | 0.01 | 0.04 | 0.06 |
| | (0.29) | (0.07) | (0.04) | (0.22) | (0.04) | (0.04) |
| Observations | 350 | 350 | 271 | 350 | 351 | 348 |
| Municipalities | 157 | 157 | 155 | 157 | 157 | 157 |

Notes: This table reports the effects of royalty payments on political competition and selection in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). All regressions exclude the municipalities on the top 1% of royalty distribution (Quissamã and Rio das Ostras). Royalty value is instrumented by oil output. Both values are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. All the regression s are conditional on mayor being in his first-term and control for population and year effects. Column 1 dependent variable is the number of candidates who run for mayor. Column 2 dependent variable is the effective number of candidates who run for mayor, which is computed by dividing one by the Herfindahl index. Column 3 dependent variable is the incumbent's margin of victory, which is the difference in vote-share between the incumbent who if running for reelection and the closest opponent. Column 3 only considers municipalities whose mayors ran for reelection. Columns 4-6 considers average opponents' characteristics. High skilled occupation in column 6 refers to the percentage of candidates that have a high skilled occupation before running for mayor. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 8– Municipal Revenue

| | Total revenue pc | Tax revenue pc | FPM transfers pc | FUNDEF transfers pc |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **A- R$ per capita** | | | | |
| Royalties pc | 1.13 | 0.06 | -0.01 | -0.01 |
| | (0.04)*** | (0.01)*** | (0.01) | (0.01) |
| Observations | 1620 | 1619 | 1620 | 1354 |
| Municipalities | 157 | 157 | 157 | 157 |
| Y mean | 1.23 | 0.20 | 0.22 | 0.16 |
| **B - Share of total revenue** | | | | |
| Royalties pc | | 0.0005 | -0.04 | -0.03 |
| | | (0.005) | (0.01)*** | (0.01)*** |
| Observations | | 1619 | 1620 | 1354 |
| Municipalities | | 157 | 157 | 157 |
| Y mean | | 0.14 | 0.25 | 0.15 |

Notes: This table reports the effects of royalty payments on public revenues in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). These regressions exclude the municipalities on the top 1% of royalty distribution (Quissama and Rio das Ostras) and include only municipalities which report most of revenues and expenses. In all regressions, royalty value is instrumented by oil output and population, year and municipal effects are used as controls. All regressions cover 1997-2008 period. On Panel A, dependent variables are measured in R$ 1000 per capita and on Panel B they are computed as a share of total revenue. Royalty data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. On column 3, FPM stands for Fundo de Participação dos Municípios . FPM is the most important transfer to municipalities in Brazil. FUNDEF on 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 by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 9 – Municipal Expenses

| | Current expenses pc | Payroll pc | Other labor and service contracts pc | Invest-ment pc | Debt amortization pc | Administration and planning pc | Education and culture pc | Health and sanitation pc | Housing and urbanization pc |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| **A- R$ per capita** | | | | | | | | | |
| Royalties pc | 0.63 | 0.19 | 0.20 | 0.23 | 0.01 | 0.21 | 0.17 | 0.17 | 0.18 |
| | (0.13)*** | (0.04)*** | (0.04)*** | (0.04)*** | (0.01) | (0.06)*** | (0.02)*** | (0.04)*** | (0.03)*** |
| Observations | 1620 | 1619 | 934 | 1620 | 1469 | 1620 | 1620 | 1620 | 1620 |
| Municipalities | 157 | 157 | 154 | 157 | 157 | 157 | 157 | 157 | 157 |
| Y mean | 1.04 | 0.48 | 0.41 | 0.16 | 0.02 | 0.27 | 0.35 | 0.24 | 0.18 |
| **B - Share of total revenue** | | | | | | | | | |
| Royalties pc | -0.05 | -0.06 | -0.00 | 0.02 | -0.00 | 0.00 | -0.03 | -0.01 | 0.02 |
| | (0.02)*** | (0.01)*** | (0.01) | (0.01)** | (0.00) | (0.01) | (0.01)*** | (0.00)** | (0.01)* |
| Observations | 1620 | 1619 | 934 | 1620 | 1469 | 1620 | 1620 | 1620 | 1620 |
| Municipalities | 157 | 157 | 154 | 157 | 157 | 157 | 157 | 157 | 157 |
| Y mean | 0.86 | 0.39 | 0.28 | 0.12 | 0.02 | 0.21 | 0.31 | 0.19 | 0.14 |

Notes: This table reports the effects of royalty payments on public expenses in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). These regressions exclude the municipalities on the top 1% of royalty distribution (Quissama and Rio das Ostras) and include only municipalities which report most of revenues and expenses. In all regressions, royalty value is instrumented by oil output and population, year and municipal effects are used as controls. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence. All regressions cover 1997-2008 period. On Panel A, dependent variables are measured in R$ 1000 per capita and on Panel B they are computed as a share of total revenue. Royalty data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. Current expenses include all direct and indirect labor cost, interest payments and other current expenses. Payroll expenses include direct labor expenses, payroll taxes, outsourced labor and other labor expenses, and do not include pensions. Other labor and service contracts include consulting services, outsourced services and labor hired on a temporarily basis (locação de mão-de-obra + contrato por tempo determinado). Payroll (column 3) and other labor and service contracts (column 4) are subdivisions of current expenses (column 2).

Table 10 – Public Employment

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Number of employees 9/30 | Relative wage (public/private) | Number of employees 12/31 | Number of employees with tenure 31/12 | Number of employees without tenure 31/12 | Percentage of employees with college degree | Number of teachers 31/12 | Number of physicians 31/12 |
| Royalties pc | 7.24 | 0.06 | 6.41 | 0.85 | 5.53 | -0.02 | 0.91 | 0.70 |
| | (1.44)*** | (0.06) | (1.70)*** | (2.83) | (3.40) | (0.01) | (0.47)* | (0.18)*** |
| Observations | 1804 | 1519 | 1804 | 1804 | 1804 | 838 | 1524 | 1524 |
| Municipalities | 157 | 157 | 157 | 157 | 157 | 157 | 157 | 157 |

Notes: This table reports the effects of royalty payments on municipal public employment in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). These regressions exclude the municipalities on the top 1% of royalty distribution (Quissama and Rio das Ostras). In all regressions, royalty value is instrumented by oil output and population, year and municipal effects are used as controls. 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 2008 values. All employment variables are measured in per 1000 habitants. Columns 1, 3, 4 and 5 cover 1997 -2008 period and regressions on columns 2, 7 and 8 include 1999- 2008 years. The dependent variable in column 6 is from “Perfil dos Municipios Brasileiros: Gestao Publica" database and cover 1999, 2001, 2002, 2004, 2005, 2006 and 2008. Number of employees in column 1 relates to all employees hired by the local municipality on September 30th. Average relative wage is the ratio between public and private sector wages. Number of employees in column 3 indicates employment level on December 31st . Columns 4-5 and 7-8 are subdivisions of column 3. Teachers in column 7 include all professionals hired by local authorities who teach in any educational grade. It includes professionals with different levels of education and school inspectors. Health professionals in column 8 refer to any professional hired by local authorities who provide medical services. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 11 - Education Supply

| | Schools per young habitants* | School enrollment per young habitants* | Number of teachers with college degree | Hours of school per day | Percentage of studends with slow school progress | School dropout** |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Annual data** | | | | | | |
| **A** | 1999-2006 | | | 1996-2006 | | 1996-2005 |
| Royalties pc | 0.08 | 25.76 | -0.36 | -0.02 | -0.80 | -2.46 |
| (2 years lag) | (0.16) | (24.18) | (4.93) | (0.03) | (1.93) | (1.54) |
| Observations | 1254 | 1254 | 1521 | 1696 | 1552 | 1540 |
| Municipalities | 157 | 157 | 157 | 157 | 157 | 157 |
| **Long-differences** | | | | | | |
| **B** | 1999-2006 | | | 1996-2006 | | 1996-2005 |
| Royalties pc | 0.04 | 18.04 | -1.24 | -0.14 | 1.29 | -0.98 |
| | (0.16) | (24.36) | (3.76) | (0.06)** | (1.16) | (1.12) |
| Observations | 312 | 312 | 278 | 280 | 282 | 282 |
| Municipalities | 156 | 156 | 139 | 140 | 141 | 141 |
| **C** | 1999-2000 | | | 1996-2000 | | |
| Royalties | 0.01 | -30.90 | 0.98 | -0.09 | -8.56 | -4.14 |
| | (0.44) | (106.17) | (5.15) | (0.13) | (4.28)** | (6.57) |
| Observations | 312 | 312 | 278 | 280 | 282 | 282 |
| Municipalities | 156 | 156 | 139 | 140 | 141 | 141 |
| **D** | | | 2000-2004 | | | |
| Royalties | -0.27 | 21.46 | 7.13 | -0.01 | 2.92 | -4.18 |
| | (0.43) | (24.46) | (18.43) | (0.03) | (2.48) | (5.55) |
| Observations | 314 | 314 | 256 | 314 | 314 | 314 |
| Municipalities | 157 | 157 | 128 | 157 | 157 | 157 |
| **E** | | | 2004-2006 | | | |
| Royalties | -0.07 | -22.25 | -68.73 | -0.04 | 3.37 | |
| | (0.05) | (18.38) | (54.81) | (0.03) | (2.73) | |
| Observations | 314 | 314 | 256 | 314 | 314 | |
| Municipalities | 157 | 157 | 128 | 157 | 157 | |

Notes: This table reports the effects of royalty payments on public expenses in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). These regressions exclude the municipalities on the top 1% of royalty distribution (Quissama and Rio das Ostras). In all regressions, royalty value is instrumented by oil output and population, year and municipal effects are used as controls. The period covered in each regression is indicated on the columns. Royalty and oil data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence. Robust standard errors clustered by municipalities are reported in parentheses.

Table 12 - Health Supply

| | Municipal clinics per 100,000 hab | Municipal hospitals per 100,000 hab |
|---|---|---|
| | (1) | (3) |
| **Annual data** | | |
| A 1998-2008 | | |
| Royalties (2 years lag) | 1.03 | -0.58 |
| | (1.99) | (0.66) |
| Observations | 1205 | 1205 |
| Municipalities | 156 | 156 |
| **Long-differences** | | |
| B 1998-2000 | | |
| Royalties pc | 6.73 | -0.84 |
| | (4.90) | (0.81) |
| Observations | 276 | 276 |
| Municipalities | 138 | 138 |
| C 2000-2002 | | |
| Royalties pc | 2.80 | 0.28 |
| | (4.26) | (0.22) |
| Observations | 312 | 312 |
| Municipalities | 156 | 156 |
| D 2006-2008 | | |
| Royalties pc | -4.85 | -0.15 |
| | (7.95) | (0.13) |
| Observations | 288 | 288 |
| Municipalities | 144 | 144 |

Notes: This table reports the effects of royalty payments on public expenses in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). The regressions exclude the three largest beneficiaries of royalty revenue (Quissama, Rio das Ostras and Carapebus). In all regressions, royalty value is instrumented by oil output and population, year and municipal effects are used as controls. Regressions on Panel A are based on annual data from 1998 to 2002 plus 2006 to 2008. On Panels C-D we consider long differences between the years indicated. Royalty and oil data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. Health clinics are the sum of `unidades basicas de saude' and `postos de saude'. Hospital units include `Ambulatório de Unidade Hospitalar Geral' and `Ambulatório 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. Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 13 – Public employment and elections

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| A- Dependent variable: | Municipal employees 1998 - 2000 | | | Municipal employees 2002 - 2004 | | | Municipal employees 2006 - 2008 | | |
| | Total | Tenured | % tenured | Total | Tenured | % tenured | Total | Tenured | % tenured |
| Royalties pc | 10.33 | 19.01 | 0.23 | 10.63 | 0.21 | -0.11 | -2.01 | -4.07 | -0.05 |
| | (4.49)** | (7.15)*** | (0.11)** | (1.47)*** | (0.87) | (0.05)** | (2.60) | (3.11) | (0.05) |
| Observations | 274 | 274 | 274 | 146 | 146 | 146 | 232 | 232 | 232 |
| Municipalities | 137 | 137 | 137 | 73 | 73 | 73 | 116 | 116 | 116 |
| F-stat | 26.77 | 26.77 | 26.77 | 63602 | 63602 | 63602 | 21.23 | 21.23 | 21.23 |
| B - Dependent variable: | Mayor reelection 2000 | | | Mayor reelection 2004 | | | Mayor reelection 2008 | | |
| Total employees pc | 0.06 | | | 0.01 | | | -0.10 | | |
| (2 years change) | (0.03)** | | | (0.01) | | | (0.07) | | |
| Tenured employees pc | | 0.04 | | | -0.22 | | | -0.08 | |
| (2 years change) | | (0.02)** | | | (0.50) | | | (0.04)** | |
| % of tenured employees | | | 3.86 | | | -1.00 | | | -9.15 |
| (2 years change) | | | (2.89) | | | (0.76) | | | (8.89) |
| Observations | 137 | 137 | 137 | 73 | 73 | 73 | 116 | 116 | 116 |
| F-stat | 5.733 | 5.289 | 1.651 | 8.897 | 0.178 | 5.229 | 3.194 | 4.799 | 0.850 |

Notes: Panel A reports the effects of royalty payments on municipal public employment . The dependent variable is the total number of public employees per 1000 habitants on columns 1,3 and 6; total number of tenured employees per 1000 habitants on column s 2, 4 and 7 and the percentage of tenured employees on total employment on columns 3, 6 and 9. All employment measures are from September 30$^{th}$ of the years indicated on the columns. 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 2008 values. Population, municipal fixed effects and year dummies are included as controls and royalty value is instrumented by oil output. Robust standard errors clustered by municipalities are reported in parentheses. Panel B reports regressions coefficients of a dummy variable indicating whether the mayor was reelected on two-year change of municipal employment instrumented by two-year change of oil output. These regressions use as controls year effects, state fixed effects and

municipality 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).
The sample used in both panels include municipalities whose mayor is on his first-term. We consider only municipalities from the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR) and exclude the municipalities on the top 1% of royalty distribution (Quissama and Rio das Ostras). Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence. F-stat is the Kleibergen-Paap Wald rk F statistic for a weak instruments test.

Table 14 – Audits

| Dependent variable: | Number of employees pc | |
|---|---|---|
| | 2004 | 2008 |
| | (1) | (2) |
| Royalties pc | 25.11 | 23.97 |
| | (12.65)** | (5.47)*** |
| Royalties pc * audit | 2.72 | -21.58 |
| | (23.69) | (5.70)*** |
| Audit | -3.77 | 17.50 |
| | (4.61) | (6.89)** |
| Observations | 88 | 88 |
| R-squared | 0.53 | 0.57 |
| F-stat | 37.41 | 87.00 |

Notes: This table reports the effects of royalty payments and audits on municipal public employment . The dependent variable is the total number of public employees per 1000 habitants on September 30$^{th}$ of the years indicated on the columns. 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 are the value received in the contemporaneous year, are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. The sample includes only Rio de Janeiro municipalities. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence. F-stat is the Kleibergen-Paap Wald rk F statistic for a weak instruments test.

Table 15 – Local media presence

| Dependent variable: | Mayor Reelection 2008 | | |
|---|---|---|---|
| Media: | Number of local radio stations | Local TV | Local newspaper |
| | (1) | (2) | (3) |
| Royalties pc | 0.18 | 0.19 | 0.17 |
| | (0.15) | (0.15) | (0.18) |
| Royalties pc * media | -0.02 | -0.26 | -0.29 |
| | (0.02) | (0.16)* | (0.19) |
| Media | 0.04 | 0.09 | 0.06 |
| | (0.03) | (0.23) | (0.20) |
| Y mean | 3.5 | 0.18 | 0.34 |
| Observations | 77 | 77 | 77 |
| R-squared | 0.17 | 0.17 | 0.17 |
| F-stat | 8.04 | 9.48 | 7.01 |

Notes: This table reports the effects of royalty payments and local media presence on municipal public employment . The dependent variable is a dummy indicating whether the mayor was reelected in 2008. In column 1, media is the number of local radio stations. In column 2, media is a dummy variable indicating whether the municipality has a television channel with local transmission, while column 3 media variable is a dummy indicating whether the municipality has a local newspaper. These regressions use as controls 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). We instrument royalty value and the interaction variable by oil output and oil output interacted with media dummy. 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 2008 values. The sample includes only 77 municipalities from the 157 coastal municipalities for each the media information is available. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence. F-stat is the Kleibergen-Paap Wald rk F statistic for a weak instruments test.

Annex 1 – Robustness of Reelection Results

| | Mayor reelection | | | Party reelection | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **All municipalities in producing states** | | | | | | |
| Royalties pc 1996 | | | | 0.82 | 1.53 | 2.61 |
| | | | | (0.64) | (1.06) | (1.73) |
| Royalties pc 2000 | 0.33 | 0.32 | 0.51 | 0.46 | 0.66 | 0.80 |
| | (0.10)*** | (0.13)** | (0.32)* | (0.10)*** | (0.15)*** | (0.31)*** |
| Royalties pc 2004 | 0.55 | 0.44 | 0.81 | 0.25 | 0.29 | 0.37 |
| | (0.14)*** | (0.18)** | (0.27)*** | (0.08)*** | (0.10)*** | (0.17)** |
| Royalties pc 2008 | -0.02 | -0.03 | -0.10 | -0.01 | -0.00 | 0.04 |
| | (0.07) | (0.08) | (0.16) | (0.04) | (0.05) | (0.08) |
| Observations | 4995 | 4995 | 4998 | 8320 | 8320 | 8338 |
| Municipalities | 2151 | 2151 | 2145 | 2151 | 2151 | 2157 |
| **Producing municipalities** | | | | | | |
| Royalties pc 1996 | | | | 0.14 | 1.62 | 2.52 |
| | | | | (0.79) | (1.43) | (1.96) |
| Royalties pc 2000 | 0.35 | 0.33 | 0.42 | 0.45 | 0.60 | 0.75 |
| | (0.13)*** | (0.17)* | (0.28) | (0.10)*** | (0.19)*** | (0.30)** |
| Royalties pc 2004 | 0.46 | 0.49 | 0.74 | 0.22 | 0.27 | 0.36 |
| | (0.16)*** | (0.24)** | (0.30)** | (0.09)** | (0.13)** | (0.18)** |
| Royalties pc 2008 | 0.03 | 0.02 | -0.04 | -0.03 | 0.00 | 0.05 |
| | (0.09) | (0.11) | (0.14) | (0.05) | (0.06) | (0.08) |
| Observations | 280 | 280 | 280 | 471 | 471 | 471 |
| Municipalities | 124 | 124 | 124 | 124 | 124 | 124 |
| Instrumented? | No | Yes | Yes | No | Yes | Yes |
| Year effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality effects | No | No | Yes | No | No | Yes |
| Municipality characteristics | Yes | Yes | No | Yes | Yes | No |

Notes: This table reports the effects of royalty payments on mayor and party reelection. Panel A includes all municipalities from the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). Panel 2 considers only offshore and onshore oil producing municipalities. In both panels, we exclude the municipalities on

the top 1% of royalty distribution (Quissama and Rio das Ostras). Robust standard errors clustered by municipalities are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence. Royalties are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. Odd columns show the average effect for all the elections on the sample and even columns let the coefficient vary per election. Columns (1) and (3) controls for year effects, 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 (2) and (5) controls for year effects, municipal characteristics and state fixed effects and use oil output as an instrument for royalty payments. Columns (3) and (6) are also panel IV regressions which control for municipal effects, year effects and population. Columns (1) to (3) cover three municipal elections (2000, 2004 and 2008) and consider only municipalities where the mayor is in his first-term. Column (4) to (6) cover four municipal elections (1996, 2000, 2004 and 2008). There is no information on 1996 election for Espirito Santo state and for most of Rio Grande do Norte's municipalities. For municipalities created between 1993 and 2001, we use information on the party in power on the origin municipality to construct party reelection.

Annex 2 –Robustness Checks

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Sample | Coastal municipalities | All municipalities | Producing municipalities | Coastal municipalities |
| Outliers | No | No | No | Yes |
| **Public Employment** | | | | |
| Number of employees on 9/30 | 7.24 | 11.23 | 7.62 | 4.60 |
| (RAIS corrected) | (1.44)*** | (2.30)*** | (1.67)*** | (1.07)*** |
| Number of employees on 9/30 | 6.74 | 10.84 | 7.09 | 4.32 |
| (RAIS uncorrected) | (1.42)*** | (2.21)*** | (1.69)*** | (1.04)*** |
| Number of employees on 12/31 | 6.41 | 9.90 | 7.35 | 4.27 |
| (RAIS corrected) | (1.70)*** | (2.58)*** | (2.07)*** | (0.98)*** |
| Number of employees on 12/31 | 5.92 | 9.53 | 6.85 | 3.99 |
| (RAIS uncorrected) | (1.63)*** | (2.48)*** | (2.00)*** | (0.94)*** |
| Number of employees with tenure | 0.85 | 2.88 | 0.27 | 0.57 |
| on 12/31 | (2.83) | (2.87) | (3.03) | (1.92) |
| Number of employees without | 5.53 | 7.01 | 7.03 | 3.68 |
| tenure on 12/31 | (3.40) | (3.61)* | (3.89)* | (1.85)** |
| Percentage of employees with | -0.02 | -0.02 | -0.01 | -0.02 |
| college degree | (0.01) | (0.01) | (0.01) | (0.01)** |
| Number of teachers 31/12 | 0.91 | 1.44 | 1.44 | 0.06 |
| | (0.47)* | (0.54)*** | (0.55)*** | (0.83) |
| Number of physicians 31/12 | 0.70 | 0.77 | 0.51 | 0.33 |
| | (0.18)*** | (0.17)*** | (0.21)** | (0.27) |
| Number of employess | 6.87 | 7.85 | 6.54 | 5.44 |
| (MUNIC) | (1.94)*** | (2.08)*** | (1.85)*** | (1.12)*** |
| Relative wage | 0.06 | 0.07 | 0.03 | 0.09 |
| | (0.06) | (0.06) | (0.07) | (0.04)** |
| **Education supply** | | | | |
| Schools per young habitants | 0.08 | 0.50 | 0.18 | 0.09 |
| | (0.16) | (0.15)*** | (0.16) | (0.04)** |
| School enrollment per young | | | | |
| habitants* | 25.76 | 22.94 | 40.99 | 9.23 |
| | (24.18) | (22.66) | (26.73) | (12.67) |
| Number of teachers with college | | | | |
| degree | -0.36 | 5.81 | 8.09 | 0.30 |
| | (4.93) | (4.77) | (6.01) | (1.18) |
| Hours of school per day | -0.02 | -0.06 | -0.05 | -0.03 |
| | (0.03) | (0.06) | (0.06) | (0.01)*** |
| Percentage of students with slow | | | | |
| school progress | -0.80 | -5.24 | -0.40 | -0.06 |
| | (1.93) | (2.01)*** | (1.96) | (0.57) |
| School dropout | -2.46 | -3.08 | -0.85 | -1.20 |
| | (1.54) | (1.32)** | (1.68) | (0.50)** |
| **Health supply** | | | | |
| Municipal clinics per 100,000 hab | 1.51 | 0.20 | 0.05 | -0.14 |
| | (1.82) | (1.93) | (2.23) | (1.16) |
| Municipal hospitals per 100,000 | | | | |
| hab | -0.51 | 0.33 | -0.38 | -0.54 |
| | (0.59) | (0.50) | (0.59) | (0.35) |

Notes: Each entry is the coefficient and correspondent robust standard-error of royalty value on the dependent variable indicate in the line. All regressions use annual data and use population, municipal and year effects as controls. Each column indicates a different sample as explained in the top of the table. In all regressions, royalty value is instrumented by oil output. We use the contemporaneous value of royalty payments in public employment regressions and the 2-year lag in the education and health supply regressions. Outliers refer to the municipalities on the top 1% of royalty distribution (Quissama and Rio das Ostras).

Figure 1 – Oil Production 1994-2008

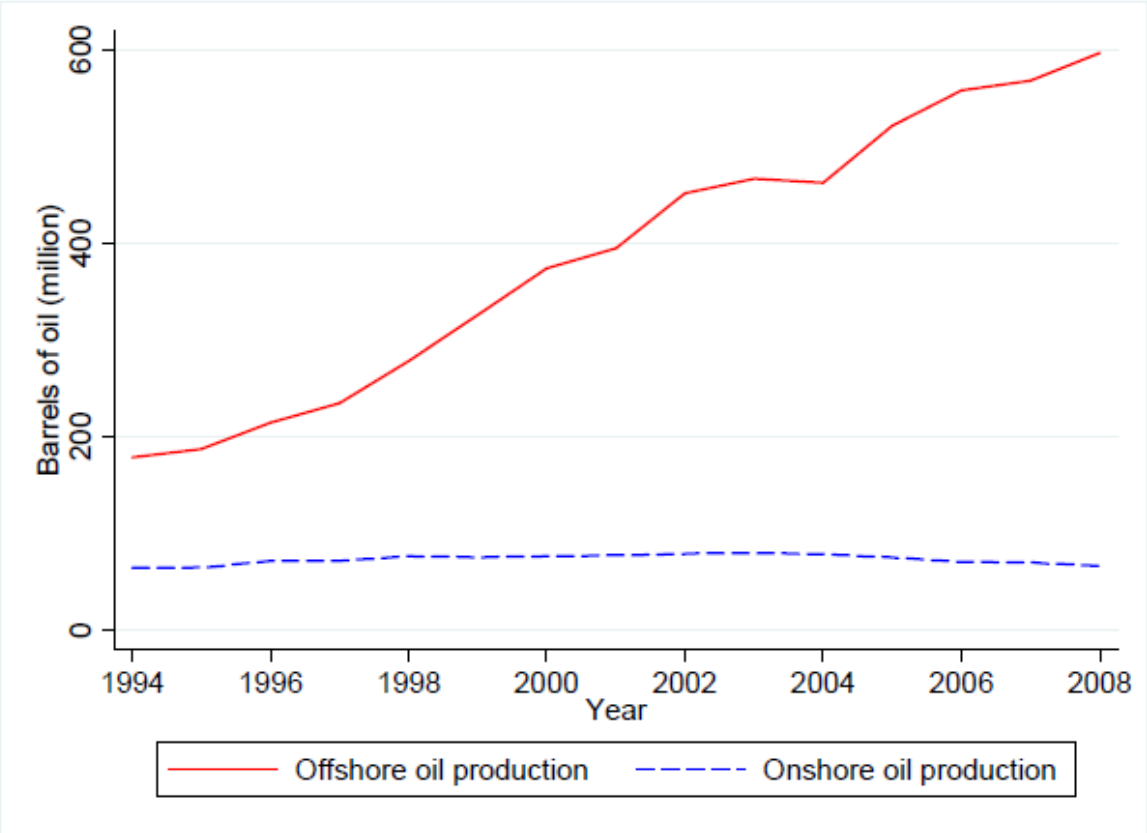
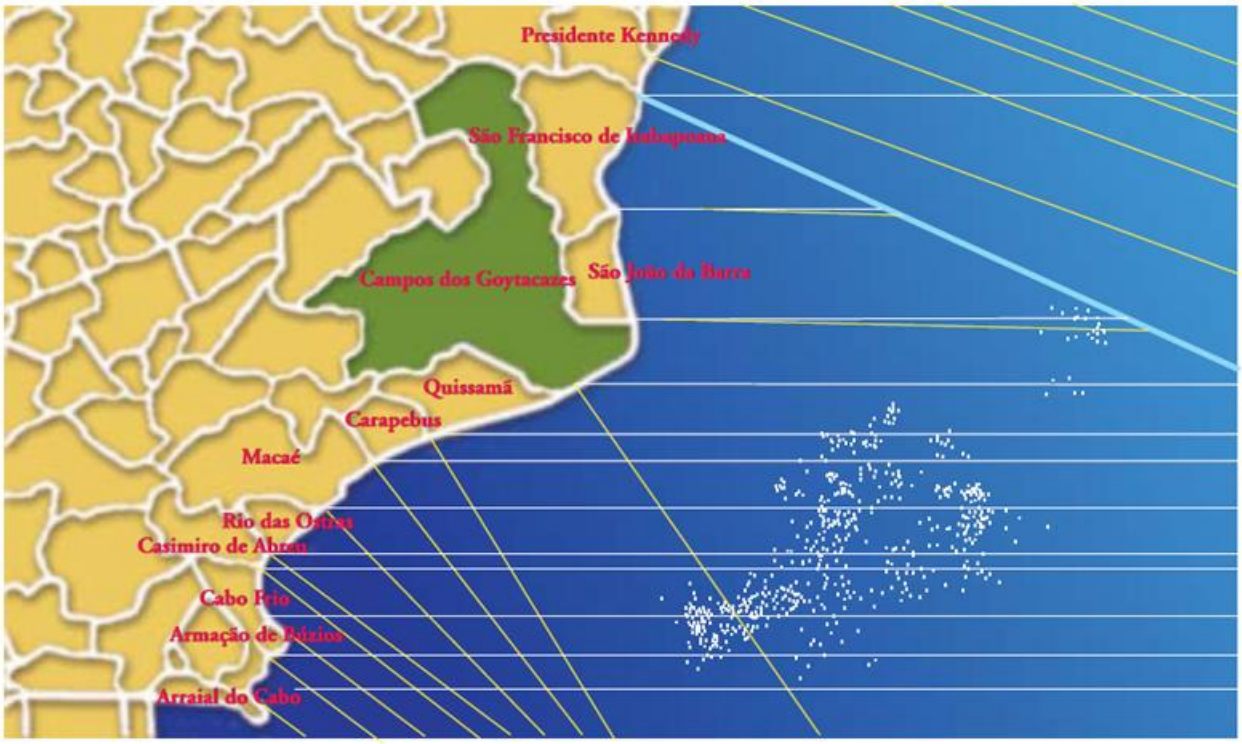


Figure 2 –Orthogonal and parallel lines on Rio de Janeiro coast




Source: ANP (2001b). Guia dos Royalties de Petróleo e do Gás Natural.

Figure 3 – Royalty payments to Brazilian municipalities 1995-2008
(R$ million, real values)

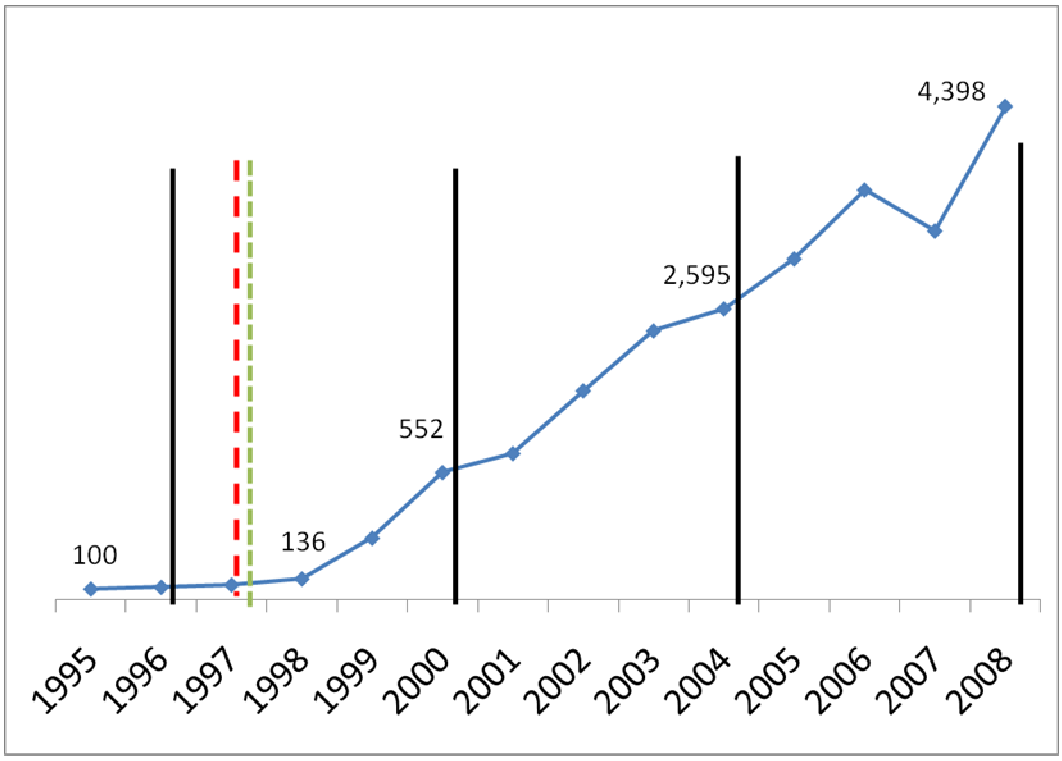
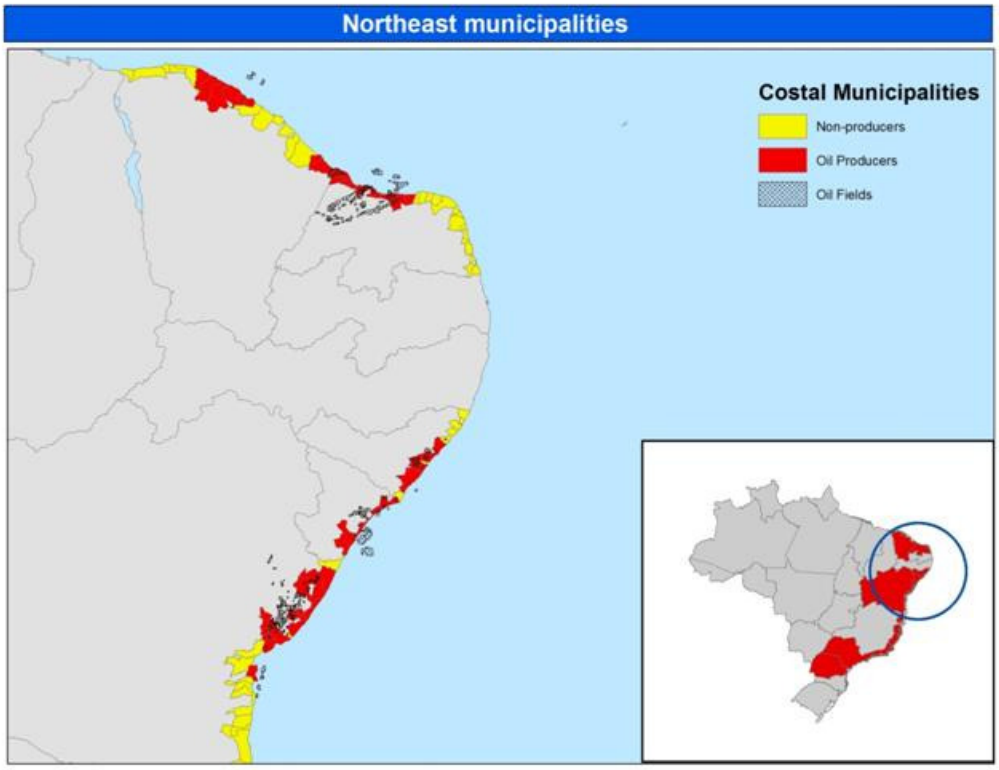


Figure 4 – Location of producing and non-producing municipalities



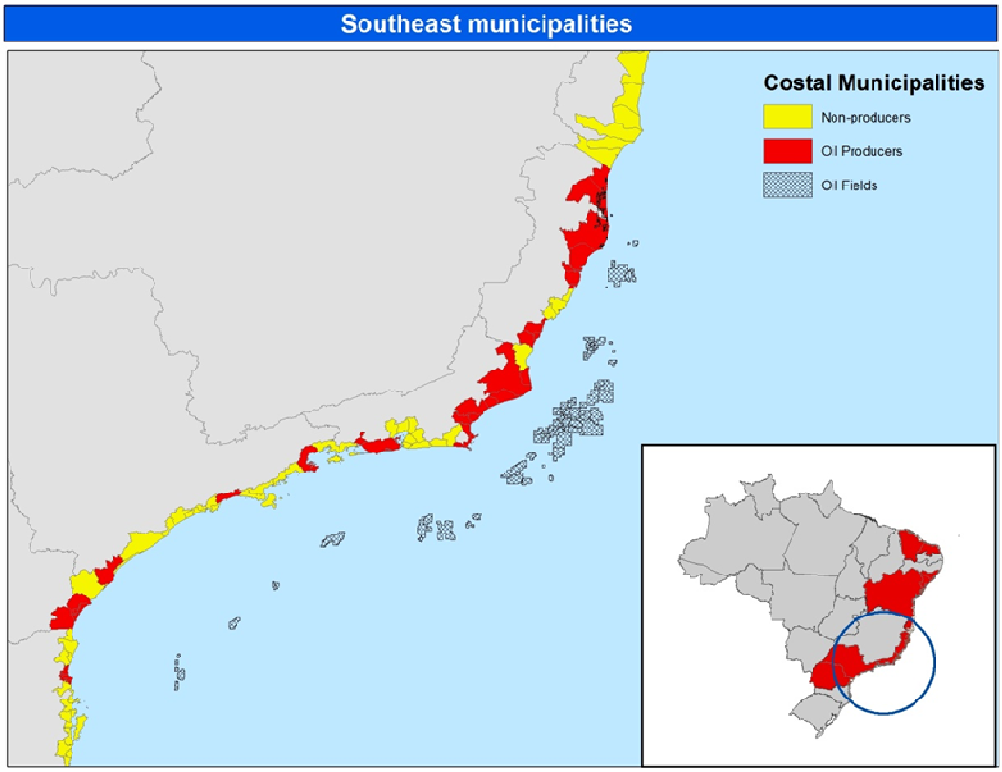
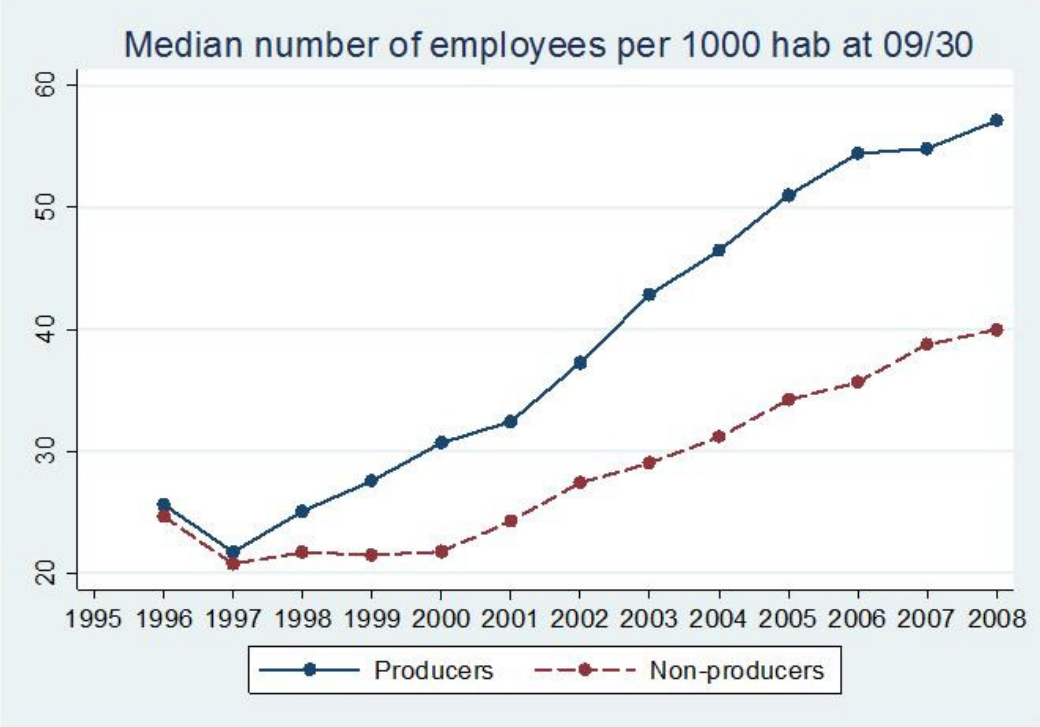



Figure 5 – Municipal employees 1996-2008
A - Median number of total employees per 1000 habitants on September 30th (Coastal municipalities in producing states)




B - Median number of tenured and non-tenured employees per 1000 habitants on September 30th (Coastal municipalities in producing states)

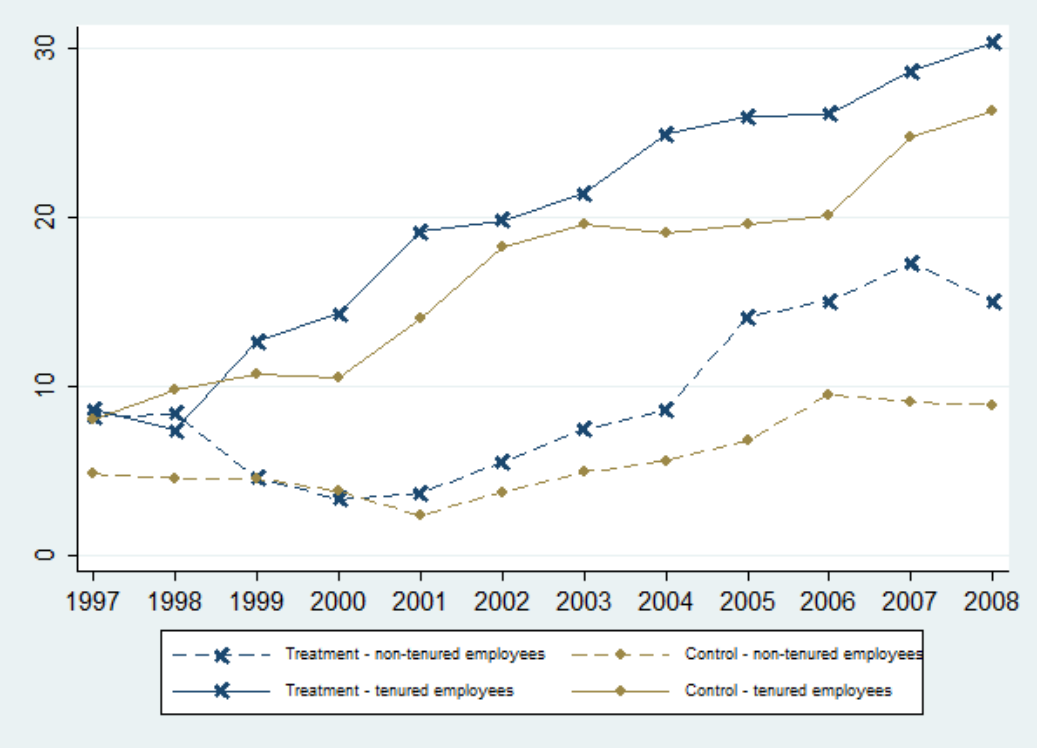
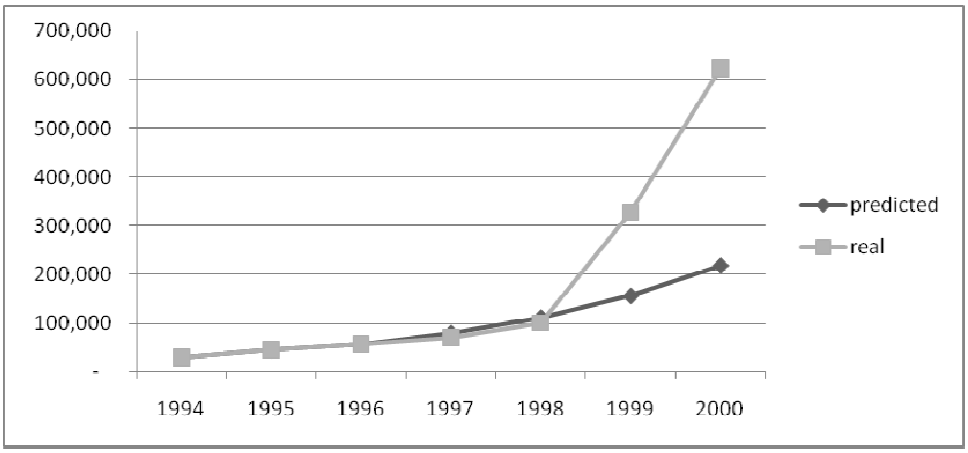
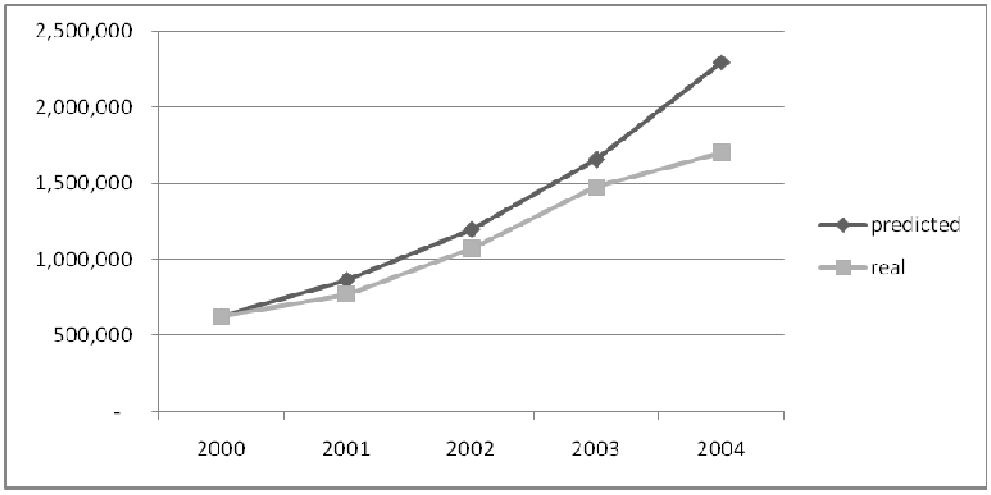


Figure 6 - Real and predicted royalty revenue

A- 1997-2000




B - 2001-2004




C- 2005-2008

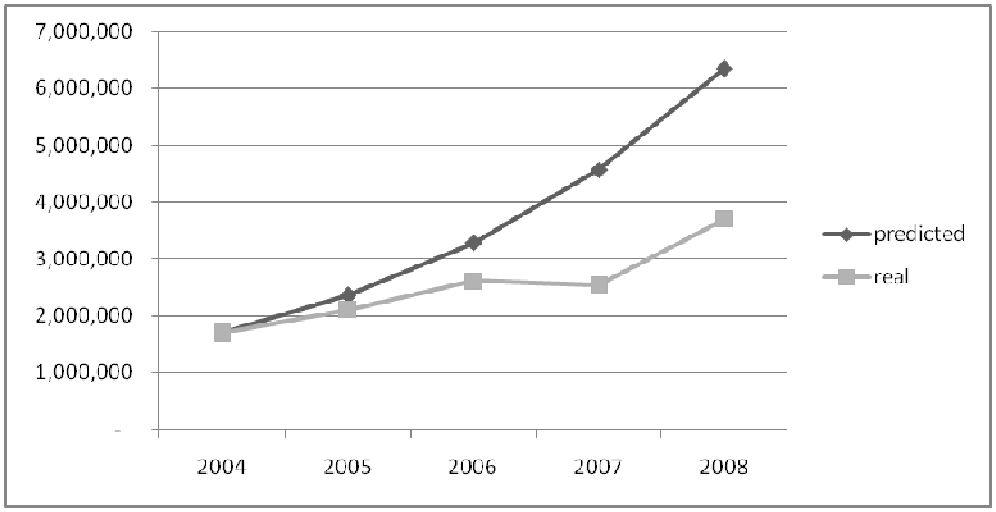


Figure 7 – Number of newspaper articles