1 Brazil's Oil Boom and its Effects on Local Economies

1.1 Introduction

An abundance of natural resources can be a blessing or a curse. While some countries are able to exploit resource riches to improve their welfare, many others are doomed by such discoveries (e.g. Botswana and Nigeria). Despite the existence of many studies that examine the effects of resource abundance on economic performance across countries, great controversy still exists over the true effects of resource booms (Haber & Menaldo (2010), Hodler (2006), Lederman & Maloney (2007), Sachs & Warner (1995), Mehlum et al. (2006), Rodriguez & Sachs (1999), Ross (1999), Ross (2001), Ross (2009)). There are two main reasons for this lack of consensus. First, there are inherent difficulties in controlling for other factors that co-vary with both resource abundance and economic performance in cross-country regressions. Second, resource endowment is usually measured by production, which is endogenous to country level of development and institutions, thus making it hard to interpret the results as causal estimates of the effect of resource abundance.

This chapter examines the impact of oil booms on Brazil's local economies. Specifically, we study how oil windfall is invested by municipalities and whether it improves living standards. 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 in 1997 to 663 million barrels in 2008. Moreover, royalty payments increased from 5 to 10 percent of the production value and were indexed to oil's international price. Hence, royalty payments 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 comparison, the FPM, the main federal transfer to municipalities in Brazil, increase by one-fold in the period. Municipalities lucky

[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".

enough to be situated in front of an offshore oil field according to the geographic lines benefited disproportionately and received a huge windfall. To have an idea of the size of the budget impact, the top beneficiaries, on average, saw their municipal budget increase three times in real terms between 1997 and 2000, and doubled that number between 2000 and 2004.

This paper presents innovations which allow a better estimation of the effects of oil booms on development. First, because most oil production is offshore and oil revenue is distributed according to a fixed geographical rule, we can use it as an exogenous windfall to incumbent. We also instrument royalty revenue by oil output in order to only assess the variation that results 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 allows 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 economic outcomes.

We provide evidence that oil windfall does not have major impact on local economies. The number of firms in different sectors, the private payroll and the non-industrial GDP do not change as a consequence of more oil funds. The main impact appears to have occurred on the municipal public budget, which enjoyed a large boost due to royalty payments. Although municipalities report to have increased all their expenses, we are not able to find significant improvements in local economies. By far, the most important impact is on the number of public employees, which increased a great deal from 1997 to 2008. An one standard-deviation increase in royalty revenue is associated with an average annual increase of 10 percent in the number of municipal employees, which implies that the municipal public sector increased more than two-fold in the twelve years under analysis. Most of this increase was driven by non-tenured employees. About 25 percent of the new employees were hired to provide more health and educational services, but this increase was not translated into better education outcomes nor accompanied by an increase in the number of health clinics or hospitals.

Taken together, these results indicate that oil rents did not guarantee economic development, and that municipalities lost a great opportunity to improve their living standards. However, we don't find evidence to support the resource curse story, since municipalities' situations have not worsened due to these revenues. We should emphasize that these results indicate medium run effects and the long run consequences of oil revenues could be more pervasive, especially by finding that municipalities use oil windfall to increase current expenses and boost the public sector rather than investing in areas that can promote long run economic development.

This paper relates to the literature that aims to understand the impacts of natural resource abundance. Some cross-country studies find that nations that specialize in the production of natural resources grow less (Sachs & Warner (1995), Rodriguez & Sachs (1999)) and tend to be less democratic (Ross (1999) Ross (2001)). These findings, however, have been challenged by several authors that use alternative measures of natural resource specialization (Lederman & Maloney (2007)), or studies that use within-country variation (Michaels (2009)). Another line of research argues that an increase in the stock of natural resources induces rent-seeking which distorts the incentives for productive investment (Baland & Francois (2000), Lane & Tornell (1996), Tornell & Lane (1999), Torvik (2002)). Finally, Gylfason (2001) and Leamer et al. (1999) argue that politicians in resource-rich environments do not have incentives to spend on education and the lack of human capital accumulation reduces long run growth.

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 the oil sector increased education and per capita income without causing ill effects on industrialization or inequality. More related to this study is Caselli & Michaels (2009) who use variation in oil abundance among Brazilian municipalities to assess the effects of resource abundance on local economic activity, public spending, public good provision, and living standards. They find only modest effects on non-oil GDP and public good provision, and no significant improvements in living standards, leading them to conclude that most of the oil royalties received by municipalities go missing. We employ a different empirical strategy than Caselli & Michaels (2009) by focusing on municipalities located on the Brazilian coast and by exploring within variation in addition to using oil output as an instrument for royalty revenue. Moreover, we look at a different time period and different databases, which explain why both papers find different results in respect to public employment. Overall, though, our paper corroborates Caselli & Michaels (2009) main message that oil windfall does not promote increases in living standards.

The remainder of the chapter 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 chapter.

1.2 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 the coast of Rio de Janeiro, were discovered and the increase in international oil prices made offshore production viable.[3] The industry prospects improved during the 1980s when the first giant oil fields were found as shown in Figure 1.1.[4] An important industry upturn occurred in 1997, with the enactment of Law no. 9478, named the Oil Law, which phased out the state oil extraction monopoly.[5] Oil output increased and more than doubled between 1997 and 2008, reaching 663 million barrels in 2008. Figure 1.2 shows that offshore oil output drove this increase, by tripling from less than 200 million barrels a year in 1994 to 600 million barrels in 2008, while onshore output was stable around 65 million barrels a year in this period.

Ten states produce oil in Brazil but production is highly concentrated in Rio de Janeiro, which is responsible for 92% of offshore or 82% of Brazilian oil output. Looking within the states, 53 municipalities have onshore oil wells and 73 are classified as producing municipalities because they face offshore oil fields (see below for a formal description of "facing" municipalities). The industry which supports offshore activities is concentrated in one city, Macaé, which is located in the north of the state of Rio de Janeiro.[6]

Oil companies must pay up to 10 percent of output value in royalties to federal, state and local governments. The legislation that determines the value and the beneficiaries of royalty revenue was modified several times. Onshore royalties were introduced in 1953 and were paid to states and municipalities.

[3]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)

[4]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.

[5]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.

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

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 began to be paid to states, municipalities and the Navy.[7] In this decision, one key issue was to determine which municipalities were affected by offshore oil production. Politicians chose a geographic criteria and classified municipalities into four groups: producing municipalities, secondary zones, neighboring municipalities and non-affected municipalities. In 1986, Decree 93.189/86 classified as 'producing municipalities' those that lie in front of an oil well according to orthogonal and parallel lines to the Brazilian coast. These lines were not the object of political bargain since, by law, they were designed by the National Bureau of Statistics (IBGE) based on the geodesic lines orthogonal to the Brazilian coast which are used as reference in nautical letters. Figure 1.3 illustrates the criteria for the coast of Rio de Janeiro.[8]

The main modification in the oil royalty rule occurred with the enactment of Oil Law in 1997. This law increased royalty payments from 5 to 10 percent of the output value and indexed the reference price to the oil international price. In addition, the Law created special quotas ("participações especiais") or extra payments received from highly productive oil fields.[9] The second parcel of 5% of royalty payments followed a different rule than the previous one and benefited even more producing municipalities (see Annex for details).[10] The new legislation was followed by the upward trajectory of international prices and two large Brazilian Real devaluations. All these facts together induced an enormous increase in royalty payments from R$ 190 million in 1997 to R$ 10.9 billion in 2008.

Taken together, royalty payment rules imply that local governments are the main beneficiaries of oil windfall. In 2008, municipalities directly received 34 percent of royalty payments, followed by states, which received 30%, the Ministry of Science and Technology (16%), the Ministry of Navy (12%) and a special fund (8%).[11] This level of decentralization of natural

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

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

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

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

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

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

These rules also imply that geographic location is the main determinant of who receives what and how much of the oil windfall each municipality gets. The largest share of royalty revenue that goes to municipalities is paid to 'producing municipalities" because they are considered the ones most affected by oil production. In addition, the proximity to these municipalities determines the status of 'neighboring cities". However, the amount paid to each municipality depends not only on geographic position, but also on population and the location of production plants, pipelines and transportation facilities (see Annex for details on the payment rule).

Every month an oil windfall is paid to the Brazilian Treasury, which in turn distributes it to the beneficiaries. Municipalities are free to allocate this income, with two restrictions. They cannot use this rent to hire public employees on a permanent basis, nor can they pay debts with it.[12] The Tribunal de Contas of each state (TCEs) is the institution in charge of auditing the allocation of royalty revenues. This windfall can be invested in different types of public goods and services. Local governments in Brazil are the main providers of basic education and basic health services. In addition, they are responsible for local transportation and infrastructure. Security, however, is supplied by state governments and few Brazilian municipalities have a local police.

1.3 Empirical Strategy

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

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

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

However, oil windfall is not exogenous to local economies because it depends on the geographic proximity to an oil field, population and the location of oil facilities. The main concern is related to the location of oil plants and facilities which may vary over time and are not perfectly observed by us. In

receive 80% of the special fund and 25% of the payments that go to state governments. This implies that municipalities receive 47.6 percent of royalty revenue. In our analysis, we only take into account the direct payments to municipalities.

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

order to deal with this potential problem, we follow Caselli & Michaels (2009) and apply an instrumental variable approach, using the following equation as a first stage equation:

$$R_{it} = \gamma_1 Z_{it} + X_{it}\gamma_2 + c_i + \lambda_t + \epsilon_{it} \tag{1-2}$$

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

The validity of this approach depends on two main assumptions: (i) Z_{it} has a significant effect on R_{it} and (ii) the only impact of Z_{it} on Y_{it} is through R_{it} (the exclusion restriction). The first assumption is guaranteed by the royalty rule, which generates a strong first stage, as a fraction of oil output is paid in royalties to municipalities where drilling is done. In addition, the rule allocates offshore output among municipalities according to lines that lie parallel and orthogonal to the Brazilian coast, creating a geographic instrument. Figure 1.4 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 1.4 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 restrict our analysis to coastal municipalities in producing states. This provides 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.[13] In addition, we exclude the top 1 percent of municipalities in royalty distribution in order to deal with outliers, which implies excluding two municipalities from the sample (Quissamã and Rio das Ostras).[14] As robustness checks, we replicate most of the results in the 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 includes all the 2,157 municipalities from the nine producing coastal states and in a third sample we restrict our analysis

[13]Although the state of Amazonas also produces oil, we exclude it from the analysis because it only has onshore production. Santa Catarina also produces oil but its output is small, intermittent and attributed to just two municipalities, which led us to exclude it from the sample.

[14]Some results are quite sensitive to the exclusion of these two cities because they are huge outliers. Quissamã received 86% more royalty payments per capita 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 list of most benefited municipalities in per capita terms.

to the 124 onshore and offshore producing municipalities.[15]

The second main assumption in the identification strategy (the exclusion restriction) requires that oil output does not generate any direct effect on outcome variables, for instance, through economic impacts or income effects. We believe that this is plausible because 90% of oil is produced offshore in Brazil and services and industrial plants that support offshore production are concentrated in one city (Macaé).[16] Although we cannot test this assumption, we provide evidence in the empirical results that oil production does not have any economic effect on local economies other than through the municipal budget.

Therefore, our main empirical specification employs a panel IV strategy, described by equations (1-1) and (1-2). Table 1.1 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 strong first stage relationship.

Our approach is different from the one used in Caselli & 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 covers 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 output series for 1996-1998, which allow us to understand royalty effects before the boom. In turn, Caselli & Michaels (2009) analyze variation on outcome data mainly from 1991 and 2000, having few outcomes whose values were gathered more recently. Third, our analysis of the impact of royalty revenue on public goods supply and municipal expenses explore a within-variation in addition to the IV strategy, leading to more clean estimates. Finally, our unit of analysis is the municipality rather than the AMC ('área minima de comparação). In Brazil, the fact that many municipalities split during the 1990s led to the creation of the AMC concept, which aggregates municipalities according to their original political borders and allows comparisons across decades. While this is an easy way to deal with municipal divisions, the results generated by this strategy do not have a clear economic interpretation. The main concern is related to public budget analysis and the size of municipal civil service. For instance, consider a municipality which was split in three during the 1990s. AMC measures

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

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

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),[17] which allow us to understand the impact of royalties on municipalities, which is the actual political division.

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

1.4 Data

We use several data sources in this study. Agência Nacional de Petróleo (ANP) is the main source of information for the oil sector in Brazil and provides data on oil output, oil fields location and royalty payments to municipalities from 1999 to 2008. We complement this data with information on oil output from the Oil and Gas Journal (Oil & Special (1999)).[18] The December editions of this magazine report oil output per oil field in Brazil and other countries from 1991 to 1997. This allows us to construct the series of oil output and to recover royalty payments data for the 1990s. As a result, we have oil output and royalty payments series from 1995 to 2008, which let us understand how municipalities were affected by oil windfall before and after the boom in royalty payments promoted by the Oil Law. This is the first work that provides oil data at the municipal level for the 1990s. In the Annex we explain in details how we built oil production annual values, how we linked oil output to specific municipalities and how we recovered royalty payments series. We

[17]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.

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

double checked our calculation and we show that the 1994-1997 royalty series constructed based on Oil and Gas Journal data is almost equal to the one provided by ANP at the state level (correlation 0.9997).

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 the '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 the periods of 1998-2002 and 2006-2008. Information on municipal public employees for the 1996-2008 period was gathered from the Social Security Registry of all formal workers in Brazil (RAIS), and collected by the Brazilian Ministry of Labor. We also use RAIS to obtain information on private employees, total payroll and number of firms per sector in order to estimate oil windfall effects on economic activity. This analysis is also complemented with information on municipalities' GDP available from the IBGE for the period 1999-2007.

The analysis to identify endogeneity issues is based on geocoded information regarding when and where oil fields were discovered in Brazil. We gathered this data from ANP's Exploration and Production Database (Banco de Dados de Exploração e Produção de Petróleo - BDEP). Finally, we got 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 illiterate population available from the 1991 and 2000 population census as controls in some regressions and to understand differences among municipalities before the oil boom. In addition, we use the IBGE inter-census population estimates to obtain yearly data on municipal population, which are used in all regressions. All monetary variables used throughout the analysis have been deflated using IPCA index and represent real values on 2008 prices. In the annex, we provide the sources of all variables.

Table 1.2 shows summary statistics for royalty payments in each political mandate. There were 103 oil 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 the 1997-2000 electoral mandate, which was equivalent to 9% of their municipal revenue or to 2 percent of Brazil's per capita income in 2000. Royalty payments increased more than three-fold on average in the period under analysis, reaching R$ 478 per capita per year in the 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) of oil 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 oil 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 1.3 provides information on how oil 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 higher percentage of urban population, larger illiterate population, lower household per capita income, higher poverty rate, lower human development index, higher infant mortality and lower percentage of households with water pipes. More importantly to our analysis, the evolution of these variables between 1991 and 2000 show that they follow more or less the same growth pattern, 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 municipalities on the Brazilian coast. 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 made more progress in reducing poverty and experienced a lower increase in income inequality. Table 1.3 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.

1.5 Empirical Results

We begin the empirical analysis by providing evidence that endogeneity in oil output is not a concern in the context under analysis. We present the timing of oil discoveries and the relation between having a oil field discovered in its boundaries and municipal political alignment. We then show evidence that oil production does not have any economic effect on local economies rather than through the public sector. We follow by investigating how municipalities spend oil windfall. We show that municipalities report having increased all their expenses but do not change their budget composition. Oil windfall is associated with a large increase in the number of non-tenured employees, which in particular increased from 1999 to 2006. No significant impacts on education or on health supply were found.

1.5.1 Determinants of Oil Discovery and Production

As briefly discussed in the Empirical Section, there are few reasons to believe that local municipalities have the capacity to influence Petrobras and other multinational company plans on where and when to drill an oil field. Figure 1.1 shows that the largest oil fields in terms of 2008 oil output were discovered in the mid-1980s and in 1996. Therefore, for mayors to influence drilling locations in order to receive more royalties would require that the same political groups were in power in oil-rich municipalities for more than 10 years (from mid-1980s to 2000s) and that mayors from oil-rich areas could anticipate or influence the enactment of the Oil Law in 1997, which was responsible for the major increase in royalty revenue. Although both facts seems unlikely, Table 1.4 provides direct evidence that mayors indeed do not influence discoveries and output from oil fields. We explore the association between the timing of discoveries and initial production of new oil fields and municipalities political alignment. Each observation is one municipality. The sample covers the period from 1993 to 2008 and includes all Brazilian municipalities that have at least one oil field (onshore or offshore) discovered within its boundaries in any moment in time. In column 1, the dependent variable is equal to one if an oil field within a municipality's borders was discovered in the respective year, while in column 2 the dependent variable indicates whether oil began to be extracted on the respective year. The regressions include a dummy indicating whether the party in power in the municipality is from the same political coalition of the federal government, party dummies, year and city effects. We see that the fact that the party in power in the municipality is from the same federal government political coalition is not associated with the municipality having an oil field discovered within its borders or with the year oil field entered into production. In addition, we see that few, if any, parties have a higher or lower probability than PT (the Workers Party, which governed the country from 2003 to 2010, and the omitted party in this regression) of influencing the timing of oil production. Finally, columns 3 and 4 look at the time gap between discovering the oil field and beginning its production and confirm that there is no indication of municipal political influence on oil production decisions.[19]

1.5.2 Impact on Economic Activity

One of the main hypotheses in our empirical strategy is that oil output does not affect municipal outcomes through other channels than the public budget. We believe that this assumption can be supported because 90% of oil produced in Brazil comes from offshore wells and most of municipalities which face oil fields does not suffer any externality from oil output. Table 1.5 presents evidence on that direction by showing oil output effects on population and different variables of economic activity. The results presented in columns 1-10 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 includes 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 only of oil producing municipalities.

Table 1.5 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 reflects 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 the coastal municipalities sample. Columns 2-5 reveal that oil output does not affect the number of firms in any sector in benefited municipalities. Columns 6-8 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

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

effect occurs mainly through the public sector. Finally, columns 9-10 show the effect of oil output on municipal GDP per capita. We see that oil production is associated with an increase in total GDP per capita (column 9). However, this result should be interpreted with caution. Municipal GDP in Brazil is not directly computed. The National Bureau of Statistics (IBGE) computes the state GDP and then divides each sector's GDP among municipalities according to reference variables (variáveis de rateio). The key issue in our analysis is that the reference variable used to divide mineral industry GDP is precisely the royalty rule. Hence, the estimated association between oil output and industry GDP is tautological. To assess whether oil output affects municipal economic activity, it is more informative to look at non-industry GDP, which we measured by subtracting industry GDP from total GDP. Column 10 indicates that there is no effect on this variable. Table 1.5 also shows that the results are robust to alternative samples. As an additional exercise, we checked that the results are robust to the presence of Macaé on the sample, the municipality that concentrates oil facilities for offshore production (results not shown and available upon request).

Our findings complement Caselli & Michaels (2009) paper, which shows 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.

1.5.3 Municipal Budget

We now turn to assess how oil windfall impacts municipal budget and how municipalities report spending this money. Table 1.6 shows how oil windfall impacts municipal revenue. Panel A indicates the royalty effect on components of municipal revenue measured in R$ per capita, while Panel B shows the impact of oil windfall on each expense as a share of total revenue. The results are from panel-IV regressions that cover the period from 1997 to 2008 period and use municipal and year effects as controls. This analysis includes only municipalities that report the most revenues and expenses, which results in a smaller sample than in other exercises. In column 1 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.[20] A one-standard-deviation increase in oil windfall is associated with an increase in R$ 0.03 per capita in tax revenue,

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

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 and federal governments (see footnote 11).

Columns 3 and 4 look at the effects of royalty revenues on two other federal transfers. FPM stands for "Fundo de Participação dos Municipios" and it is the most important transfer to municipalities in Brazil, while FUNDEF is the acronym for Fundo de Desenvolvimento da Educação Fundamental (Basic Education Development Fund) and is a fund to finance education.[21] The idea is to understand whether the federal government tries to offset royalty payment by reducing other transfers. Columns 3 and 4 indicate that this does not occur since oil windfall is not associated with changes in both transfers. 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 revenues.

Table 1.7 investigates how municipalities report to allocate revenue. Each column presents the coefficients from panel IV regressions of different types of expenses on royalty payments instrumented by oil output. Column 1 shows that for every Real received, 63 cents are allocated in current expenses,[22] 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). These results indicate that oil-rich municipalities apply equivalent amount of resources on payroll and on "other labor and service contracts", which include consulting services, outsourced services and labor hired on a temporarily basis than on payroll. We interpret this result as a reflection of law restrictions to the use of royalty revenues, which do not allow municipalities to use royalty revenue to hire public employees on a permanent basis. A way to circumvent this restriction is to hire people through other means. When we disaggregate "other labor and service contracts" by its components,[23] we see that the bulk of this expense is used to pay for

[21]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.

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

[23]Consulting services, outsourced services and labor hired on a temporarily basis (locação

outsourced services provided by companies (results not shown and available under request). This budget line can include several expenses, including two famous expenses in oil-rich municipalities: free live concerts and labor hiring through NGOs. Both expenses are usually cited by the media in scandals about the use of public funds in oil-rich municipalities and have been object of police investigation.[24] Panel B shows the impact of oil windfall on each expense as a share of total revenue. We see that oil revenues do not affect much the composition of public budget. Payroll expenses were slightly reduced as a proportion of total budget while investments suffered a small percentage increase.

Columns 6 to 10 offer another way to look at budget allocation by examining the destination of expenses. We observe that local governments report spending similar amounts in all areas, with the exception of transportation. 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), education 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 revenue), followed by administration and planning (33%), health and sanitation (30%) and education and culture (19%). As a share of total 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 into how municipalities apply oil windfall, we cannot use it as strong evidence of public goods provision. We have two main concerns with these data. First, the simple report that the municipality spent resources on a service does not necessary imply that the service was 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.[25] Campos dos Goytacazes, the largest recipient of royalty

de mão-de-obra + contrato por tempo determinado).

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

[25]Caselli and Michaels (2009) use 2001 values to impute the missing observations for 2000 in order not to lose many municipalities. We do not perform any imputation. We do not

revenues in absolute terms, for instance, only disclosed information on its public expenses on 2000 and 2006.[26] If oil benefited municipalities have a higher probability of not disclosing their public accounts, this can limit the capacity of these data to inform how municipalities are investing royalty revenues. Indeed, a regression of the probability of declaring FINBRA on a dummy on whether the municipality is an oil producing site (onshore or offshore) shows that producers's municipalities have a 4.5 percentage point lower probability of disclosing their public accounts (results not shown).[27]

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

1.5.4 Public Goods and Service Provision

Public Employment

A major destination of public expenses is the payroll. In order to shed light on public employment trends, Figure 1.5 shows the evolution of the median number of municipal employees per 1000 habitants in coastal producing and non-producing municipalities from 1997 to 2008. We see that although the median levels in the two groups of municipalities are quite similar in 1997 and 1998, they began to diverge in 1999, exactly when municipalities were most affected by the the large boost in royalty payments caused by the Oil Law.[28] Both groups increased substantially the number of public employees, but producing municipalities began to increase municipal public employment earlier and did it at a faster pace.

Table 1.8 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 covering 1997-2008 period and use population, municipality 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 closest to the election,

need it because we use several years of data, and we do not think this is appropriate as municipalities can allocate their budget in different ways from one year to another.

[26]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.

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

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

which takes place every four years in the first weekend of October.[29] Column 1 shows that for each R$ 1,000 per capita received, municipalities hire more 7.22 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 revenues, which is equivalent to an 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 the annex Table 1.11, we show that this estimation is robust to alternative measures of public employees, to different samples and to the inclusion of outliers. In particular, the estimate for the royalty impact on municipal employment is quite similar if we use the 'Perfil dos Municípios Brasileiros: Gestão Pública" database, 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.[30]

Note that municipalities are forbidden to use royalty income to hire employees on a permanent basis. However, it is widely believed in Brazil that a large share of royalty revenues was used to hire employees.[31] In practice, municipalities have several options for hiring more employees: they can reallocate expenses in order to use the regular budget to pay for hirings, they can bring in temporarily employees or they can hire people indirectly, by establishing contracts with companies which hire people in their place (see footnote 24 on corruption scandals related to this last point). Since the data on Ministry of Labor only consider direct employees, these results should be viewed as a lower bound for the effects on royalties on public employment.

Column 2 in Table 1.8 shows the results of a regression which assesses whether oil windfall affected municipal public sector wages between 1999 and

[29]The RAIS database includes the information on the employment level on December 31st but also discloses monthly hirings and firings. We calculate the level on September 30th as EmploymentLevel9/30 = EmploymentLevel12/31 - (HiringOctNovDec - FiringOctNovDec). In addition, we did a correction in this measure to account for huge variations in reported employment levels in certain years. Since we believe that these drastic variations are misreports, we replaced by missing any record that reports an annual decrease of more than 75% in the number of employees followed by an increase of more than 200% in the following year. As a result, we lose 60 observations out of 1864 in the sample that includes only coastal municipalities. We performed this correction because we don't want artificial jumps in employment level to affect within-estimates. However, the result is robust to the use of corrected or uncorrected measure.

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

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

2008.[32] In order to account for differences in price levels among municipalities, we use the ratio between the average wage in public sector and the average rate in the private sector as a measure. The average of this variable is 1.17 in Brazil for the period from 1999 to 2008, indicating that public employees earn, on average, 17 percent more than private sector employees.[33] Column 2 shows that oil windfall raises the relative public-private 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 5 we shed light on the composition and quality of the payroll increase. Columns 3 and 4 divide the number of employees between those with and without tenure. Column 3 indicates that the effect on the number of employees with tenure is small and not statistically different from zero. Column 4 shows that most of new employees (96% percent) were hired on a temporary-basis and don't have tenure. A one-standard-deviation increase in royalty payments is associated with the hiring of more 6.9 employees without tenure per 1000 habitants, which represents an average annual increase of 58 percent. Both results are consistent with the fact that, by law, municipalities cannot use oil windfall to hire employees on a permanent basis.

Column 5 shows the results of a regression that uses the percentage of public employees with a college degree as a dependent variable. The point estimate is negative and indicates that in oil-rich municipalities, a one-standard-deviation increase in royalty revenue promotes 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 a 13 percent confidence level. In order to understand the significance of this result, it worth mentioning 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 degrees 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, even though they also improved the educational level of its employees, they did so at a more reduced level than other Brazilian municipalities. We cannot tell whether this difference is a consequence of intentional decisions by public authorities to hire people with low levels of education or whether it is

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

[33]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.

a consequence of a supply constraint in the number of habitants with college degrees in oil-rich municipalities.[34]

In sum, the results present on Table 1.8 indicate that oil windfall is associated with a huge expansion in the public sector and that the majority of new employees don't have tenure.

Education and Health Supply

Table 1.9 looks at the impact of oil windfall on education outcomes. In all regressions, royalty value is instrumented by oil output and population, and we use year and municipal dummies as controls. In Panel A we look at the contemporaneous effect of royalty payments, while in Panel B we use a 2-year lag in order to account for the fact that some investments might take longer to take effect. Column 1 investigates whether the oil windfall was used to increase the number of professionals in education services. We see that oil windfall is associated with an increase in the number of professionals who work at schools. Panel A indicates that municipalities hire more 0.46 education professionals per 1000 habitants for every standard-deviation increase in royalty payments, which represents an increase of 5 percent. This effect is even larger if we estimate the impact of royalty payments received two years earlier. Panel B indicates that a one standard-deviation increase in royalty payments is associated with 1.1 more education professionals two years later, which is equivalent to a 12 percent increase.

In the remaining columns of Table 1.9, 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 royalty revenue per capita. 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. Neither Panel A nor Panel B shows that oil windfall improves any of the education outcomes under analysis.

Overall, Table 1.9 indicates that oil windfall increases the number of education professionals, corroborating the previous results that oil royalties increase the number of public employees, but has negligible effects on other

[34]A supply constrain may emerge in two cases. If fewer people in oil-rich municipalities have college degrees, local governments would not be able to hire enough highly-skilled people. However, this does not seem to be the case since educational levels in oil-rich municipalities are higher than those in non-recipients in the 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 a college degree.

education outcomes that indicate education supply and performance. Our results are in accordance with Caselli & Michaels (2009) paper, which finds that the only effect of oil windfall on education outcomes is through the increase in the number of teachers. We use a different database and find a similar result.

Turning to health outcomes, Table 1.10 looks at whether oil windfall is associated with an increase health resources. In this Table, we exclude the three largest beneficiaries of royalty revenues.[35] Again, Panel A looks at the contemporaneous effect of royalty payments, while in Panel B we use a 2-year lag in order to account for the fact that some investments might take some time to take effect. Column 1 indicates a positive impact on the number of health professionals per 1000 habitants. A one standard-deviation increase in royalty payments is associated with 0.35 more health professionals if we use the contemporaneous value of the royalty value (Panel A) or with 0.56 more employees if we consider a 2-year royalty lag (Panel B). This represents a considerable boost in the number of health employees, since these estimates imply an annual increase of 22 percent and 35 percent in the number of health professionals, depending on the royalty measure we use. Columns 2 and 3 investigates whether the increase in health expenses shown in Table 1.7 were accompanied by more health clinics or hospitals administered by local governments. We don't have a complete series for the period under analysis and these regressions cover data from 1998 to 2002 plus 2006 and 2008.[36] Both Panel A and Panel B show that oil windfall is not associated with increases in the number of health clinics or hospitals per 100,000 habitants.

1.6 Conclusion

This chapter explains Brazil's offshore oil boom and investigates how oil royalties affect producing municipalities. We show that oil production has little economic impact on the municipalities, other than in the public sector. Oil revenues increase municipal revenue directly and also positively impacts tax revenue. We don't find any evidence that the federal government tries to offset royalty transfer by reducing the two other main transfers made to municipalities, which is a reasonable result since FPM and FUNDEF allocation

[35] 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 revenues. Since their performance is sufficient to drive all the results we decided to exclude the top three royalty beneficiaries in this exercise rather than the top two.

[36] We add two databases to construct number of clinics and hospital series. Data from 1998 to 2002 is from Cadastros Extintos do SUS, while data from 2006 and 2008 was gathered from CNES database. Results for number of hospitals should be interpreted with caution because it is not clear that this variable is comparable in both series.

follows independent and fixed rules. Municipalities report having increased all their expenses but do not change their budget composition much. According to municipal reports, the areas that receive the largest improvements in expenses are housing and urbanization (41 percent increase in expenses for each standard-deviation increase in royalty revenues), followed by administration and planning (33%), health and sanitation (30%) and education and culture (19%).

Looking at de facto provision of public goods and services, we observe that the major destination of oil revenues is the hiring of municipal employees. Our results indicate that oil-rich municipalities increased the number of public employees by 10 percent per year on average for each one-standard deviation increase in royalty revenues, which means that on average they multiplied the number of employees by more than two-fold in the twelve years under analysis. The bulk of these new employees don't have tenure, which is consistent with the fact that, by law, municipalities cannot use oil windfall to hire employees on a permanent basis.

The analysis of education and health supply indicates that some of the new employees were hired to provide education and health services. The comparison of results indicates that among the new public employees, 14% were hired to provide education services and 11% to supply health services. Considering that, on average, 25% of municipal employees in Brazil are related to education supply and 5% provide health services, these results indicate that a reasonable number of health professionals were hired. However, the duties of the other 75% of new hired employees is an open question. Some of them are probably hired to provide administrative and bureaucratic services but there is no way to assess if these services have been improved.[37] Other outcomes of education and health supply do not indicate any significant improvement in health and education. The results for health resources are particularly striking since this area received a 30% increase in expenses, according to municipality reports.

The analysis of oil royalties' impact on public goods and services presented here is not exhaustive due to data constraints. Ideally, we would like to investigate whether oil revenues were translated into more urban infrastructure such as electricity, running water, sewage, housing quality and pavement. Unfortunately, most of this information is only provided at the municipal level by the Brazilian Census, and we need to wait for the results of the 2010 Census to be disclosed. However, the modest improvements in education and health,

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

which are the main areas under municipal authority, suggest that municipalities have created few improvements in living standards. This result is even starker if we consider the size of the windfall in the last twelve years. Therefore, our results indicate that oil-rich municipalities lost a great opportunity to develop, although they do not suggest that municipalities are worse due to oil windfall, which would be necessary to support a resource curse story.

This research is particularly important for policy-making in Brazil and countries that discover new natural resource fields. Oil revenues are likely to be magnified by recent oil discoveries in Brazil. One new field discovered in 2007 (the Tupi) is expected to produce between 5 billion and 8 billion barrels while a new field discovered in 2008 might contain as much as 33 billion barrels (Economist (2008)). As noted by Economist (2008), "This would make it the third-largest field ever found and would raise Brazil to eighth position in the global oil rankings". These announcements are also stimulating a debate over the best use of royalty revenues and its distribution, which requires empirical evidence in order to inform the policy debate.

The next chapter investigates whether local politics are affected by oil windfall. We also analyze whether the huge increase in the number of public employees had a political motivation.

Table 1.1: 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)***
Constant	0.000	0.036	0.027
	(0.002)	(0.016)**	(0.023)
Observations	25857	1882	1486
R^2	0.602	0.686	0.678
Municipalities	2157	157	124
F-stat	252.7	234.0	241.9

Notes: The results presented in columns 1-3 are from regressions that cover the period from 1997 to 2008 and include municipal and year effects as controls. Column 1 includes all municipalities from the nine oil producing states. Column 2 includes municipalities on the coast of the nine producing states, while column 3 sample is composed only by 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 at the municipality 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 instrument test.

Table 1.2: Royalty Summary Statistics

	All oil producing municipalities	Oil producing municipalities on the coast	Non-producing municipalities
	(1)	(2)	(3)
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$)			
1997-2000	133	189	2
2001-2004	375	545	6
2005-2008	478	697	10
Royalty standard-deviation (R$)			
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%

Notes: This table reports the number of municipalities, average per capita royalty payments, royalty standard deviation and the share of oil royalties on municipal revenue for the three political mandates under analysis and for three group of municipalities. Column 1 includes all oil producing municipalities in Brazil that produce onshore and/or offshore oil. Column 2 is a subgroup of column 1 and includes all oil producing municipalities located on the Brazilian coast. Column 3 contains municipalities that do not produce oil and are located in one of the nine oil producing states in Brazil under analysis (CE, RN, AL, SE, BA, ES, RJ, SP and PR).

Table 1.3: Municipal Characteristics

	All municipalities in oil producing states			Coastal municipalities in oil producing states		
	Oil producers	Non-producers	Dif.	Oil 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 > 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	***	0.6	0.6	
Infant mortality	0.09	0.07	***	0.08	0.08	
% of households w/ electricity	0.81	0.77		0.82	0.78	
% of households w/ water pipes	0.48	0.59	***	0.53	0.53	
Variation between 1991-2000						
Population	0.21	0.1	***	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 > 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	
% households w/ electricity	0.19	0.26	*	0.21	0.2	
% households w/ water pipes	0.66	1.65		0.67	0.79	
Level 1997						
Num of public employees (1000 hab)	24.1	23.8		21	20.7	
Revenue net of royalties (R$ pc)	708	686		831	689	
% educ. 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 aver. 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	-14.8	
Longitude	38.5	44.7	***	39.5	40	
Altitude	48.4	432.6	***	22.3	20.2	
Distance to state capital	100.9	260	***	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 oil producing states under analysis (CE, RN, AL, SE, BA, ES, RJ, SP and PR) and columns 4-5 compare municipalities on the coast of 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 1.4: Political Alignment and Timing of Oil Field Discoveries and Initial Output

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

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

Table 1.5: Oil Output Impact on Economic Activity

	Log population	Total	Number of firms pc: Manu-facturing	Number of firms pc: Trade	Services	Number of private employees pc	Public payroll pc	Private payroll pc	GDP pc	Non-industrial GDP pc
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A - All municipalities in oil 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^2	0.176	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
Panel B -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^2	0.496	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
Panel C -Oil 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^2	0.510	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 oil producing states under analysis. Panel B includes municipalities on the coast of the nine oil producing states, while panel C sample is composed only by oil producing municipalities. All regressions exclude the municipalities on the top 1% of royalty distribution (Quissamã and Rio das Ostras). The results presented in columns 1-5 are from regressions that cover period 1997-2008. Columns 6-8 include 1999-2008 years, while columns 9-10 cover 1999-2007 period. All regressions include municipal and year effects as controls. All measures are in per capita terms. Robust standard errors clustered at the municipality are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 1.6: Municipal Revenue

	Total revenue pc	Tax revenue pc	FPM transfers pc	FUNDEF transfers pc
	(1)	(2)	(3)	(4)
Panel 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
R^2	0.73	0.12	0.63	0.63
Municipalities	157	157	157	157
Y mean	1.23	0.20	0.22	0.16
Panel B - Share of total revenue				
Royalties pc		0.0005	-0.04	-0.03
		(0.0051)	(0.01)***	(0.01)***
Observations		1619	1620	1354
R^2		0.08	0.44	0.23
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 (Quissamã and Rio das Ostras) and include only municipalities reporting most revenues and expenses. In all regressions, royalty value is instrumented by oil output and population, and use year and municipal effects as controls. All regressions cover 1997-2008 period. In Panel A, the dependent variables are measured in R$ 1000 per capita and, in 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 Municipios . 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 at municipality are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 1.7: Municipal Expenses

	Current expenses pc	Payroll pc	Other labor and service pc	Invest-ment pc	Debt amortization pc	Administration and planning pc	Education and culture pc	Health and sanitation pc	Housing urbanization pc	Transport-ation pc
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A - R$ per capita										
Royalties pc	0.63	0.19	0.20	0.23	0.01	0.21	0.17	0.17	0.18	0.02
	(0.13)***	(0.04)***	(0.04)***	(0.04)***	(0.01)	(0.06)***	(0.02)***	(0.04)***	(0.03)***	(0.02)
Observations	1620	1619	934	1620	1469	1620	1620	1620	1620	1620
R^2	0.61	0.40	0.41	0.22	0.17	0.18	0.57	0.59	0.28	0.04
Municipalities	157	157	154	157	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	0.02
Panel 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	-0.00
	(0.02)***	(0.01)***	(0.01)	(0.01)**	(0.00)	(0.01)	(0.01)***	(0.00)**	(0.01)*	(0.00)
Observations	1620	1619	934	1620	1469	1620	1620	1620	1620	1620
R^2	0.09	0.10	0.07	0.11	0.11	0.06	0.18	0.22	0.01	0.11
Municipalities	157	157	154	157	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	0.02

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 (Quissamã and Rio das Ostras) and include only municipalities reporting most revenues and expenses. In all regressions, royalty value is instrumented by oil output and population, and use year and municipal effects as controls. All regressions cover 1997-2008 period. In Panel A, the dependent variables are measured in R$ 1000 per capita and, in Panel B, they are computed as a share of total revenue. 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 2) and other labor and service contracts (column 3) are subdivisions of current expenses (column 1). Royalty data are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. Robust standard errors clustered at municipality are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 1.8: Public Employment

	Number of employees	Relative public/private wage	Number of employees with tenure	Number of employees without tenure	Percentage of employees with college degrees
	(1)	(2)	(3)	(4)	(5)
Royalties pc	7.22	0.06	0.44	6.94	-0.02
	(1.44)***	(0.06)	(2.81)	(2.71)**	(0.01)
Observations	1807	1547	1807	1807	838
R^2	0.47	0.35	0.25	0.09	0.31
Municipalities	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 (Quissamã and Rio das Ostras). In all regressions, royalty value is instrumented by oil output and population, year and municipal effects are used as controls. All employment variables are measured in per 1000 habitants. Columns 1, 3 and 4 cover 1997-2008 period and regression in column 2 includes 1999-2008 years. The dependent variable in column 5 is from the "Perfil dos Municípios Brasileiros: Gestão Pública" database and cover 1999, 2001, 2002, 2004, 2005, 2006 and 2008. The number of employees in column 1, 3 and 4 relates to all employees hired by the local municipality on September 30th. The relative public-private wage is the ratio between public and private sector wages. Columns 3 and 4 are subdivisions of column 1. Royalty payments are the value received in the contemporaneous year, are measured in R$ 1000 per habitant and are deflated by the consumer price index, representing 2008 values. Robust standard errors clustered at municipality are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 1.9: Education Supply

	Education professionals per 1000 hab (1999-2008)	Schools per young habitants (1999-2006)	Enrollment per young habitants (1999-2006)	Number of teachers with college degree (1996-2006)	School hours per day (1996-2006)	% of students with slow school progress (1996-2006)	School dropout rate (1996-2005)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Royalties pc	0.96	-0.00	10.92	-3.06	-0.04	0.02	-1.03
	(0.47)**	(0.16)	(18.99)	(3.30)	(0.03)	(1.40)	(1.04)
Observations	1524	1255	1255	1521	1706	1552	1550
R^2	0.19	0.12	0.03	0.51	0.09	0.70	0.27
Municipalities	157	157	157	157	157	157	157
Royalties pc	2.17	0.07	25.60	-0.40	-0.02	-0.78	-2.47
(2 years lag)	(0.82)***	(0.16)	(24.18)	(4.93)	(0.03)	(1.92)	(1.54)
Observations	1524	1255	1255	1521	1696	1552	1540
R^2	0.20	0.12	0.04	0.51	0.08	0.70	0.27
Municipalities	157	157	157	157	157	157	157

Notes: This table reports the effects of royalty payments on education supply in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). Panel A reports the contemporaneous effect of royalty payments on different education outcomes as indicated in each column, while Panel B reports the effect of the amount received two years before. Education professionals include all public employees hired by the municipality who work at schools. The data are from RAIS database and refers to employment level on December 31st. Schools per young habitants and enrollment per young habitants are, respectively, the number of schools and enrollment in elementary school divided by the number of habitants between 5 and 19 years-old. Dropout rate refers to the average rate of student who drop out the school during the school year. The period covered in each regression varies as indicated in the columns due to data availability. Regressions exclude the municipalities on the top 1% of royalty distribution (Quissamã and Rio das Ostras). In all regressions, royalty value is instrumented by oil output and population, and use year and municipal effects as controls. 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 at municipality 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 1.10: Health Supply

	Health professionals per 1000 hab	Municipal clinics per 100,000 hab	Municipal hospitals per 100,000 hab
	(1)	(2)	(3)
Royalties pc	0.70	-2.47	-0.59
	(0.18)***	(2.92)	(0.62)
Observations	1514	1207	1207
R^2	0.38	0.07	0.04
Municipalities	156	156	156
Royalties pc (2 years lag)	1.11	1.04	-0.58
	(0.39)***	(1.99)	(0.66)
Observations	1514	1207	1207
R^2	0.37	0.07	0.02
Municipalities	156	156	156

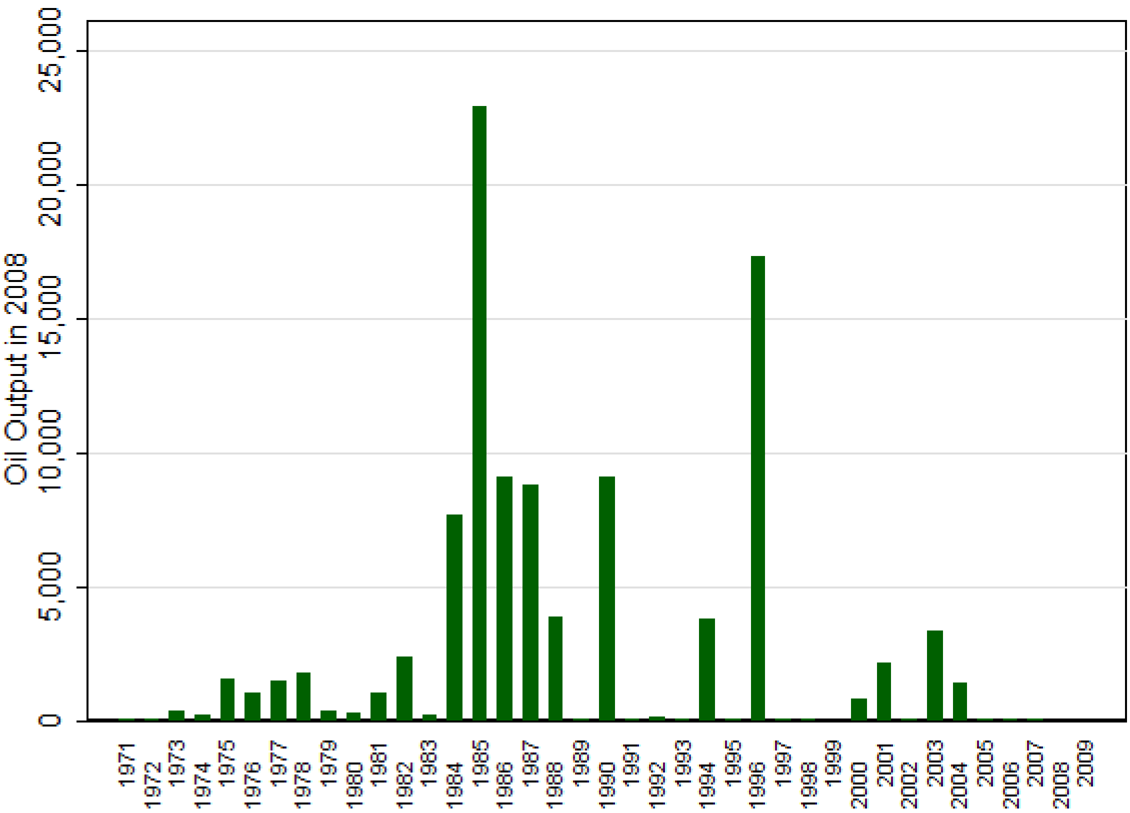
Notes: This table reports the effects of royalty payments on health supply in municipalities located on the coast of the nine oil producing states (CE, RN, AL, SE, BA, ES, RJ, SP and PR). Panel A reports the contemporaneous effect of royalty payments on different health outcomes as indicated in each column, while Panel B reports the effect of the amount received two years before. Health professionals include all public employees hired by the municipality who provide health services. The data is from RAIS database and refers to employment level on December 31st. 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. Regression presented in column 1 uses annual data from 1999 to 2008, while regressions presented in columns 2 and 3 are based on annual data from 1998 to 2002 plus 2006 to 2008. The regressions exclude the three largest beneficiaries of royalty revenue (Quissamã, 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. 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 at municipality are reported in parentheses. Significantly different than zero at 99 (***), 95 (**), 90 (*) percent confidence.

Table 1.11: Robustness Checks

	(1)	(2)	(3)	(4)
Sample	Coastal municipalities	All municipalities	Oil 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	0.44	2.70	-0.19	0.32
tenure on 9/30	(2.81)	(2.85)	(3.01)	(1.90)
Number of employees without	6.94	8.55	7.82	4.32
tenure on 9/30	(2.71)**	(3.03)***	(3.13)**	(1.76)**
% of employees	-0.02	-0.02	-0.01	-0.02
with 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 employees	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	0.08	0.50	0.18	0.09
young habitants	(0.16)	(0.15)***	(0.16)	(0.04)**
School enrollment per *	25.76	22.94	40.99	9.23
young habitants	(24.18)	(22.66)	(26.73)	(12.67)
Num of teachers with	-0.36	5.81	8.09	0.30
college degree	(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)***
% of students with slow	-0.80	-5.24	-0.40	-0.06
school progress	(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 regressing the dependent variable indicate in the line on royalty revenue. All regressions use annual data and control for population, municipal and year effects. 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 (Quissamã and Rio das Ostras).

Figure 1.1: Oil Field Output in 2008 by Year of Field Discovery



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

Figure 1.2: Oil Production 1994-2008

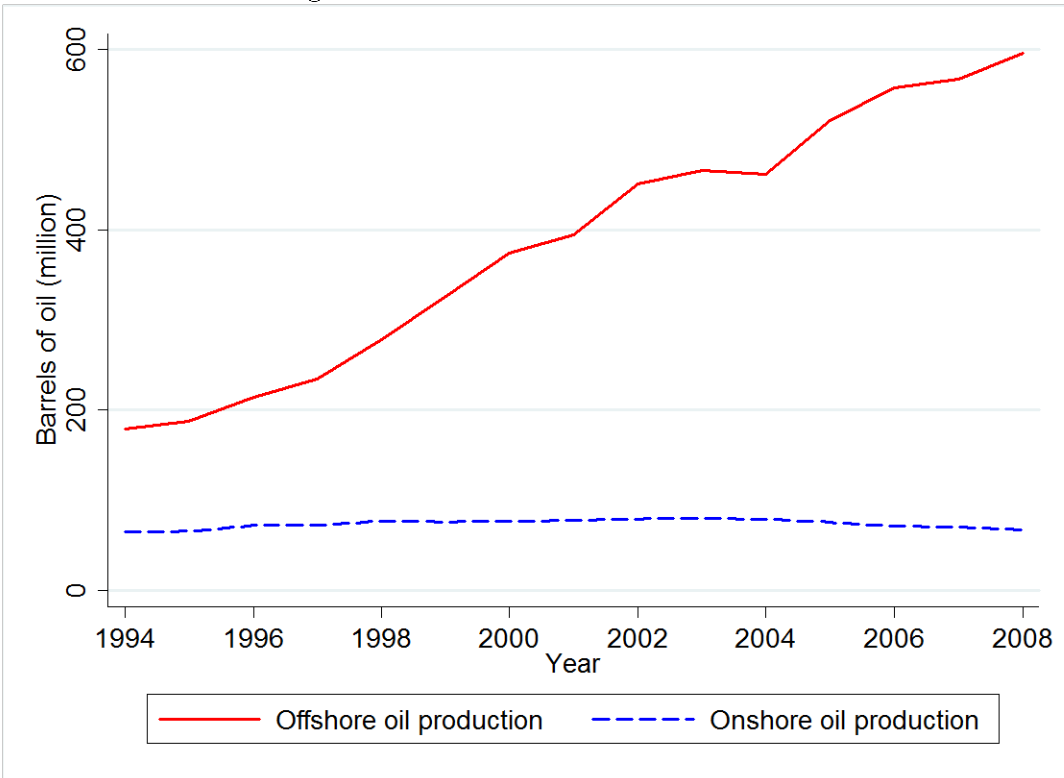
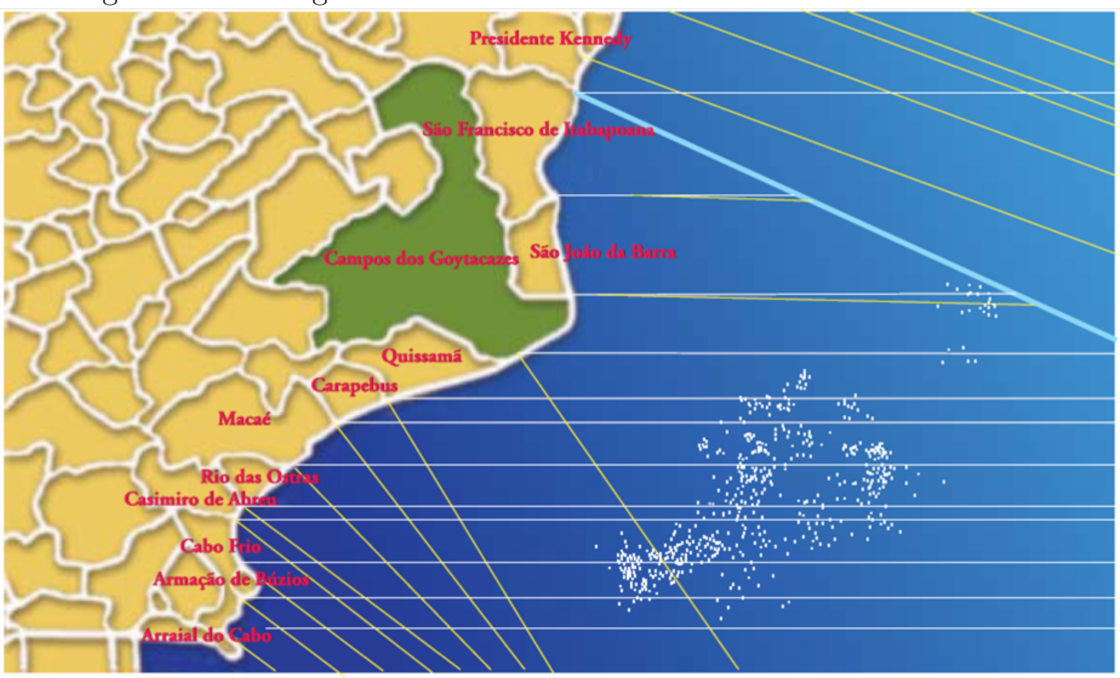


Figure 1.3: Orthogonal and Parallel Lines on Rio de Janeiro Coast



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

Figure 1.4: Location of Producing and Non-producing Municipalities

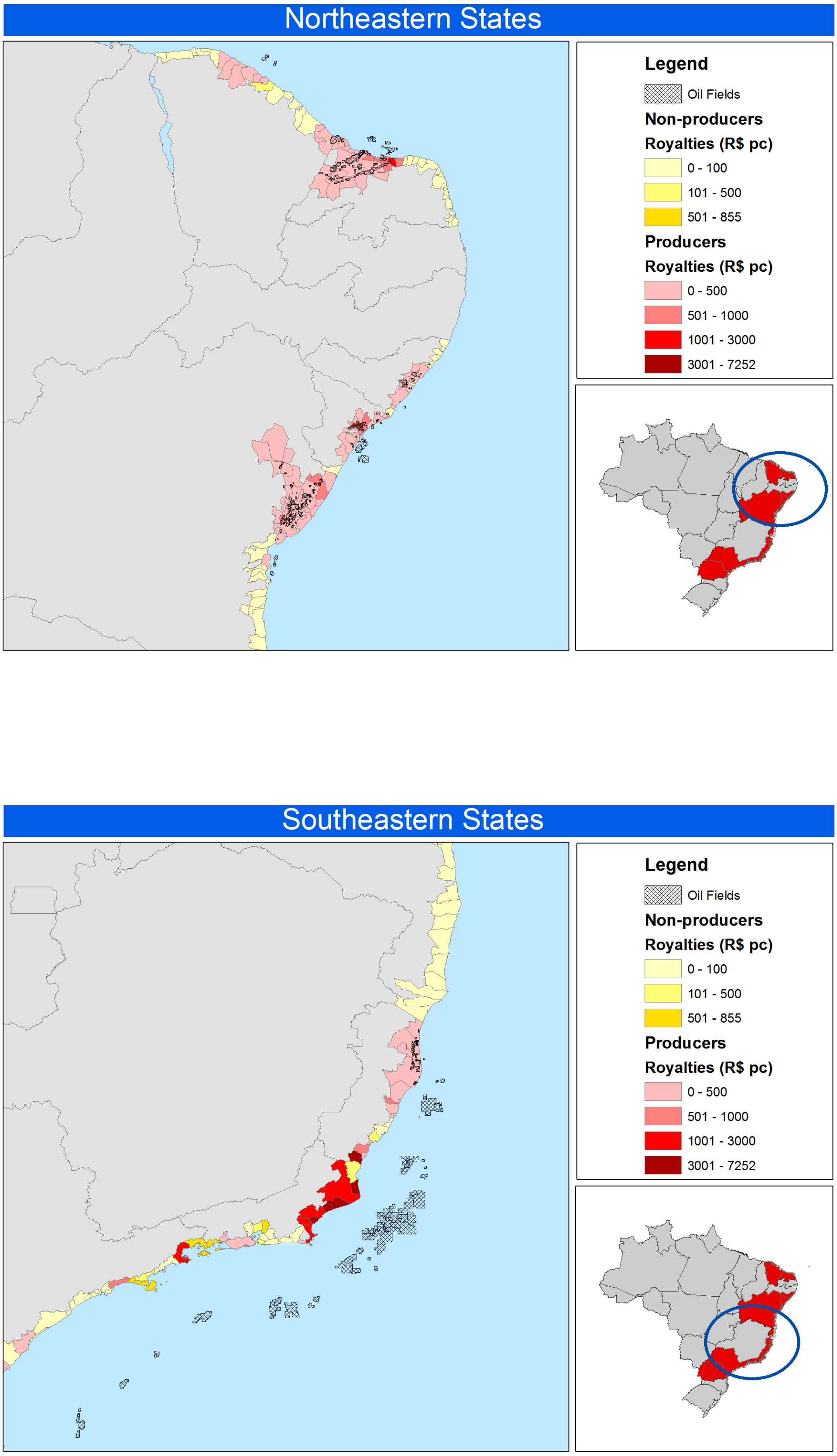
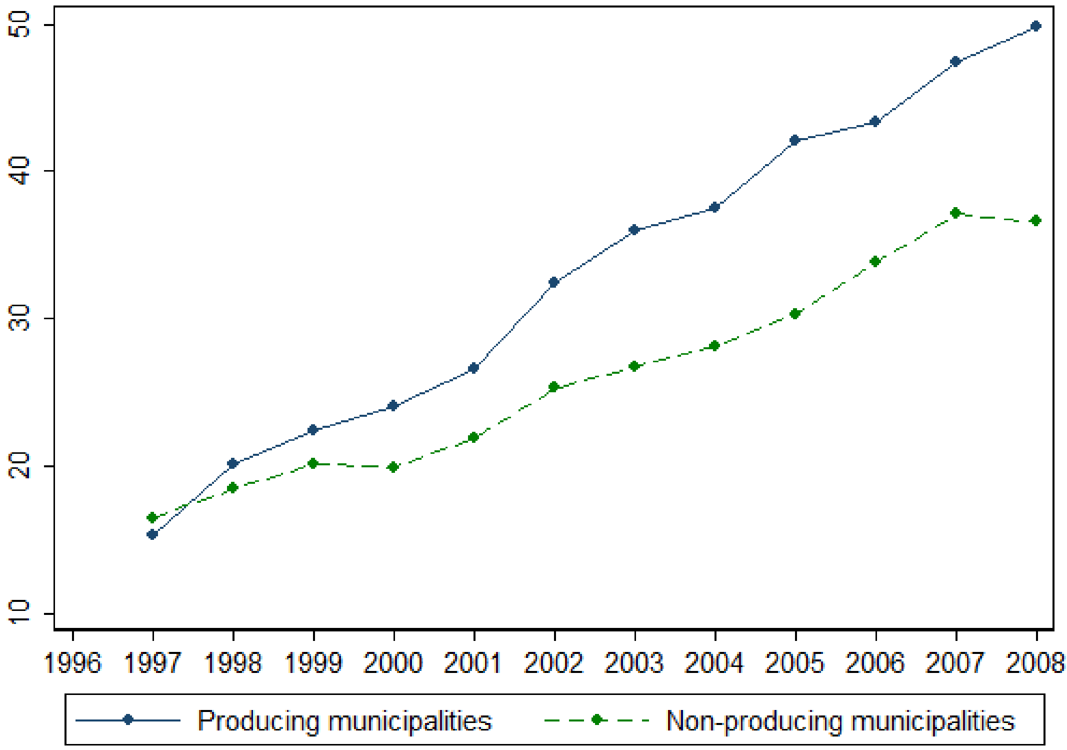


Figure 1.5: Municipal Employees in Oil Producing and Non-producing Municipalities 1997-2008



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