The Effect of Oil Windfalls on Corruption: Evidence from Brazil

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Abstract

Oil royalties provide a substantial but volatile inflow of non tax-payer money to municipal coffers. While a large literature examines the impact of oil on democratic emergence and stability, I examine how oil impacts corruption and the types of candidates elected under democracy. To predict the effects of oil royalties, I develop a formal model with moral hazard, adverse selection and endogenous entry. I show that natural resource windfalls generate the strategic entry of corrupt candidates and prevent voters from distinguishing politicians' integrity, creating cycles of corruption and reelection. I test this theory in Brazil, where offshore royalties are determined and allocated exogenously based on a geographic rule and the international price of oil. Consistent with the model, I find that a one standard deviation increase in oil royalties produces a 29% increase in corruption. The effects of windfalls on corruption are larger after elections during booms and lower during busts. Furthermore, oil royalties lead to a reelection cycle: when the price of oil is expected to be higher, incumbents are reelected more often than when the price of oil is expected to fall, independent of economic and individual level variables. I show that strategic entry of corrupt candidates during booms is likely the cause of these corruption and reelection cycles, as predicted by the theory. Taken together, these results point to a strong effect of oil royalties on local level corruption and electoral outcomes.

1 Introduction

In 2007, Brazil's President Lula da Silva announced that the oil discoveries off the shores of the Brazilian coast were a "gift from God"[1] and Dilma Rouseff, who would become Lula's successor, announced that the income from royalties would mean "more houses, more food and more health"[2] for Brazilians. However, citizens in the municipalities most affected by the windfalls from oil royalties have seen little to no improvement in their welfare, and corruption scandals involving their local governments have surfaced in these places in recent years.

Presidente Kennedy, a small coastal municipality in the state of Espírito Santo, is a case in point. Between 2005 and 2018, this small municipality was the highest royalty receiver in the state of Espírito Santo, pushing it to first place in the ranking of municipalities by GDP per capita in the entire country. However, only 38% of its residents have access to clean water and sewage systems and only 10% of its roads are paved. Additionally, about half of the municipality's population is dependent on some type of federal program like Bolsa Família, and the municipality ranks in the lower half of the distribution in terms of child mortality and educational attainment. How is it that the richest municipality in GDP per capita terms has such negative socio-economic indicators? One possible answer to this question is corruption. Since 2004, all of its elected mayors have been investigated and linked to corruption scandals. This case motivates the puzzle: Does increased access to oil revenues generally lead to an increase in corruption? And if it does, what explains this relationship?

This paper explores the effects of natural resource windfalls on political corruption. I argue that resource windfalls: (1) change politicians' budget constraints, (2) generate difficulties for voters to distinguish politicians' integrity, and (3) create incentives for corruptible candidates to enter politics, changing the pool of candidates that voters can use to replace incumbents.

[1] "dádiva de Deus" in Portuguese, https://www1.folha.uol.com.br/fsp/brasil/fc1111200721.htm

[2] "mais casas, mais comida, mais saúde", in Portuguese https://www1.folha.uol.com.br/fsp/dinheiro/fi0109200902.htm

Using a natural experiment in Brazil, I find significant effects of oil royalties on corruption outcomes, in line with the predictions of my model. Municipalities that receive oil royalties have systematically higher levels of corruption than those that do not receive royalties. I find that a one standard deviation increase in income from royalties leads to 29% increase in the fraction of funds used in a corrupt manner. Furthermore, corruption in royalty receiving municipalities is higher when the incumbent was elected during a boom than when he was elected during a bust.

Additionally, oil royalties lead to a reelection cycle: when the price of oil is expected to be higher, incumbents are reelected more often than when the price of oil is expected to fall, independent of economic and individual level variables. Findings on municipal expenditure support the theory by showing a diversion of funds towards activities which are more prone to corruption, and away from activities which are more closely audited by federal entities such as CGU in royalty receiving municipalities. Finally, I present results that suggest that endogenous entry of worse candidates during booms is likely the cause of these corruption and reelection cycles, as predicted by the theory.

Most of the literature on the resource curse discusses whether natural resources enhance the stability of autocratic regimes. We know much less about how natural resources affect the quality of democracy. A few recent studies examine the impact of resources on corruption, but most of them ignore the cyclical nature of the resource, do not consider equilibrium effects including incentives for entry into politics or suffer from identification issues. To this emerging literature on the impact of oil resources on political outcomes in democracies, I make one theoretical and two empirical contributions.

First, the theory provides micro-foundations linking resource windfalls to corruption. By focusing on politicians' incentives, I can account not only for the relationship between windfalls and corruption levels, but also the dynamic effects produced by price cycles. The theory is based on a formal model with moral hazard and adverse selection, where the politician can either be honest or dishonest, and voters do not directly observe his type. The politician competes with a pool of challengers, all of which can either be honest or dishonest. The politician can decide how much to embezzle, but voters can infer from their welfare whether the politician has stolen or not, and thus update their beliefs on politician type. Resource shocks create more uncertainty in voters' updating process, making it more difficult to identify honest types in the presence of these shocks. Given this, the politician may, under some circumstances, have incentives to act as if he were honest in order to ensure reelection, and thus steal in the next period.

Positive shocks, such as large exogenous windfalls created by oil shocks, generate interesting dynamic incentives for politicians and candidates. Larger flows of cash into government's coffers generate more opportunities to embezzle funds. Additionally, the shock generated by these windfalls creates a noisy signal to voters, making it more difficult to differentiate good types from bad types. Finally, the expectation of future inflows generates dynamic incentives for both incumbents and possible candidates. During booms, the incentive for dishonest politicians to pool with honest ones, and behave as if they were honest, is large given the expectation of more embezzlement opportunities in the future, leading to the reelection of more bad types. Furthermore, periods of booms attract more dishonest citizens into political careers, generating an additional effect on the reelection of dishonest types in office. This theory not only helps explain the observed reelection cycles in commodity dependent countries, where incumbents get reelected during booms and are voted out during busts, but also helps explain differences in the pool of candidates between royalty receiving and non-royalty receiving places, as well as during booms and busts.

My second contribution is empirical. Almost all research on the relationship between natural resource rents and political corruption is based on observational evidence and thus beset with identification problems. Oil production is potentially endogenous to the honesty of elected officials. In addition, oil windfalls determine embezzlement opportunities, affecting both the choice of citizens to run for office and the performance of those who are elected.

To overcome these difficulties, I focus on the Brazilian case. Since 1997, Brazil has distributed oil royalties to its municipalities based on an exogenous geographic rule and the international price of oil. This means that the amount of royalties a municipality receives in each period cannot be affected by the actions of the mayor in office, making Brazil an exemplary case study. Additionally, starting in 2003, the Controladoria-Geral da União (CGU - Federal Auditing Agency) began a random audit program where it randomly selected municipalities to be audited in depth. This data provides a representative sample of corruption outcomes in Brazilian municipalities, allowing for the identification of honest vs. dishonest politicians based on actual observed behavior.

The use of municipal level data resolves many of the issues that arise with cross-country data[3]. First, mayors have little say over extraction rates of oil in Brazil, especially in municipalities with offshore production. Oil production is highly centralized in Petrobras, the Brazilian National Oil Company, and decisions are made at higher administrative levels than municipalities. Second, Brazilian municipalities vary greatly in their reliance on oil royalties, which provides an excellent empirical test for both the effects of oil rents on corruption at the extensive margin (whether or not municipalities receive oil rents), and the intensive margin (how much oil rents they receive, which varies with production and price of oil). Third, offshore royalties are determined by an exogenous rule based on geographical location and the international price of oil (Caselli and Michaels 2013; Bhavnani and Lupu 2016), and offshore oil drilling does not significantly affect local economic outcomes (Caselli and Michaels 2013; Cavalcanti et al. 2019).

The third contribution is also empirical. I rely on calibration of the model to identify the

[3]Recent work has moved towards identifying micro-level effects, exploiting within country differences of resource wealth, corruption and other relevant outcomes such as economic growth, living standards, civil conflict and public goods provision (Dube and Vargas 2013; Carreri and Dube 2017; Caselli and Michaels 2013; Maldonado 2014; Martinez 2016; Monteiro and Ferraz 2012; Postali 2009; Vicente 2010) This approach is not only useful because it isolates the unobservable differences among countries, keeping general characteristics constant across observations, but it is also useful given the unreliable cross country data on corruption

effects of windfalls on decisions made by incumbents, voters and potential challengers. The incorporation of these three interrelated decision-making processes creates better estimates of the true impact of oil on corruption, and allow me to establish a causal identification of the mechanisms involved. By using the model's structure, I can disentangle the sanctioning effect from the selection effect from the entry effect. Using this method, I can quantify the effects of pooling and entry into politics.

These findings provide important insights into the micro-foundations of the oil curse and its dynamic effects. The results are generalizable to any place that is exposed to the fluctuations of the international commodity price cycle, especially those where a large part of the government budget is dependent on such price. Insulating local governments from such fluctuations could be a simple yet effective way of addressing many of the issues created by natural resource shocks.

2 The Political Resource Curse

The existing literature suggests that oil wealth has negative effects on a country's economy and governance. Although it may seem counter intuitive that ownership of a valuable natural resource generates adverse effects on a country's economy, the finding that oil has a negative impact on growth and democratic emergence and stability has been quite robust (Ross 2015). The first proponents of the idea coined the term Dutch Disease, whereby favorable conditions in the export commodity, such as a new discovery or a price increase, distort the overall economy by appreciating the real exchange rate and making other exports such as manufactures and agriculture less competitive (Corden and Neary 1982; Neary and van Wijnbergen 1985; Roemer 1983).

On top of this negative economic outcome, the literature has also identified negative political outcomes such as leader survival (Aslaksen 2010; Andersen and Aslaksen 2013), and the quality of democracy and likelihood of democratic transitions (Tsui 2011; Andersen and Aslaksen 2013; Gassebner et al. 2013). Alternatively, institutional quality at the time of the discoveries also matters when determining the effect of the discovery on the economy (Dunning 2008; Andersen and Aslaksen 2013). Politics matters, and so resource curse literature has had to account for the effects of resource shocks on institutions, as well as internalizing how political factors can mediate the negative economic consequences of the Dutch Disease. This new branch of the literature has been termed the "Institutional Resource Curse".

Empirical support for the "Institutional Resource Curse" has been found in many cross-country studies (Sachs and Warner 1995, 1999; Isham et al. 2005; Mehlum et al. 2006; Karl 1997; Ross 2001; Ahmadov 2014). The strongest effects found indicate that the negative effect of oil on democracy is through the prolongation of autocratic survival: oil entrenches autocrats and makes democratic transitions less likely (Cuaresma et al. 2011; Andersen and Aslaksen 2013; De Mesquita and Smith 2010; Egorov et al. 2009; Gandhi and Przeworski 2007; Wright et al. 2013). The relationship between oil and democracy is less straightforward. Some propose that oil has pro-democratic effects (Smith 2004; Dunning 2008; Morrison 2009; Tsui 2011), while others argue that there is no effect of oil on democracies, and that the relationship arises merely through stabilizing autocratic rulers' tenure (Caselli and Tesei 2011; Wiens et al. 2014; Andersen and Aslaksen 2013).

I argue that oil has a negative effect on specific aspects of the quality of democracy. So far, the literature has not been able to explain these differences in institutional quality within democracies that are mineral rich. Oil windfalls may not change whether a democracy breaks down or not, but they do affect more narrow institutional outcomes such as accountability, capacity to raise taxes, and corruption levels.

2.1 Windfalls, the Quality of Politicians and Corruption

While the causes of corruption have been widely studied (for comprehensive surveys see Svensson (2005), Treisman (2007), Golden and Fisman (2017)), the link between natural resources and corruption has been relatively understudied. Some work finds that natural resource wealth leads to more rent seeking behavior by economic elites as opposed to extractive corruption by politicians (Deacon and Rode 2012; Leite and Weidmann 1999) and the dynamic common pool resource models identify a similar effect related to the extraction of the resource (Lane and Tornell 1999; Velasco 1999). Bhattacharyya and Hodler (2010) develop a theoretical model with two types of politicians and show that higher levels of resource rents will lead to higher levels of corruption in weakly institutionalized countries. Their model does not consider the volatility of the resources or the incentives generated for more dishonest types to enter politics. They then test their hypothesis on panel data and find a positive effect of resource rents on corruption using the Corruption Index from the Political Risk Survey. Similarly, Arezki and Brückner (2011) find that increases in oil rents significantly increase levels of corruption. They test this hypothesis using fixed effects estimation on panel data from 1992-2005, using the Political Risk Survey as a measure of corruption. Busse and Gröning (2013) find a strong and significant effect of oil exports on corruption, but not other governance indicators.

Most of these studies however, do not provide a strong causal identification. All of them rely on cross country regressions, where measures of corruption are riddled with issues and tend to better portray corruption perceptions rather than actual corruption (Treisman 2007). It is difficult to establish causal relationships using cross-national, reduced from estimates.

In addition, most of the previous literature focuses on levels of oil dependence. In this paper, I argue that the cyclical nature of oil revenues generates dynamic effects on both corruption levels and the quality of candidates that decide to run for office. The main idea is derived from the fact that expected income from natural resources in the future can determine the way incumbents act in the present, and can also create incentives for dishonest politicians to decide to run for office, if they expect that they will be able to extract more rents in the future. This line of research focuses on the micro-foundations of the political resource curse, honing in on the ways resource rents change individual's incentives and through their actions, institutional outcomes.

Studies of this type have found that incumbents incentives change in the presence of resource shocks (Caselli and Cunningham 2009; Carreri and Dube 2017; Bhavnani and Lupu 2016). Using reduced form estimates, some find that incumbent politicians redirect funds to less productive uses (Caselli and Cunningham 2009), others find an increase in patronage and clientelistic practices (Bhavnani and Lupu 2016), and another set of studies finds that different type of politicians (linked to paramilitary groups) comes to power in presence of these shocks (Carreri and Dube 2017). In mineral-rich regions of India, Asher and Novosad (2019) report that global price shocks lead to both incumbency advantages in local elections and more frequent victories by candidates with criminal records. Vicente (2010) shows that voters perceive the higher levels of corruption that take place during an oil boom in São Tomé and Príncipe.

Monteiro and Ferraz (2012) look at oil royalties in Brazil between 2000 and 2008, and find that oil royalties generated an incumbency advantage effect only in the first term that a municipality received royalties, arguing that voters learn to disentangle the economic effect of the shock from the incumbent's performance. My paper provides an alternative mechanism to this argument, showing how price fluctuations generate dynamic incentives which can account for the cycles identified by Monteiro and Ferraz (2012). I also use elections between 2000 and 2016 to test my argument, and incorporate corruption data and cyclical, time varying effects into the theory. Furthermore, I show that the reduction in the effects of royalties estimated by them is likely due to the fall of oil prices during the 2008 election (the last election they consider), but the positive effects of oil on corruption show up again in 2012, so learning is likely not the mechanism that drove the reduction in the effect in 2008.

Theoretically, Brollo et al. (2013) is the closest study to this paper. The authors look at the effect of federal transfers to Brazilian municipalities on corruption levels. Their theory is based on a career concerns model with endogenous entry of candidates, where types are defined by competence and measured by years of schooling. They use a regression discontinuity design (RDD) to find that municipalities that received larger transfers had higher levels of corruption and candidate pools with lower average educational attainment.

Federal transfers, however, are not exogenous; rather, they are stable in time and are ultimately derived from taxes. The cyclical nature of oil is an important, and innovative aspect of my theory. Additionally, for Brollo et al. (2013), resource shocks deteriorate the quality of politicians as measured by their educational attainment. My argument is that this might not be the case since it is unclear whether educational attainment is negatively correlated with corruption. Because honesty is not an observable trait, the formal model and calibration exercise become an important part of the research design, since they allow us to estimate the candidate type from observed behavior. Finally, the sample in Brollo et al. (2013) is limited first by the number of municipalities for which they have corruption data and second by the conditions for the RDD where only municipalities close to the population thresholds are considered in their estimation. Therefore, their estimates can only be thought of as measuring a local average treatment effect.

This paper uses a similarly motivated model of entry into politics but the expected future inflows vary in a cyclical way, which generates effects that are substantially different to those identified in Brollo et al. (2013). I use the expected price of oil as determined in the futures market to define whether inflows are expected to grow or fall. This generates different expectations for periods of booms, when inflows are expected to keep growing, versus periods of busts, when inflows are expected to collapse. Additionally, I am able to calculate the effect of windfalls on corruption for all municipalities for which there is corruption data, since the assignment of royalties is exogenous to local politics. Finally, the model calibration allows me to recover the latent characteristics like honesty of the incumbent and honesty of the candidates entering into the pool, which in Brazil is likely uncorrelated with educational levels.

3 Theory: Intuition of the Model

The theory is based on a formal model with moral hazard and adverse selection, where the politician can either be honest or dishonest, and voters do not directly observe his type. The incumbent competes with a pool of challengers, all of which can either be honest or dishonest. The incumbent can decide how much to embezzle, but voters can infer from their welfare whether the politician has stolen or not, and thus update their beliefs on politician type. Voters' welfare depends on how much the politician spends, but there are decreasing returns to spending on public goods.

Incumbents must decide how much to spend on public goods provision and how much to extract for themselves, taking into account the effect their actions will have on their possibilities of reelection. Under some circumstances, the politician may have incentives to pool with the honest types, in order to ensure reelection, and thus steal in the next period.

The large exogenous windfalls created by oil shocks generate interesting dynamic incentives for politicians and candidates. Larger flows of cash into municipal coffers generate more opportunities to embezzle funds. Additionally, the shock generated by these windfalls creates a noisy signal to voters, making it more difficult for them to differentiate honest types from corrupt ones. Finally, the expectation of future inflows creates dynamic incentives for both incumbents and possible candidates. During booms, the incentive for dishonest incumbents to behave as if they were honest is large, given the expectation of more embezzlement opportunities in the future. This leads to the reelection of more corrupt types during periods when the expected future price of oil is high.

Additionally, periods of booms attract more dishonest citizens into political careers, generating an additional effect on the reelection of dishonest types in office. From the perspective of possible candidates, dishonest types have more incentives to enter politics when the expected future inflows are high, since they foresee more extraction opportunities. This creates an additional positive effect on the reelection of incumbents during booms, since the expected quality of the candidate pool deteriorates during these periods. This theory not only helps explain the observed reelection cycles in commodity dependent countries, where incumbents get reelected during booms and are voted out during busts, but also helps explain corruption outcomes and differences in the pool of candidates between royalty receiving and non-royalty receiving places which should change depending on whether the commodity prices are rising or falling.

4 A Model of Political Agency and Endogenous Entry in the Presence of Oil Royalties

The framework is based on a simple model of political agency by Besley (2004). The model shows how oil shocks affect corruption levels through three channels: (i) ex ante selection: oil shocks affect the type of politician who decides to run for office; (ii) moral hazard: oil shocks affect the incentives politicians have while in office; and (iii) ex post selection: oil shocks can affect the capacity of voters to evaluate politician type and select good politicians.

In the model, politicians can serve a maximum of two terms. In period 1, a randomly chosen incumbent sits in office and voters do not know his type. Elections take place at the end of each period, $t = 1, 2$. Politicians can either be honest (g) or corrupt (b) types, such that politician $i \in \{g, b\}$, and $Pr(g) = \pi_1$, denotes the probability that a randomly picked incumbent will be honest in period 1. For now, $\pi_1 = \pi_2$, and they are exogenous. Later I endogenize entry into politics, so π_2 will vary with the proportion of honest types that enter politics. The Politicians' utility functions are such that $U_t^i = R_t + (1 - c^i)s_t$, where $c^g = 1$ and $c^b = 0$, the honest politician cares about his ego rents and salary from being in office, R, while the corrupt politician cares about being in office and his rents, $s_t + R$. We can think of c_i as a morality cost of stealing.

During their first period in office, incumbents must decide how to allocate the funds they receive from taxes and federal transfers, x_t, and from oil royalties, Ω_t. Incumbents can use these funds to provide public goods, at a cost θ_t or to extract them as rent, s_t. I impose a maximum amount of rent extraction $\bar{s}$, which can be interpreted as a level of rent extraction that would inevitably land the politician in jail. θ_t can either be high or low, $\theta_t \in \{L, H\}$, and $Pr(\theta_t = H) = q$, where q denotes the probability that θ_t is high. We can think of θ_t as a random cost or competence shock, when it is high, the cost of providing public goods is higher, which could also represent lower competence. Thus, the politician's budget constraint is given by:

$$\Omega_t + x_t = \theta_t G_t + s_t \tag{1}$$

The two components of the government income follow different distributions in time, with x_t being a very stable and predictable source of income, and Ω_t representing a cyclical and unpredictable source of income, subject to strong external shocks determined by the international price of oil. Throughout the model, this feature of Ω will drive many interesting results.

Each period, nature determines the state of the world (realization of θ and Ω) and type of the politician if the incumbent is not reelected. The elected politician then chooses his preferred actions, G and s. Voters observe their welfare, $W_t = G_t^k$, where $k < 1$. Voter's utility is a concave function of G_t, which means that there are diminishing returns to public goods provision. Once voters observe their welfare, they decide whether to re-elect the incumbent or vote him out, randomly choosing a politician from the pool of challengers.

An equilibrium in this model is a series of actions and voting behaviors such that voters use Bayes' rule to update their beliefs on the type of politician, and both voters and politicians optimize (Besley 2004).

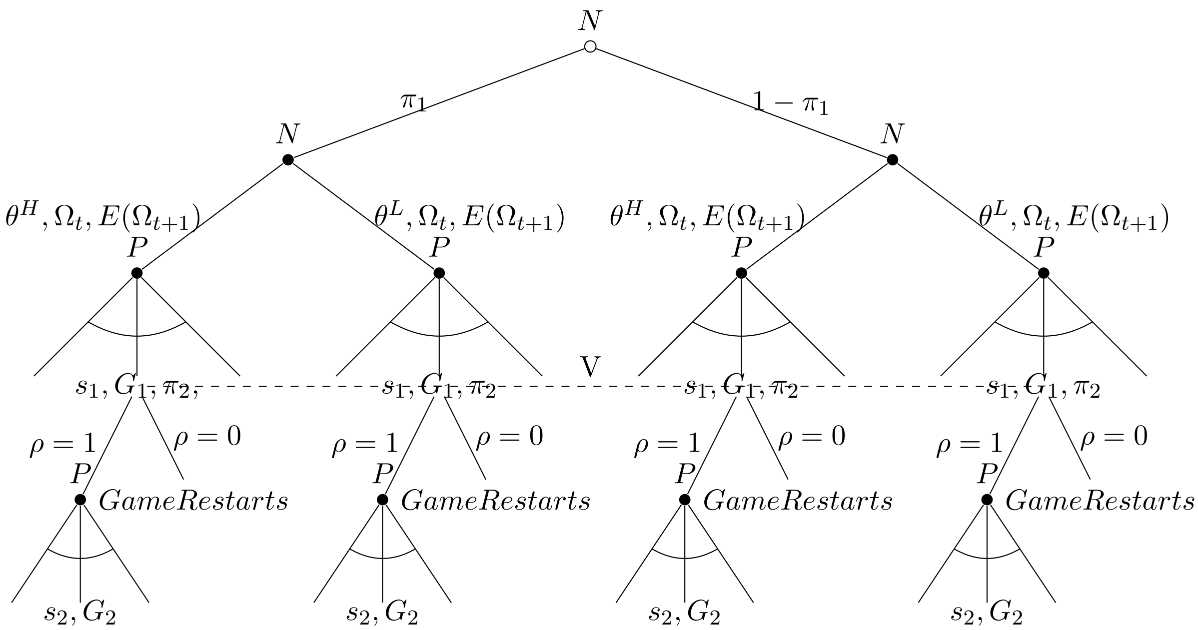

Figure 1: Extensive-form Game

4.0.1 Equilibrium Behavior

Honest politicians will never steal, so their equilibrium behavior for both periods will be $s_t^g = 0$ such that $G_t = \frac{x_t+\Omega_t}{\theta_t}$. The behavior of the corrupt politician is more interesting. To solve his optimal strategy, I use backwards induction. A corrupt politician in his second period, t=2, has no incentives to pretend to be an honest politician because he cannot be reelected for a third period. Thus, his optimal strategy is $s_2^b = \bar{s}$ and $G_2^b = \frac{x_2+\Omega_2-\bar{s}}{\theta_2}$.

In his first term, a corrupt politician has incentives to pool with honest politicians if this will increase his chances of reelection, thus allowing him to steal in the second period. This is especially true during periods where $\theta = L$. Given the cost shock, $\theta_t \in H, L$, we can see that $G_t(\theta = H) = \frac{x_t+\Omega_t}{H} < G_t(\theta = L) = \frac{x_t+\Omega_t}{L}$, so public goods provision will be higher during periods where the cost is low. Since θ is not observed by voters, a corrupt politician with a realization $\theta = L$ can pretend to be an honest politician with a realization $\theta = H$. This would lead to higher chances of him being reelected, as well as him being able to steal a bit in period 1, and a lot in period 2. Under this circumstances, an incumbent can steal

$s_b^{L_p}$, the amount a bad type can steal when the cost shock is low and he is pooling, which is defined by:

$$s_b^{L_p} = \frac{(H-L)(x_t + \Omega_t)}{H}$$

or $s_b^{L_p} = \bar{s}$ if $s_b^{L_p} \geq \bar{s}$.

Let λ denote the probability that voters observe $G(\theta = H)$ given that the type was (b, L), such that $\lambda = Pr(G = G(H)|\theta = L, i = b)$. Voters will update their beliefs about whether an incumbent is honest or dishonest depending on what they observe. The bayesian updating that takes place is defined by:

$$Pr(g|G(H)) = \frac{\pi q}{\pi q + (1-\pi)(1-q)\lambda} = \gamma$$

In this scenario, voters will reelect an incumbent with a positive probability, σ, only when $\gamma > \pi_2$, which only happens when $\lambda \leq \frac{q}{1-q}$. Note that since a politician is rational and takes into account his opportunity cost, he will only choose to pool, so $\lambda > 0$, if $s_b^{L_p} + \beta\sigma(x_2 + E(\Omega_2) + R_2) \geq x_1 + \Omega_1 + R_1$.

The dishonest politician thus has three choices when $\theta = L$: (1) he can pool with the honest politician, stealing a bit in period one in order to pretend to be good and ensure reelection and then extract maximum rents in period 2, (2) he can steal $\bar{s_1}$ and get voted out, or (3) he can pursue a mixed strategy equilibrium where with some probability he plays a pooling equilibrium and with some probability he plays a separating equilibrium.

The conditions under which the politician will choose each equilibrium are as follows:

Equilibrium Type	Behavior	Conditions: Exists iff
Pooling Equilibrium	$\lambda = \sigma = 1$	$q \geq \frac{1}{2}$ & $s_b^{L_p} + \beta\sigma(x_2 + E(\Omega_2) + R_2) \geq x_1 + \Omega_1 + R_1$
Hybrid Equilibrium	$\lambda = \frac{q}{1-q}$; $\sigma > 0$	$q < \frac{1}{2}$ & $s_b^{L_p} + \beta\sigma(x_2 + E(\Omega_2) + R_2) = x_1 + \Omega_1 + R_1$
Separating Equilibrium	$\lambda = 0; \sigma = 1$	$s_b^{L_p} + \beta\sigma(x_2 + E(\Omega_2) + R_2) \leq x_1 + \Omega_1 + R_1$

4.0.2 Endogenous Entry

The decision of politicians to pool or not depends on their expected probability of reelection, which in turn depends on voters' decisions to reelect the incumbent or not. Voters will choose to reelect an incumbent when they perceive that the probability that the incumbent is honest, γ, is larger than their expected probability of choosing an honest politician from the pool of candidates, π_2. In this section, I allow for endogenous entry into politics, so that π_2 is endogenously determined by the choice of citizens to enter politics or not.

In order to construct solutions for the endogenous determination of π_2, we assume that society is composed of n people. A proportion α of these people are honest, while $1 - \alpha$ denotes the proportion of dishonest citizens. Citizens decide whether to enter politics or seek employment in the private sector, where outside wages are determined by a uniform distribution: $w^i \sim U[0, W^i]$, where $W^g \lesseqgtr W^b$. The pool of candidates for a given place is thus determined by the number of honest and the number of dishonest citizens that wish to enter politics. If voters choose not to reelect an incumbent, they elect a candidate from the pool. The challenger that wins is a random draw from the pool of politicians[4].

At the beginning of period 2, dishonest citizens will enter politics if $x_2 + E(\Omega_2) + R_2 \geq \bar{w}$, while honest politicians will enter politics if $R_2 \geq \bar{w}$, where $\bar{w}$ denotes the threshold level. This means that a fraction $\eta^g = \frac{R_2}{W^g}$ of honest citizens will enter politics, while a fraction $\eta^b = \frac{x_2+E(\Omega_2)+R_2}{W^b}$ of dishonest citizens will enter politics. Given these rates of entry, the pool of candidates will be composed of $\frac{R_2}{W^g}\alpha n$ honest challengers and $\frac{x_2+E(\Omega_2)+R_2}{W^b}(1-\alpha)n$

[4] This is a simplification based on Besley (2004). Like Besley, I do not allow for challengers to signal their type or make investments to modify their chances of winning. These are possible extensions of the model.

dishonest challengers.

Thus, the endogenously determined probability of selecting an honest candidate from the pool of candidates is now:

$$\pi_2 = \frac{\frac{R_2}{W^g}\alpha}{\frac{R_2}{W^g}\alpha + \frac{x_2+E(\Omega_2)+R_2}{W^b}(1-\alpha)}$$

This can also be written as $\pi_2 = \frac{1}{1+\Delta}$ where

$$\Delta = \frac{x_2 + E(\Omega_2) + R_2}{R_2}\frac{W^g}{W^b}\frac{1-\alpha}{\alpha}$$

The main impact of π_2 on the equilibrium behavior of politicians and voters comes from the comparison voters make between γ and π_2, when choosing whether to reelect the incumbent politician. This, in turn, affects a politician's behavior by creating incentives for him to pool or not pool with an honest type, which changes his probability of being reelected.

We have that

$$Pr(g|G = G(H)) = \frac{\pi_1 q}{\pi_1 q + (1-\pi_1)(1-q)\lambda} = \gamma$$

Voters will reelect incumbent with a positive probability (σ) only when $\gamma > \pi_2$. How does the relationship between γ and π_2 change with endogenous entry? We can see that $\frac{\partial \gamma}{\partial \pi_1} > 0$, which means that for higher values of π_1, voters can expect with a higher probability that the politician is an honest type when they observe $G(H)$. This derives from the fact that a higher π_1 means that there was a higher ex ante probability that the politician was honest. However, for now π_1 is held constant, since we are not solving for endogenous entry in the first period.

We are interested in the comparison of γ and π_2, where π_2 is determined by a series of factors. Our main variable of interest is $E(\Omega_2)$. We can see that $\frac{\partial \pi_2}{\partial E(\Omega_2)} < 0$, meaning that when the expected future price of oil is high, more dishonest citizens are running for office, causing a deterioration of the candidate pool. Thus, when the expected future price of oil is high, the expected quality of challengers is lower and voters will tend to observe that $\gamma > \pi_2$, and reelect the incumbent. The opposite is also true, when the expected price of oil is low, voters expect the pool of candidates to be better because dishonest candidates have less incentives to run for office, and thus voters are more likely to observe $\gamma < \pi_2$, and choose to vote out the incumbent, electing a challenger from the candidate pool.

Equilibrium Type	**Behavior**	**Conditions: Exists iff**
Pooling Equilibrium	$\lambda = \sigma = 1$	$q \geq \frac{(1-\pi_1)\pi_2}{\pi_1 - 2\pi_1\pi_2 + \pi_2}$ & $s_b^{L_p} + \beta\sigma(x_2 + E(\Omega_2) + R_2) \geq x_1 + \Omega_1 + R_1$
Separating Equilibrium	$\lambda = 0; \sigma = 1$	$s_b^{L_p} + \beta\sigma(x_2 + E(\Omega_2) + R_2) \leq x_1 + \Omega_1 + R_1$

Given this equilibrium behavior, we can derive the following propositions:

Proposition 1: The pooling equilibrium will occur only if (1)$q \geq \frac{(1-\pi_1)\pi_2}{\pi_1 - 2\pi_1\pi_2 + \pi_2}$ and (2) $s_b^{L_p} + \beta\sigma(x_2 + E(\Omega_2) + R_2) \geq x_1 + \Omega_1 + R_1$.

(1) is the necessary condition for voters to reelect the incumbent given that they observe G^H, while (2) is the incentive compatibility condition that ensures that it is worthwhile for the incumbent to pretend to be a good type in period one so that he can be reelected and steal more in period 2.

Proposition 2: The effect of oil can influence the equilibrium via two channels: through its effect on π_2 in (1) and through its effect on the incentive compatibility restriction, (2). The higher the expected oil rents, the higher the likelihood that (1) is satisfied, and the higher the likelihood that (2) is satisfied. Thus, pooling becomes more likely when expected oil rents are high.

4.1 Predictions of the Model and Comparative Statics

The results of the model suggest that we can make the following predictions derived from the model's different parameters:

Prediction 1: Rents (s_1) are an increasing function of oil revenue today Ω_1.

Prediction 2: Rents (s_1) are a decreasing function of oil revenue tomorrow $E(\Omega_2)$ compared to oil revenue today Ω_1. This is driven by corrupt first term mayors pooling in an attempt to get reelected.

Prediction 3: Reelection is more likely when the initial pool of candidates , π_1, is high.

Prediction 4: Reelection is more likely when the incoming pool of candidates is low, which happens when $E(\Omega_2)$ is high, since $(\frac{\partial \pi_2}{\partial E(\Omega_2)}) < 0$. Corrupt incumbents enter the race in an attempt to access rents in the future.

Prediction 5: More corrupt types will be reelected when $E(\Omega_2)$ is high compared to Ω_1. This is also a function of corrupt types stealing a little less in their first term in an effort to pool and get reelected.

Prediction 6: The number of candidates entering a race should be higher when $E(\Omega_2)$ is high compared to Ω_1.

Prediction 7: The quality (honesty) of the pool of candidates should be lower when $E(\Omega_2)$ is high compared to Ω_1.

For the purposes of the paper, I consider elections that happen when $\Omega_1 < E(\Omega_2)$ as elections during booms, and elections where $\Omega_1 > E(\Omega_2)$ as elections during busts. Table 1 shows the comparative statics derived from the model for royalty receiving municipalities. The comparative statics imply certain effects during elections, such as reelection rates, number of candidates running for office and the quality of the pool of candidates, as well as effects for the period after elections, such as the number of corrupt incumbents that are reelected (due to pooling) and the levels of corruption.

4.2 Empirical Implications of the Model

In the Brazilian context under study, the implications of the model are the following:

H1: *Corruption will be higher in royalty receiving municipalities.* This is mainly driven

Table 1: Comparative Statics for Royalty Receiving Municipalities: Booms versus Busts

	Elections during Booms $\Omega_1 < E(\Omega_2)$	**Elections during Busts** $\Omega_1 > E(\Omega_2)$
Prob. Reelection	+	-
Candidates Reelected	+	-
Corrupt Candidates Reelected	+	-
Number of Candidates	+	-
Honesty of Pool of Candidates	-	+
	Term After Boom Election	**Term After Bust Election**
Prop. Corrupt Incumbents	+	-
Corruption	+	-

by the moral hazard effect of the shocks. Large inflows generate more opportunity to to embezzle at a lower cost to voters (given the diminishing returns to scale).

H1.b: *Corruption will be higher for second term mayors.* This is driven by the fact that second term mayors have no incentive to pretend to be good types because they cannot get reelected.

H1.c: *Corruption will be high after a boom election and lower after a bust election* This is driven by the selection effect. Corrupt mayors pool more during booms and so are reelected more often during booms, leading to higher corruption in the term after a boom election.

H2*: Reelection rates will be high when the expected price of oil is high, resulting in a higher number of corrupt types getting reelected and high levels of corruption in their second term.* This is driven by two effects. First, the fact that corrupt types will pool with honest types with a higher probability when the expected inflows from oil are higher in the next period. Second, the fact that more corrupt types will enter politics when expected royalties are expected to be high, leading voters to reelect incumbents more often.

H2.b*: Reelection rates will be lower when the expected price of oil is lower than the current price of oil.* When the level of royalties is high and the expected future income from royalties is low, corrupt incumbents will steal as much as possible and likely not get reelected.

H3*: The pool of candidates will contain more corrupt types when future royalties from* *oil are expected to be high.* This hypothesis stems from the fact that corrupt types will perceive that there are more embezzlement opportunities in these municipalities, making politics relatively more attractive compared to the outside market.

5 Data, Measurement and Identification Strategy

In order to test the hypotheses, I turn to the case of Brazil. Almost all previous research on the relationship between natural resource rents and political corruption is based on observational evidence and thus beset with identification problems. Oil production is potentially endogenous to the honesty of elected officials. In addition, oil windfalls determine embezzlement opportunities, affecting both the choice of citizens to run for office and the performance of those who are elected. Brazil provides us with an optimal setting to test the theory at the micro-level, given the existence of exogenously determined oil royalties and unbiased corruption measures for a representative sample of municipalities.

5.1 Measuring Windfalls

To overcome identification concerns, I exploit a natural experiment where royalties in Brazil are allocated to municipalities based on an exogenous geographic rule and the international price of oil. In Brazil, oil royalties are distributed on a monthly basis to States and Municipalities as a way of compensating for the exploitation and production of petroleum and natural gas. These royalties began to be distributed when the state owned oil company, Petroleo Brasileiro SA (Petrobras) was created under Law No. 2004 of October 3, 1953. At this point, Brazil was not a large producer of oil, and most of the reserves were onshore, and the expectation was that any future discoveries would likely be found in the North East of Brazil (Brambor 2016).

It was only after the important discovery of oil in the Campos Basin, off the coast of the state of Rio de Janeiro, that the law was extended to include and regulate offshore royalty payments. The rule of allocation was defined by projecting the borders of municipalities

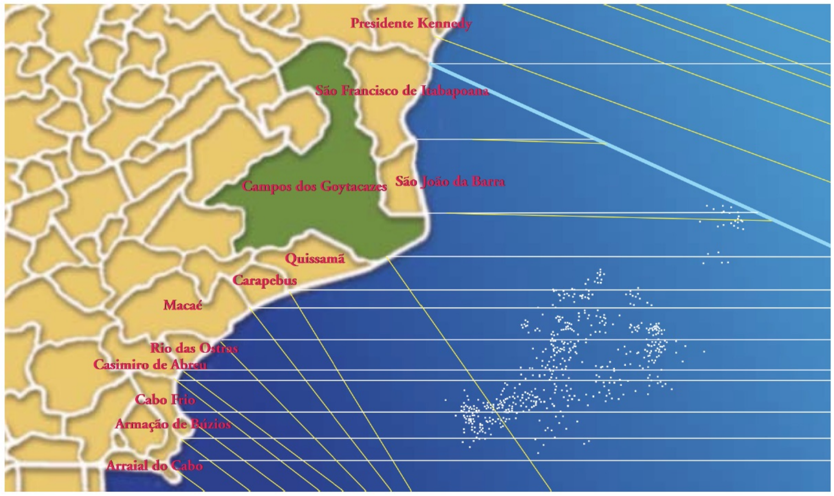

Figure 2: Geographic Rule for Royalty Assignment in Rio de Janeiro, Brazil. Source: Barbosa (2001)

into the ocean, using both parallel to the latitude lines and orthogonal to the municipal borders, as shown in Figure 2. Municipalities can receive royalties if they are designated as principal producing municipalities, secondary producing municipalities (neighboring cities) and whether they are in any way affected by production of oil (for example, if a pipeline passes through the municipality.

A municipality is considered a producing municipality if it faces an oil well, according to the parallel and orthogonal lines. Furthermore, these lines were not defined by political negotiations and were not subject to municipal interests since they were defined by the IBGE based on geodesic lines. Offshore royalties are thus exogenously determined, as municipalities have no capacity to determine where oil fields will be located, and once these rules were set in 1985, they could not modify their geographic characteristics. Additionally, offshore production represents 90% of total oil production in Brazil, and the infrastructure dedicated to provide support and services to this offshore production is concentrated in one city in Rio de Janeiro, Macaé (Monteiro and Ferraz 2012). Figure 3 shows that most of the royalties are concentrated in coastal states, with the exception of a large source of onshore royalties located in the Amazon (Brambor 2016).

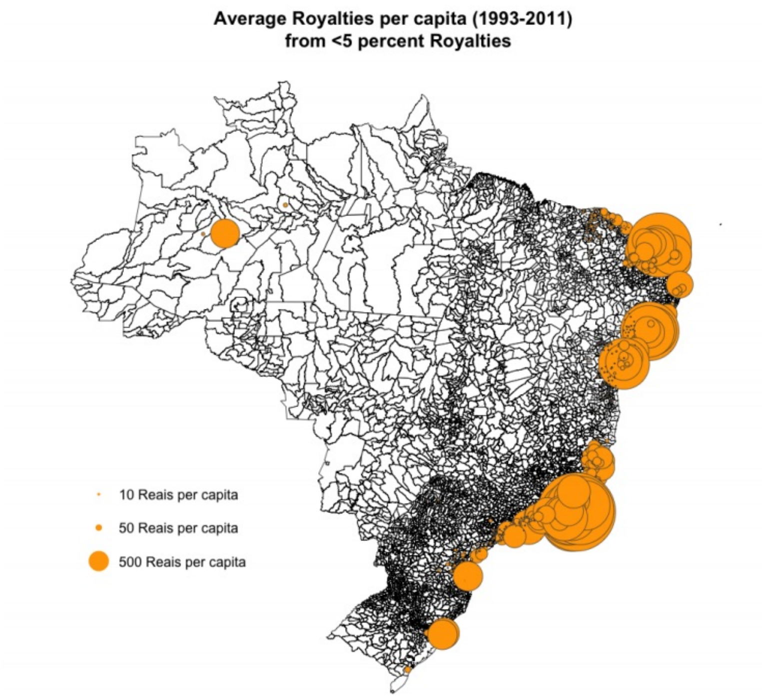

Figure 3: Geographic Distribution of Oil Royalties (includes offshore and onshore). Source: Brambor (2016)

Municipalities in Brazil are the main receivers of royalties, receiving between 34% and 24% of total royalty payments distributed by the Federal Government, depending on the year we analyze. All this has resulted in royalty receiving municipalities experiencing a strong external shock to their finances.

The change in the law in 1997 together with the rise of the price of oil meant a large increase in external transfers to municipalities. The drop in the price of oil in 2008-2009 together with the political and management crisis in Petrobras has only made oil royalties more volatile and unpredictable. Brazilian municipalities thus provide a uniquely suitable setting for testing the theory presented above.

5.2 Measuring Corruption

To overcome the difficulty of observing and measuring political corruption, I use data on corruption obtained from random audits conducted by the Brazilian federal government.

Most of the previous literature on corruption relies on cross-national measures of corruption, which suffer from important data limitations. Transparency International's Corruption Perceptions Index and the Political Risk Survey Corruption Index are ultimately measures of perceived corruption by elites (Treisman 2007). It is not clear how well actual levels of corruption map onto corruption perceptions, since it is likely that such perceptions are muddled by other factors such as overall economic strength and lack of bureaucratic hurdles (Treisman 2007). These factors may in turn correlate with the outcomes of interest, making the estimated effects unreliable. The use of micro-level measures of observed corruption solves many problems associated with corruption perceptions indexes used in previous literature, since the measure reveals actual corruption levels.

Brazil has some of the best micro-level data on actual corruption levels. In 2003 the auditing agency (CGU- Controladoria-Geral da Uniao) began randomly selecting 50 municipalities with population less than 500,000 to be audited. The number has now risen to 70 randomly selected municipalities. Due to the population cut-off, this process excludes about 8 percent of Brazil's approximately 5,500 municipalities, comprising mostly the state capitals and large coastal cities which are more heavily populated.

In this paper, I use data from the random audits to construct dataset that contains corruption measures between 2000 and 2017. My measure follows Brollo et al. (2013) who create a corruption variable which identifies the fraction of audited funds which were involved in corrupt acts.[5] The randomization of the audits eliminates any bias in the measure of corruption which could result from selection of municipalities into being audited. Common concerns with measures of corruption through audits that are not randomly assigned include issues like: (i) municipalities that are more corrupt are more likely to be audited, which leads to overestimation of corruption; (ii) politically connected municipalities are less likely to be audited, and if these are also more corrupt, then corruption would be underestimated. Given

[5] Results are robust to using only Brollo et al. (2013) data or only Ferraz and Finan Avis et al. (2018) data, however my data provides a longer timeline which helps capture the dynamic effects of oil.

the random assignment to audits, the data used for this paper is free of these issues. The types of corrupt acts covered by the dataset include fraud in procurement activities, missing funds or diversion of funds, over-invoicing and other inconsistencies in the municipalities' finances such as fake receipts, invoicing fake firms, etc.

The data on corruption is thus a pooled cross section of random audits. The data provides a representative sample of municipalities, making it possible to make comparisons without having typical problems of pooled cross sections that are not randomly selected. However, the probability of a municipality being selected for audit more than once during this period is quite low. The data is available for 4 terms (2001, 2005, 2009 and 2013) from 40 lotteries between 2001 and 2017.

When a municipality is selected to be audited, CGU issues a number of service orders to determine which funds it will audit. On average, CGU issues 6.4 service orders per Municipality-Year, which means that in a four year term, there will be about 26 service orders per municipality. CGU then prepares a report where it identifies instances within each service order. Instances are generally defined as "Falha Grave", serious offenses, or "Falha Media", medium offenses. Serious offenses are generally acts of corruption such as the detections of fraud in procurement activities, diversion of funds, over-invoicing and other inconsistencies in the municipalities' finances such as face receipts and invoicing fake firms. Medium offenses usually imply some form of mismanagement where relevant information is missing, workers miss important deadlines, etc.

I consider only serious offenses as corruption, since most of the medium offenses seem like bureaucratic errors that are either due to incompetence or human error, but would not qualify as a pre-meditated act of corruption. Under this coding scheme, there is an average of 1.15 corrupt acts per municipality-year and 6.64 corrupt acts per municipality-term. Figures 4- 7 show the distribution of service orders and corrupt acts identified per municipality-year and municipality-term. Thus, the fraction of audited funds that were involved in corruption can be seen in Figure 8. The average percentage of funds involved in corruption is 19.5%, which means that almost 20% of all audited funds were associated with an act of corruption.

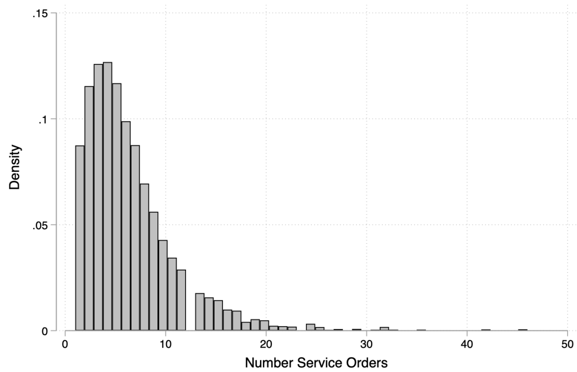

Figure 4: Number of Service Orders Per Municipality-Year

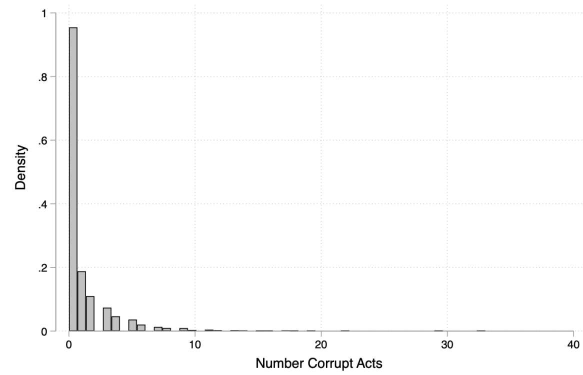

Figure 5: Number of Corrupt Instances per Municipality-Year

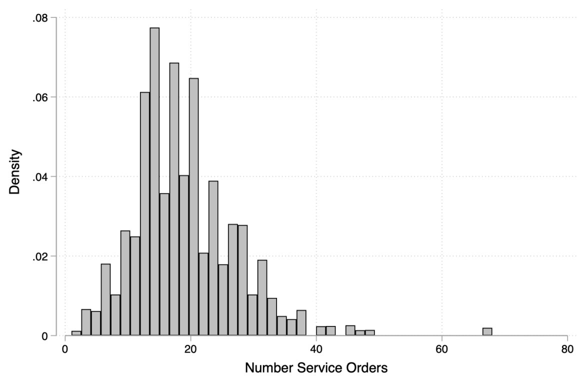

Figure 6: Number of Service Orders Per Municipality-Term

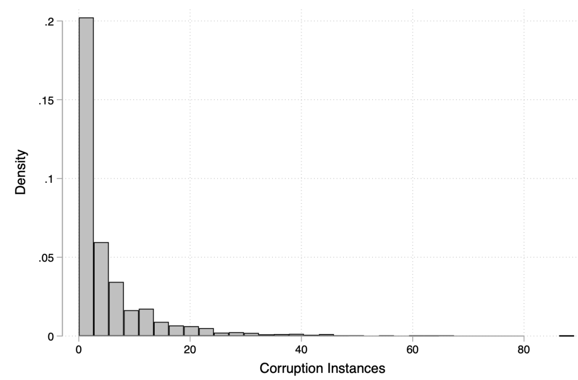

Figure 7: Number of Corrupt Instances per Municipality-Term

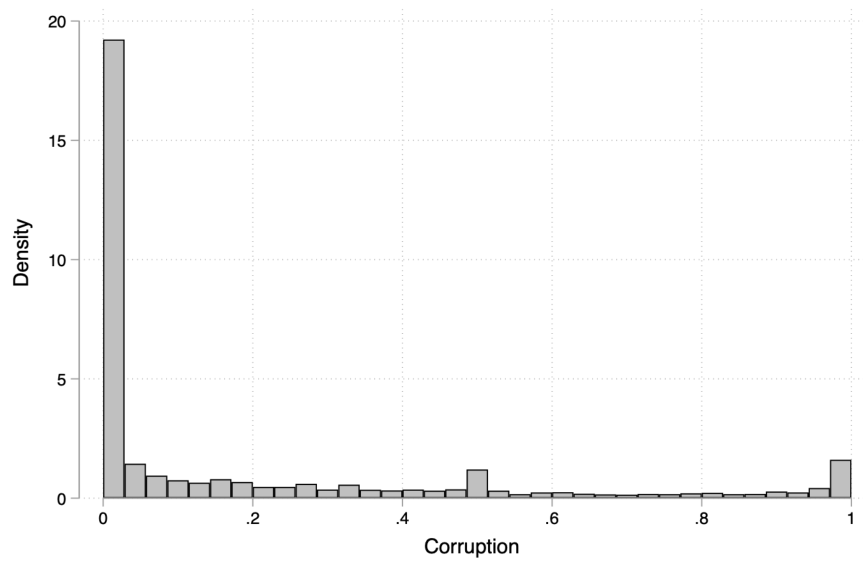

Figure 8: Fraction of Audited Funds Identified as Corruption

6 Results

In this section, I present results for the hypotheses derived from the model. All regressions that include corruption are run on the sample of municipalities selected to be audited. Table 2 shows the summary statistics for these dataset by whether a municipality is a royalty receiver (Oil) or not (Non Oil). The mean levels of corruption appear to be higher in oil municipalities, where corruption reaches 21.6%. In non oil municipalities, corruption is about 14.8%. Oil municipalities also are larger, richer and more urban, which makes sense given that they are mostly coastal cities which tend to be richer and more populous in Brazil. In what follows, I will restrict the sample to compare only to municipalities in coastal states and will control for all relevant variables which may capture any systematic differences between oil and non oil municipalities. It is worth mentioning that given the geographic rule of royalty allocation, sometimes two neighboring municipalities which have very similar characteristics will differ greatly on the amount of royalties received, which makes the strategy of identification more sound.

Table 2: Balance between Oil and Non Oil Municipalities in Sample

Variable	(1) Non Oil	(2) Oil	(3) Difference
Corruption	14.797	21.583	6.787***
	(21.792)	(27.578)	(0.945)
PMDB	0.190	0.163	-0.027*
	(0.392)	(0.370)	(0.016)
PSDB	0.131	0.120	-0.011
	(0.338)	(0.325)	(0.014)
PT	0.064	0.075	0.010
	(0.246)	(0.263)	(0.010)
PTB	0.061	0.043	-0.018*
	(0.239)	(0.204)	(0.009)
Term Limited	0.240	0.280	0.040**
	(0.427)	(0.449)	(0.018)
Highscool Education	0.775	0.842	0.068***
	(0.418)	(0.365)	(0.017)
College Education	0.487	0.556	0.069***
	(0.500)	(0.497)	(0.020)
Industry	0.132	0.132	0.000
	(0.000)	(0.000)	(0.000)
Agriculture	0.491	0.491	0.000
	(0.000)	(0.000)	(0.000)
services	0.085	0.085	0.000
	(0.000)	(0.000)	(0.000)
Municipal GDP	682869.688	2.989e+06	2.306e+06***
	(5.722e+06)	(2.617e+07)	(537662.500)
Population	34,229.953	79,907.078	45,677.129***
	(115370.562)	(459617.531)	(9,665.949)
Percent Urban	0.605	0.639	0.033***
	(0.232)	(0.225)	(0.010)
Percent Rural	0.395	0.361	-0.033***
	(0.232)	(0.225)	(0.010)
Female	0.061	0.087	0.025**
	(0.240)	(0.282)	(0.010)
Total Revenue	0.098	0.098	0.000
	(0.000)	(0.000)	(0.000)
Taxes	0.055	0.055	0.000
	(0.000)	(0.000)	(0.000)
Federal Transfers	0.232	0.232	0.000
	(0.000)	(0.000)	(0.000)
Total Expenditure	0.100	0.100	0.000
	(0.000)	(0.000)	(0.000)
Admin Expenditure	0.182	0.182	0.000
	(0.000)	(0.000)	(0.000)
Observations	2,823	761	3,584

6.1 The Effect of Royalties on Corruption

Do oil royalties lead to higher corruption? A preliminary analysis of the data shows that the levels of corruption found in royalty receiving municipalities is higher than the levels of corruption in non royalty receiving municipalities. Figure 9 shows the difference in the distribution of corrupted funds between oil municipalities and non oil municipalities, where oil municipalities are classified as those municipalities which received offshore royalties in the period. The distribution for oil municipalities is skewed to the right when compared to non oil municipalities, which indicates that there is higher levels of corruption in municipalities which are receiving offshore royalties.

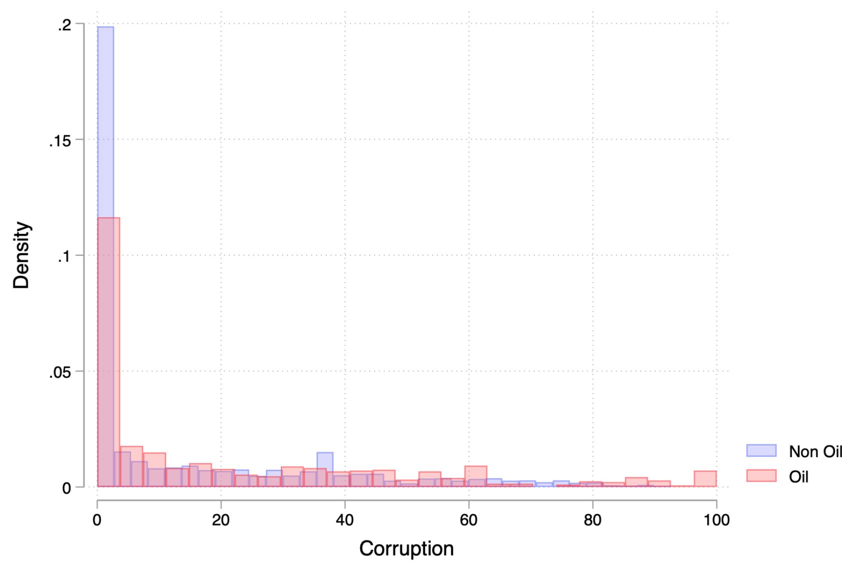

Figure 9: Corruption in Oil and Non Oil Municipalities

In order to test whether the difference in corruption levels between royalty receiving municipalities and non royalty receiving municipalities is robust to the addition of controls and other municipal characteristics, I turn to regression analysis. Ideally I would want to run a panel regression using municipality fixed effects, but since my data is a pooled cross section, I conduct the following regression:

$$C_{i,t} = \alpha_1 R_{i,t} + X'_{i,t}\beta + \epsilon_s + \epsilon_t + \mu_{i,t} \quad (2)$$

Where C_i represents the level of corruption in municipality i, during term t measured as the fraction of the funds received during term t which where used in a corrupt way. $R_{i,t}$ represents a variable measuring royalties. $X'_{i,t}$ represents control variables which may influence the level of corruption, such as the amount of federal funds and local taxes received, as well as mayor characteristics such as education, gender and party, ϵ_s, ϵ_t are state fixed effects and term fixed effects $\mu_{i,t}$ is an idiosyncratic error. Errors are clustered at the state level.

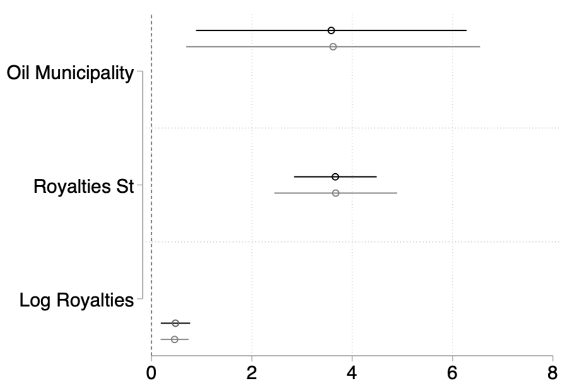

Figure 10: Effect of Royalties on Corruption: Dependent Variable is Fraction of Funds Used in a Corrupt Way in Each Municipality-Term.

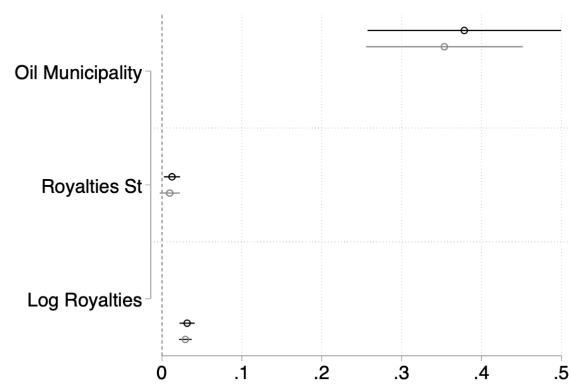

Figure 11: Effect of Royalties on Corruption: Dependent Variable is Indicator For Whether Corruption was Identified in this Municipality-Term.

This regression is run with three measures of $R_{i,t}$: (i) an indicator, "Oil Municipality", for whether the municipality was a royalty receiving municipality in that term, (ii) a variable which measures the standardized amount of royalties received, and (iii) the natural logarithm of royalties received. All regressions include state, lottery and term fixed effects. Standard errors are clustered at State level.

The results are presented in Figures 10 and 11. For each independent variable $R_{i,t}$, the dark gray coefficient is from a model only with state and term fixed effects and the light gray coefficient is from a model which includes relevant covariates such as population, GDP, federal transfers, income from taxes, whether the incumbent was college educated, female, term limited, and political party indicators. Figure 10 shows the effects our three measures of royalties on the percent of funds used in a corrupt way, while Figure 11 shows the effect of the measures of royalties on an indicator which takes the value of 1 if any corrupt acts are identified within a municipality-term. The full regression results can be found in Tables 9 and 10 in the appendix.

The coefficient on royalties is positive and significant for all specifications, indicating that municipalities that receive higher royalties display higher levels of corruption. The coefficients of the indicator variable suggest that royalty receiving municipalities display about 3.6% more funds used in a corrupt way than their non royalty receiving counterparts. Considering that the average level of corrupt funds is 20%, this is a sizable effect. Similarly, oil municipalities are about 36% more likely to present at least one corrupt instance within the audits. This is the extensive margin, i.e. whether you receive royalties or not.

When we look at the intensive margin, i.e. how much royalty income a municipality receives, the effects are also significant and large. A one standard deviation increase in royalties leads to about a 3.7% increase in corruption. The results for the corruption indicator shown in Figure 11 show that a one standard deviation in royalties leads to only a 1% probability increase in the likelihood of having a corrupt instance, which demonstrates that the effects found are likely to be driven by municipalities that receive a lot of funds and display significantly higher levels of corruption. Again, this is shown by the coefficients for the Log Royalties variable, where a 1% increase in royalties leads to a 0.5 percentage point increase in corruption. This means a 10% increase in royalties would lead to 5% more of audited funds being used in corrupt acts, a sizable effect. Finally, the coefficients for Log Royalties in Figure 11 shows that a 1% increase in royalties leads in increase of about 3% in the likelihood of having at least one corrupt instance in the term.

Term limited mayors appear to be more corrupt in most intensive margin specifications, however do not show any significance on the extensive margin (see Table 10 in Appendix). This is in line with the results found by Ferraz and Finan (2011), and is also in line with the predictions of my model. Political parties do not appear to be significant. Furthermore, most of the controls do not appear to be significant except for the model with coastal municipalities only where municipalities with higher total revenue (excluding oil royalties) appear to be less corrupt, municipalities with higher federal transfers appear to be less corrupt and municipalities with higher total expenditures are more corrupt. The size of these effects is smaller (but similar) to the effects of oil rents.

Figure 12 shows the differential effects of royalties on first versus second term mayors. Dark gray coefficients correspond to first term mayors while light gray coefficients correspond to second term mayors. The first two coefficient show the effects of the royalty indicator variable, the 3rd and 4th coefficient show the effects of the standardized royalty variable and the 5th and 6th coefficient show the effects of the log royalties variable. We can see that the effect of royalties is larger on second term mayors than first term mayors for all measures of royalties. This is likely showing the fact that second term mayors no longer face reelection, and so they are not trying to pool in order to get reelected. These results suggest that the selection effect identified in the model is probably taking place, when there is a lot of money to be stolen, second term mayors who face no accountability from a future election prospect will steal more money than first term mayors, who are somewhat restricted by the possibility of gaining office in the future.

6.1.1 The Dynamic Effect: Booms versus Busts

The theory predicts that it is not just the amount of royalties received, but the expected royalties that matter for determining rent extraction and reelection rates. In order to test these hypotheses, first I show that royalties are highly correlated with the international price

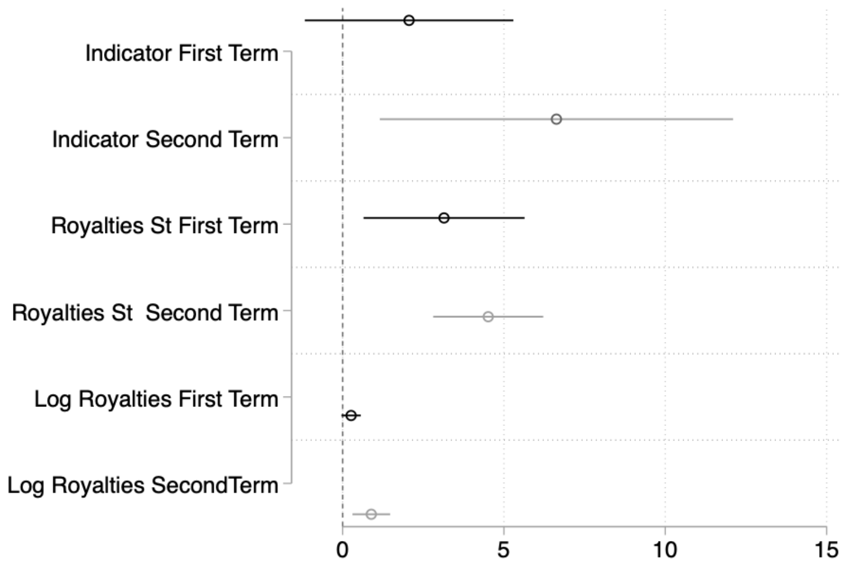

Figure 12: Effect of Royalties on Corruption: First Term versus Second Term Mayors. Dependent variable is Fraction of Audited Funds Identified as Involved in Corruption (0-100)

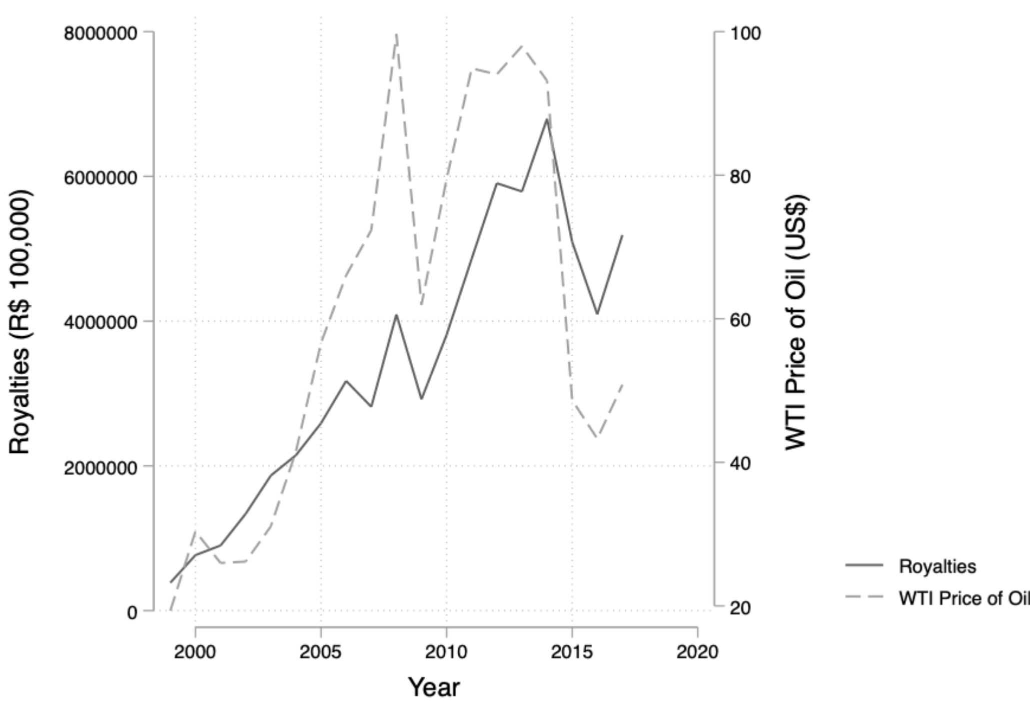

Figure 13: Royalties and International Price of Oil

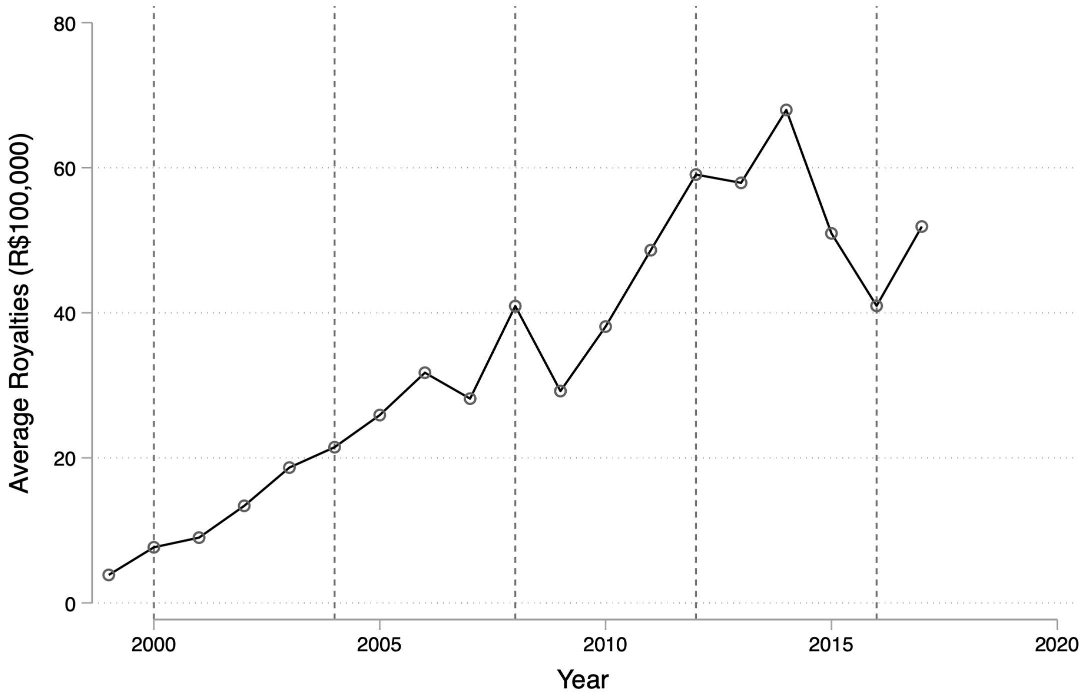

Figure 14: Royalties and Timing Elections. Dashed lines represent dates of Municipal Elections.

of oil, as can be seen in Figure 13. This validates the choice of using expected prices of oil as a measure of expectation of future royalties in royalty receiving municipalities. Figure 14 shows what royalties looked like during each election, which is marked with a dashed line. Additionally, Figure 15 shows the evolution of the price of Cushing Oil Futures contracts and elections, marked with a dashed line.

Given these dynamics in the oil price and the distribution of royalties, I classify the 2000, 2004 as booms, and the 2008 and 2016 elections as busts since the average amount of royalties during the period (Ω_1) is lower than the expected royalties at the date of the election ($E(\Omega_2)$), as measured by the futures contracts seen in Figure 15. The 2012 election is difficult to classify since Ω_1 is similar to $E(\Omega_2)$, although the constant rise in royalties could lead us to classify it as a boom election.

In order to test whether the price of oil has an effect on corruption outcomes, I run the

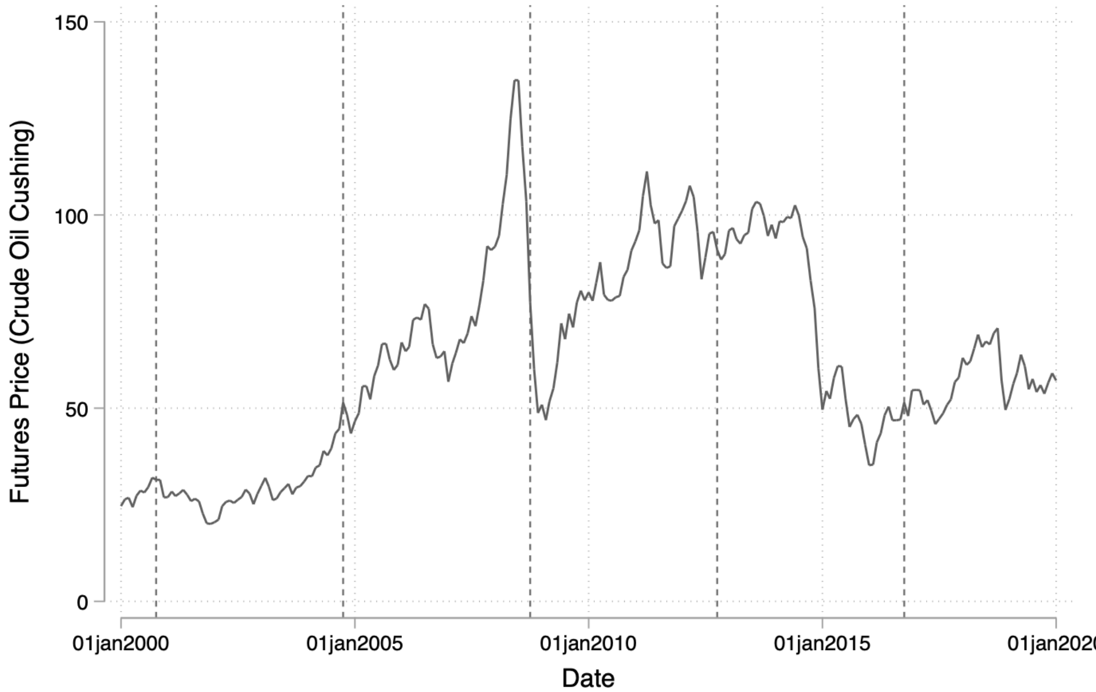

Figure 15: Oil Futures Prices and Elections

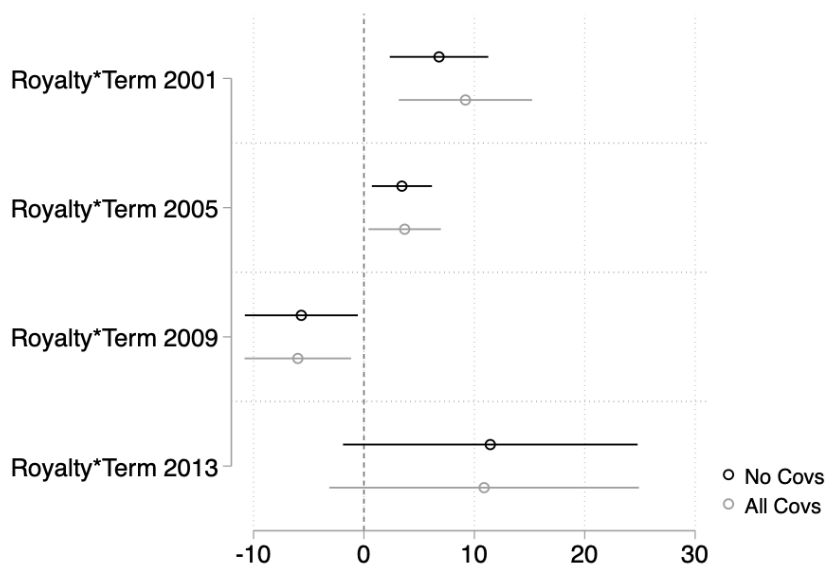

Figure 16: Effect of Royalties on Corruption, by Term

following event-study style regression:

$$C_i = \alpha T_i * R_i + \beta T_i + X_i' \beta + \epsilon_s \qquad (3)$$

where R_i is a royalty indicator, T_i is the term after the election, X_i' corresponds to a vector of covariates and ϵ_s corresponds to state fixed effects. Errors are clustered at the state level. The main coefficient of interest here is α, the coefficient on the interaction between the royalty variable (which represents the oil shock) and the term variable. Following the comparative statics in Table 1 and the hypotheses laid out above, I expect this to be positive for terms after elections held during booms and negative for elections being held during busts. Figure 16 shows the results of this regression. Dark gray coefficients correspond to the specification without covariates, while light gray coefficients correspond to the specification controlling for relevant covariates such as population, GDP, revenue from taxes, federal transfers and mayor characteristics such as gender, political party and education. The full regression results can be found in Table 11 in the Appendix.

Figure 16 shows that going from royalty receiving municipalities had between 6.8% and 9.2% higher corruption levels in the term following the 2000 election (depending on whether covariates were used or not). Similarly, the effect was between 3.4% and 3.7% for the term after the 2004 election. Since both of these elections are considered boom elections, these results confirm our hypotheses. The term after the 2008 election, however, shows a negative coefficient which varies between -5.7% and -5.9%. This means that during the period after the 2008 election, royalty receiving municipalities displayed lower levels of corruption. This could have been driven by the selection effect: the bust led to many corrupt incumbents being kicked out together with an improvement in the pool of candidates, which ends up producing lower levels of corruption in the term after the election. The results for the period after the 2012 election are positive but not significative, which could be due to the fact that the "boom" during this election was not very significant, since Ω_1 was similar to $E(\Omega_2)$.

6.2 The Effect of Royalties on Reelection Rates

The model also predicts that reelection rates will vary depending on royalties and expected income from royalties. Incumbents will be more likely to be reelected when the price of oil is high and expected to keep rising (booms), while they will be less likely to be reelected when the price of oil is expected to fall (busts).

Given the comparative statics and hypotheses derived, and using the price variation in the time periods presented in Figures 13, 14 and 15, I expect royalties to have a positive effect on reelection rates in the 2000, 2004 and 2016 elections, while I expect a negative effect on reelection rates in 2008. I am agnostic on the effects during the 2012 election given the very subtle boom which has been discussed above. Figures 17 and 18 show the result of running the regressions for each election year. Figures 17 shows the results of running the regressions on the full sample of municipalities, while Figures 18 runs the same regression only on the municipalities for which we have corruption data, to check that the results hold for our corruption random sample. The main dependent variable is Log Royalties/10, so that the coefficients represent the effect of a 10% increase in royalties. The large sample regressions include all relevant covariates, municipal and term fixed effects and clustered SEs at the municipal level. The small sample regressions include all relevant covariates. The full results of the regression can be found in Tables 13 and 14 in the Appendix.

As hypothesized, royalties have a positive effect on reelection rates for the 2000 and 2004 election and a negative effect for the 2008 and 2016 election. The positive but insignificant result for the 2012 election is, again, not surprising. For the 2000 election, the effect of a 10% increase in royalties leads to a 6.1% increase in the chance of reelection, while in 2004 it leads to a 3.5% increase in the chance of reelection. For the 2008 election, a 10% increase in royalties leads to a 4.1% reduction in the chance of reelection. The effect for the 2012 election is not significant, while the effect for the 2016 election is a 3.1% decrease in the chance of reelection. The baseline level reelection rates is close to 20%, so these effects are

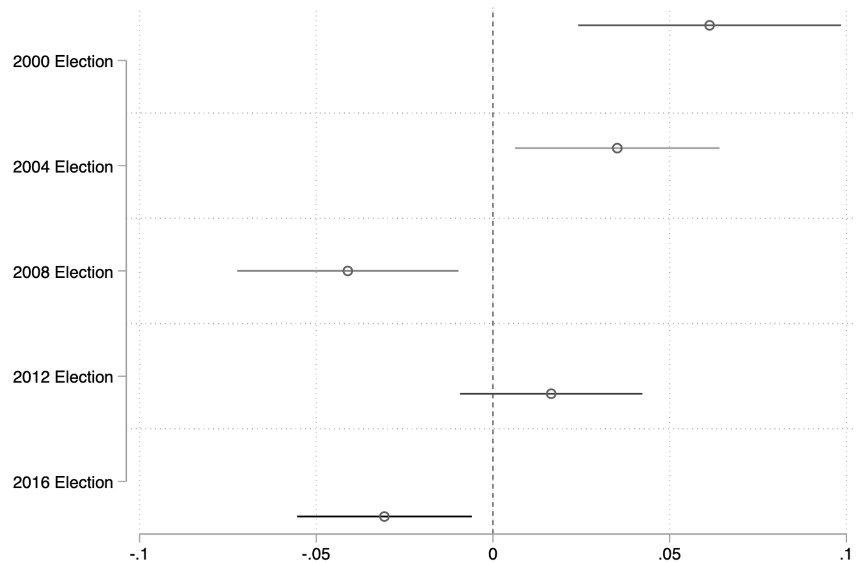

Figure 17: Effects of Royalties on Reelection Rates, By Election. Full Sample

quite significant. The effects are similar for the small sample, although the negative effects for the 2008 election are not significant.

Another way of testing the hypotheses in the model has to do with the likelihood that an incumbent who can run for reelection actually runs. Figure 19 shows the results of similar regressions to those above but using an indicator for whether eligible incumbents ran for reelection or not. If we believe the story that incumbents pool during booms and don't during busts, then, on average, incumbents should be more likely to run for reelection during booms in the hopes of winning reelection, while they may steal everything in their first period and not run for reelection at all.

The results seem to support this hypothesis. a 10% increase in royalties leads to a 5.3% increase in the likelihood of running for reelection during the 2000 elections and a 4.1% increase in the likelihood of running for reelection during the 2012 elections. The baseline level of running for reelection is close to 30%, so these effects are quite significant. The effects are positive but not significant for the 2004 election. The effects are negative and significant for the 2008 elections, showing that mayors may not be running for reelection as

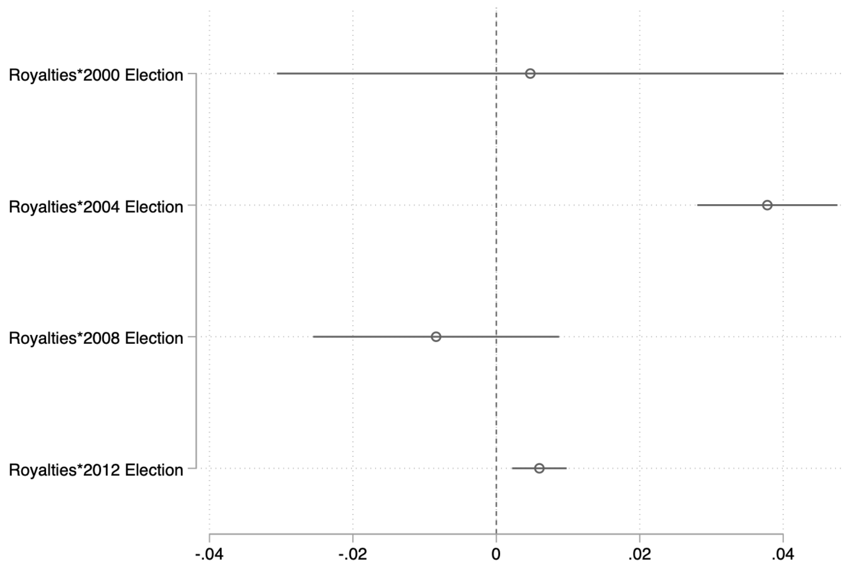

Figure 18: Effects of Royalties on Reelection Rates, By Election. Small Sample

often during this bust.

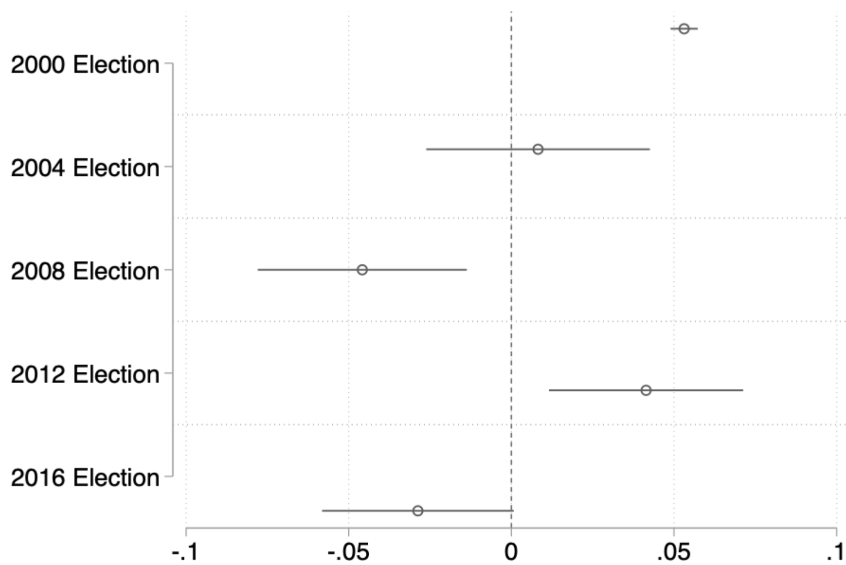

Figure 19: Effect of Royalties on Likelihood of Incumbent Running for Reelection, By Election. Large Sample

Overall, the results in this section confirm the predictions from the model laid out in H2 and H2.b. During booms, royalties lead to higher reelection rates of incumbents and a higher likelihood of the incumbent running for office. During busts, the opposite is true, reelection of the incumbent becomes less likely, and incumbents are less likely to run for reelection. The model would predict that the incumbents not running for reelection are choosing to extract maximum rents in their first period and forfeit reelection, since the expected rents in period 2 are not worth the sacrifice of pooling in the first term. In other words, during booms we observe more of a pooling equilibrium, while during busts the separating equilibrium is more likely.

6.3 Alternative Mechanisms: Voter Information

One alternative mechanism which could be leading to similar outcomes for corruption and reelection has to do with the unobservability of oil windfalls on behalf of voters. If voters do not observe windfalls, then the existence of these extra funds in government coffers could lead to more corruption and also more reelection through an economic voting channel. Under this alternative theoretical framework, only moral hazard would be at play, and there would be no incentive for mayors to pool. I believe this theoretical framework is unlikely to capture the Brazilian reality due to the intense coverage by local media of the royalties received by municipalities. However, in order to discard this alternative mechanisms, I run a series of tests using proxies for voter information. If the mechanism leading to the observed corruption outcomes is the information mechanism, we should see the effect of royalties on corruption dampened by the presence of more informed voters.

Table 3 shows the results of interacting different information proxies with royalties. In order to capture how informed voters in a municipality are, I use four different variables from the census: (1) the proportion of households who own a TV (column 1), (2) the proportion of households who own a radio (column 2), (3) the literacy rate (column 3) and (4) the average years of schooling for people in that municipality (column 4). All of these variables are measured in 2000. Panel A shows the results of interacting royalties with the information proxies for all the observations, while Panel B shows the results only for first term mayors,

Table 3: Heterogeneous Effects of Royalties on Corruption by Information Exposure

DV is Corruption	(1) % Tv	(2) % Radio	(3) Literacy Rate	(4) Schooling
Panel A: All Mayors				
Royalties St	19.37*	11.87***	11.95**	23.42***
Information	-11.69	-7.755	-23.22	-2.171
Royalties St × Information	-18.03*	-9.291*	-25.45***	-1.961**
Observations	2210	2210	2210	2210
R-Squared	0.295	0.297	0.295	0.298
Panel B: First Term Mayors				
Royalties St	1.616	9.352	8.786	6.782
Information	-7.813	-11.53	-27.89	-2.694*
Royalties St × Information	3.194	-5.476	-5.395	-0.511
Observations	1632	1632	1632	1632
R-Squared	0.310	0.309	0.312	0.312
Panel C: Second Term Mayors				
Royalties St	15.33***	25.77**	34.59***	17.79***
Information	-10.31	-26.52	-14.24	-2.307
Royalties St × Information	-13.90**	-26.30**	-40.85***	-3.588**
Observations	578	578	578	578
R-Squared	0.294	0.297	0.302	0.299

Information represents the variable indicated in each column header.

Sample includes only municipalities for which we have Corruption data.

Includes state and term fixed effects. State level clustered SE.

All regressions include controls.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

and Panel C shows the results for second term mayors. The results from Panel A suggest that the information mechanism might be generating the results, since there is a strong negative effect of the interaction term between information and royalties. However, once we divide the sample on whether the mayors are first or second term, we can see that the effects of information are driven by second term mayors, and are not significant for first term mayors.

This is more in line with my theory presented above. The fact that information is only relevant for second term mayor shows that informed voters have an effect on the maximum amount that politicians can steal, $\bar{s}$, and are thus leading to lower corruption rates in the second term. However, informed voters do not seem to have an effect on corruption in the first term, s_1 , or on pooling decisions, λ, which is in line with the model. This suggests that informed citizens likely gain information on public spending and are more effective at monitoring politicians, however, the fact that the effects are not significant for first term mayor suggest that the unobservability of oil is not the reason we see the reelection and corruption cycles.

7 Downstream Effects: Do Windfalls Affect Policy?

In this section I turn to municipal expenditures to analyze whether municipalities that are affected by windfalls have different spending patterns than those not affected by windfalls. The analysis of municipal expenditures can help in two main ways: first, it can help rule out some of the alternative mechanisms that could be driving our results, namely clientelism and patronage; second, if spending is going towards activities where it is easier to embezzle funds and harder to detect corruption, it can help confirm the main findings of the paper.

One of the main competing hypotheses for the electoral and corruption cycles we observe in royalty receiving municipalities has to do with the fact that mayors may be using the money from royalties to buy votes. This could appear as higher corruption and as higher reelection rates in municipalities with royalties when the price of oil is high (so royalties are high), but would result in mayors not actually pocketing the funds for themselves. This practice whereby politicians spend funds in a targeted way in exchange for votes is known as clientelism, and it is a widespread electoral strategy in Brazil (Stokes 2005, Stokes et al 2013, Nichter 2008).

The study of clientelism is complex because, much like corruption, it is a hidden action. It is difficult to get data on the amount of clientelism going on in each locality and most studies of clientelism rely on surveys where people report having received benefits in exchange for their votes. However, these surveys are usually run in subsets of regions, and there is no country-wide dataset with which to compare clientelism outcomes at the municipality level.

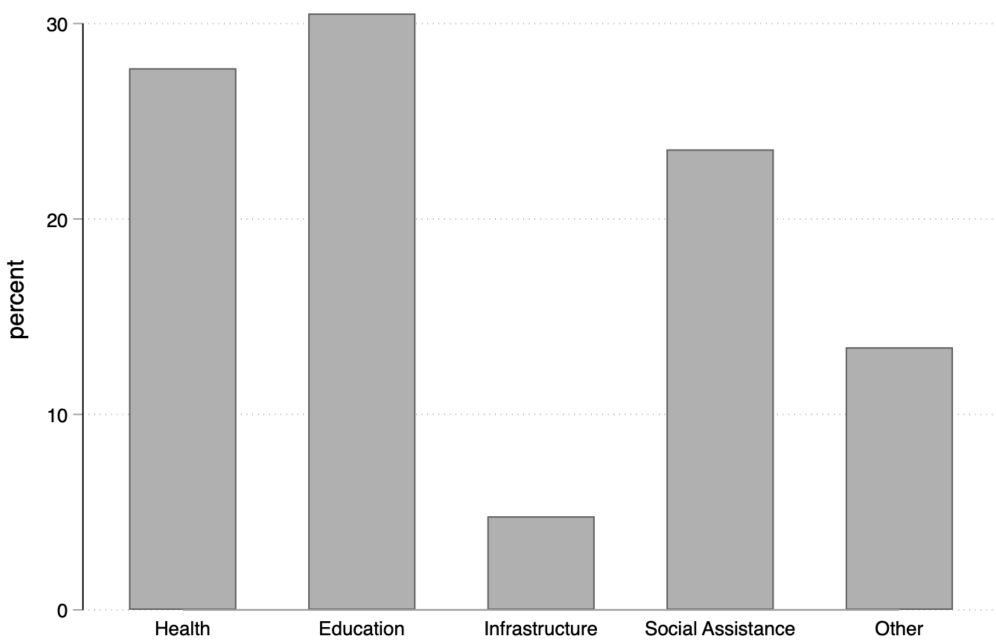

Figure 20: Number of Service Orders Issued in Each Area

Due to these data constraints, some researchers have used spending on education as a proxy of clientelistic practices because of the high discretionary power that mayors have over educational spending and the fact that is is easily targetable to individuals or smaller groups of voters (Amat and Beramendi 2017).

Another alternative is that these mayors are using the money from windfalls to engage in patronage, by hiring more people in their constituencies. Although income from royalties

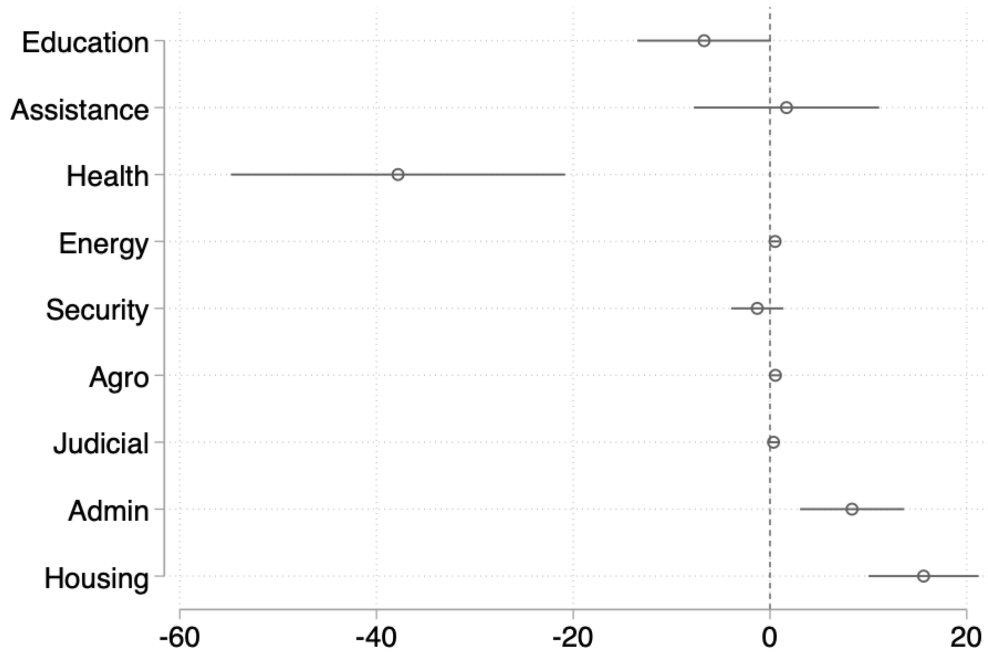

Figure 21: Effects of Royalties on Municipal Expenditures: Large Sample

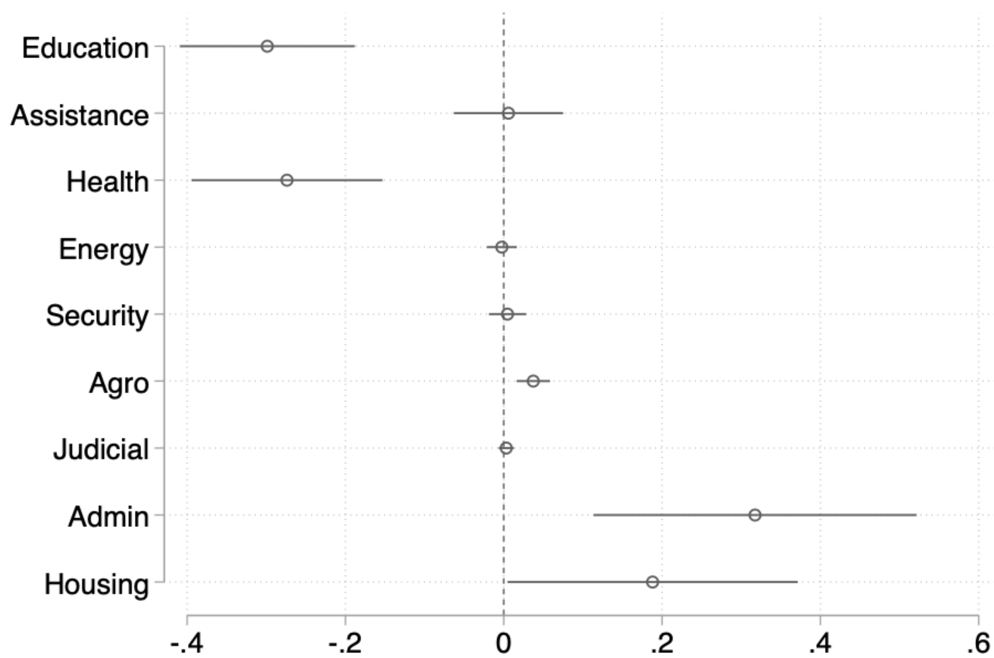

Figure 22: Effects of Royalties on Municipal Expenditures: Small Sample

is not earmarked for any particular purpose, it is legally not meant to be spent on salaries. However, since money is a fungible good, mayors could divert resources from other areas

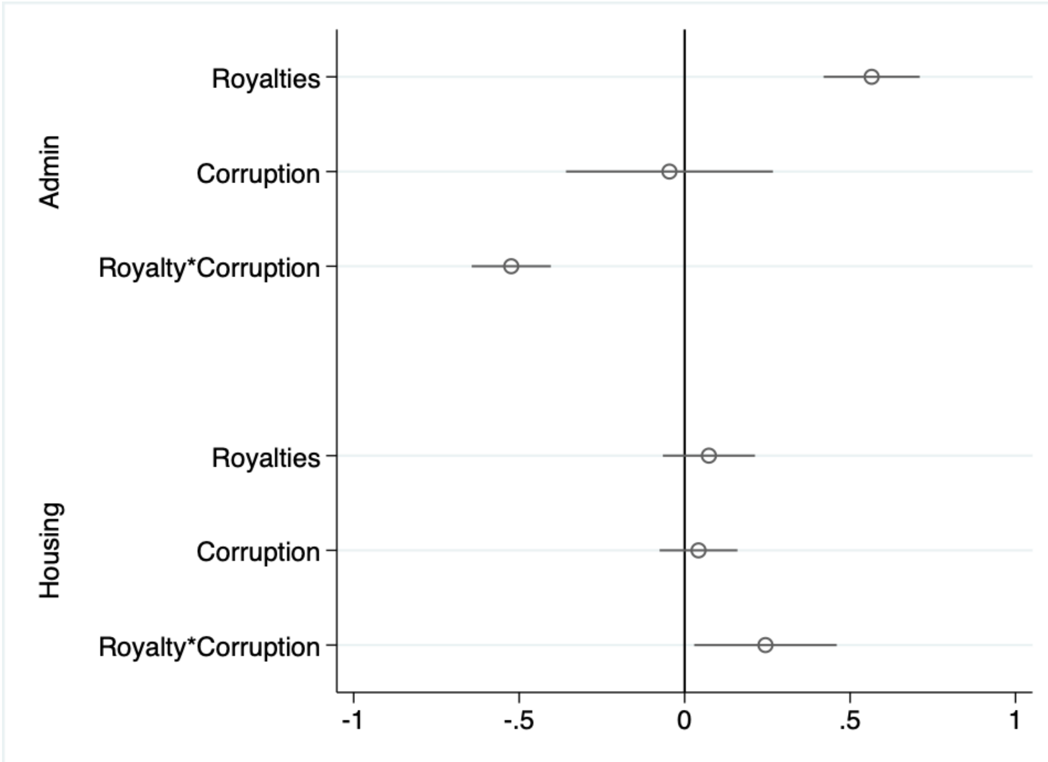

Figure 23: Is Corruption Driving the Spending Patterns?

towards paying salaries and just replace those expenditures with income from royalties. Thus, if municipalities affected by windfalls display higher levels of administrative expenditure, the item where salaries are included in the budget, then it is likely that these places are also engaging in more patronage.

Additionally, as seen in Figure 20, health and education are by far the areas of spending that are most subject to audits. Municipalities spend a large share of their revenues on health and education and are, in fact, the main providers of these goods to their populations. If mayors are trying to extract funds, it may make sense to divert funds from these areas which are more subject to federal control and auditing and spend more on areas that are less likely to get audited. Finally, as has been evidenced by the recent corruption scandals and "Lavajato", construction and infrastructure projects are a main source of corruption since it is easy to fix procurement processes, over-invoice and divert funds from such large projects.

Figures 21 and 22 presents the results of regressing each of the expenditure areas on the offshore royalties variable and a set of relevant controls, as well as term and municipal/state fixed effects depending on the specification (large versus small sample). Errors are clustered at the municipal/state level depending on specification. The full regressions can be seen in Tables 10 and 11 in the Appendix. Places affected by the windfalls are comparatively spending less on education and health than those not affected. This is not a prefect measure of the effects of royalties on clientelism but it is an indication that the effect of royalties may not be going through the clientelistic channel.

On the other hand, 21 and 22 show that the effects on administrative expenditures show that municipalities that received royalties spent more on administrative expenditures, suggesting that they may have had larger payrolls. This is consistent with the patronage story. However, from Figure 23 we can see that most of the payroll ballooning is happening in places that did not display high corruption outcomes. In fact, places with high royalties and high corruption were actually spending less on administrative expenditures. This finding helps strengthen the claim that the cycles we observe cannot be explained purely by a clientelism or patronage story, and that these mayors are in fact enriching themselves.

The second focus of analyzing expenditures was to see if mayors in royalty receiving municipalities are spending more on activities that allow for easier embezzlement of funds. In particular, we can see that royalty receiving municipalities spend significantly more on Housing and Urban Planning. Furthermore, 23 suggests that this effect is mainly driven by municipalities that are receiving royalties AND have high levels of corruption. A large proportion of Housing and Urban Planning expenditures is spent on construction projects, since it involves construction of roads, buildings and infrastructure in general. Given the explosion of corruption scandals linked to construction companies in Brazil, this is an important finding. Corrupt mayors were most likely spending the income from royalties in ways that would allow them to extract the most rent, and construction of large projects provides many opportunities for embezzlement of funds.

8 Recovering the Effects of Oil Royalties on Entry and Pooling

The final hypothesis derived from the model has to do with the quality of the candidate pool. Although there is some evidence that oil royalties lead to more candidates entering the race (see Figures 26-28 in the Appendix), it is difficult to test this with reduced form regressions. Although there results are suggestive, it is unclear whether these observable variables correlate well with a candidates honesty. There is some evidence that women are less corrupt than men (Alexander et al. 2019; Dollar et al. 2001; Esarey and Chirillo 2013; Esarey and Schwindt-Bayer 2019), but in Brazil it is unclear whether more educated candidates are less corrupt than their less educated counterparts Carnes and Lupu (2016).

To estimate the role of hidden actions (moral hazard) and hidden types (adverse selection and entry into politics), I use the structure of the model and simulated data. Since candidate type and pooling decisions are unobserved in the data, I solve the model on simulated data where types are drawn from a known distribution and use this to recover latent moments for candidate type, whether incumbents are pooling or not and the average type of the pool of candidates. First, I simulate data for a set of 1,000 municipalities where oil royalties and income from taxes are drawn from distributions which have been fit to the data. The best fit was achieved by Negative Binomials for both oil royalties and income from taxes as can be seen in Figure 32-34 in the appendix. The parameters used in the calibration of the model can be seen in Table 4. Panel A shows the parameters used in the fitted distributions for oil royalties, Ω_1 in the model, and income from taxes, x_1 in the model. The fitted mean of the negative binomial was 3.7 for oil royalties, μ_o, and 300.81 for tax income, μ_x, while the dispersion parameter was 0.0019 for oil royalties, $size_o$, and 0.5 for tax income $size_x$. Given that no municipalities in our sample have 0 tax income, but many have very small income from taxes, when $x = 0$, I set it to $x = 1$. Panel B shows other model parameters which have been chosen to calibrate the model. I set the discount factor to $\beta = 0.6561$, which represents an annual discount factor of 0.9, the probability of being in a good state, meaning that the cost shock is low, to $q = 0.7$, so that there is a 70% chance of being in a good state, where the cost shock is low and bad types can't pool, and a 30% chance of being in a bad state, where the cost shock is high and bad types can pool and pretend to be good types. The cost shocks in the good state, θ_L is normalized to 1, while the cost shock in a bad state, θ_H is set to 1.1, which means that in a bad state, providing the same public good will be 10% more expensive than in the good state. The initial proportion of honest incumbents, π_1, from which office holders in t=1 are drawn from is set to 0.5. For a boom period, growth rate in taxes, Δ_x is set to 10%, which represents an annual growth rate of 2.4%, consistent with growth in Brazil during the studied period. I simulate the model for boom periods and bust periods separately. For boom periods, the growth rate for oil royalties between period 1 and 2, Δ_o is set to 70%, which represents an annual growth rate of about 14%, consistent with the data on oil royalties for the period. For boom periods, the growth rate, Δ_o , is set to -0.5, representing a contraction of royalties. The outside wage option is set to 70 for honest types, W_g, and 100 for dishonest types, W_b. This represents the fact that dishonest types may be capable of extracting rents in other jobs as well as in office, or it also could represent that in general they are more highly skilled. Results are somewhat robust to setting both to 70, but the moment conditions match better with these values. If anything, this decision biases against the entry effect into politics, since bad types have a higher outside wage and therefore have a higher opportunity cost of entering into politics. Finally, the proportion of honest citizens who would be able to enter politics if they decided to, α, is set to 50%, and the ego rents from holding office, R, are set to 200.

The calibration of the model is targeted to the moments presented in Table 5. Here, we see that the simulated data from the model on the left column is very similar to the observed data on the right. Importantly, the model is able to capture the observed differences

Table 4: Model Calibration

Parameter	Value	Interpretation
Panel A: Simulated from fitted distributions		
Ω_1	$\backsim NB(mu_o, size_o)$	Distribution of oil royalties
mu_o	3.7	Mean of royalties distribution
$size_o$	0.0019	Dispersion parameter for royalties distribution
x_1	$\backsim NB(mu_x, size_x)$	Distribution of taxes
mu_x	300.81	Mean of taxes distribution
$size_x$	0.5	Dispersion parameter for taxes distribution
ϵ	$N(\mu_\epsilon, \sigma_\epsilon)$	Random error in perception of Public Goods
μ_ϵ	0	Mean of the error
σ_ϵ	10	Standard Deviation of error
Panel B: Calibrated model parameters		
β	0.6561	Discount factor
q	0.7	Probability of being in a good state
θ_L	1	Good state cost shock
θ_H	1.1	Bad state cost shock
π_1	0.5	Proportion of honest incumbents t=1
W_g	70	Outside wages for honest type
W_b	100	Outside wages for dishonest type
α	0.5	Proportion honest citizens
R	200	Ego rents from holding office
$\bar{s}$	0.3	Maximum % of corruption
Δ_x	0.1	Taxes growth rate
Δ_o^1	0.7	Oil growth rate: Booms
Δ_o^2	-0.5	Oil growth rate: Bust
N	1,000	Number of municipalities in each simulation

in reelection rates and corruption outcomes between oil and non oil municipalities during booms and busts. Although the model slightly over-estimates the difference in reelection rates and corruption between oil and non oil municipalities, it does a pretty good job of capturing the averages and also the differences between them.

Using the simulated data, I recover the following latent moments of interest: (1) which incumbents are honest and which are dishonest (hidden type), (2) which incumbents are pooling (dishonest types pretending to be good types in order to get reelected), which represents the hidden action (moral hazard) effect, and (3) the average honesty of the pool of candidates, which represents the entry effect (hidden type). The results are presented

Table 5: Moments - Model vs Data

Moment	Model	Data
Panel A: General Moments		
Mean Royalties (Ω)	3.72	3.43
Standard Deviation Royalties	32.26	31.00
Mean Taxes (x)	282.78	279.75
Standard Deviation Taxes	402.47	600.31
Panel B: Boom Periods		
Mean Reelection Rates (σ): oil municipalities	0.38	0.35
Mean Reelection Rates(σ): non oil municipalities	0.26	0.26
Mean Corruption (s): oil municipalities	17.56	18.33
Mean Corruption (s): non oil municipalities	20.81	20.16
Panel C: Bust Period		
Mean Reelection Rates (σ): oil municipalities	0.35	0.33
Mean Reelection Rates(σ): non oil municipalities	0.40	0.39
Mean Corruption (s): oil municipalities	24.89	22.57
Mean Corruption (s): non oil municipalities	26.05	25.76

in Table 6, disaggregated by whether a municipality is an oil royalty receiver or not and whether we are looking at a boom or a bust. During booms, oil municipalities had more dishonest incumbents to begin with, with 51% of the incumbents being categorized as dishonest in oil municipalities and 47% in non oil municipalities, although these differences are not statistically significant. Additionally, about a third of the dishonest incumbents pool in oil municipalities, while only 23% of incumbents pool in non oil municipalities. This is driven by the fact that during a boom period, future oil revenue creates incentives for dishonest candidates to pretend to be honest by stealing less in period 1, so they may get reelected and then steal more in period 2. During a boom, the large expected revenues also generate incentives for more dishonest candidates to enter politics, which is reflected in the 63% of dishonest candidates in oil municipalities. We see no disproportionate entry of dishonest types in non oil municipalities, where rents are stable. Importantly, the entry of these candidates means that $\gamma > \pi_2$[6], so voters will always reelect the incumbent when she is a good type and when she is a dishonest type pooling. Only dishonest types who reveal their type

[6]Note that the proportion of dishonest candidates in the pool presented in Table 6 corresponds to $1 - \pi_2$, since π_2 represents the expected proportion of honest candidates in the pool.

Table 6: Recovered Latent Moments

Latent Moment	Oil Municipality	Non Oil Municipality
Panel A: Booms		
Proportion Dishonest Incumbents	0.51	0.47
	[0.47 , 0.55]	*[0.44 , 0.51]*
Proportion Incumbents Pooling	0.30	0.23
	[0.27 , 0.34]	*[0.20 , 0.26]*
Proportion Dishonest in Candidate Pool	0.63	0.51
	[0.62 , 0.64]	*[0.50 , 0.53]*
Panel A: Busts		
Proportion Dishonest Incumbents	0.46	0.49
	[0.43 , 0.50]	*[0.46 , 0.52]*
Proportion Incumbents Pooling	0.05	0.21
	[0.01 , 0.09]	*[0.18 , 0.25]*
Proportion Dishonest in Candidate Pool	0.33	0.52
	[0.28 , 0.38]	*[0.51 , 0.53]*

95% confidence intervals presented in square brackets

by stealing everything they can in the first period are voted out.

During booms, the dynamics reverse. Since expected rents drop significantly in oil municipalities, hardly any incumbents have incentives to pool, in fact only 5% choose to do so. Additionally, the drop in expected rents in period 2 leads to fewer dishonest candidates entering into the pool in oil municipalities, which further decreases incentives to pool given that voters have even less incentive to reelect incumbents when they are not sure they are good types, because of the improvement in the pool of candidates. On average, the pool of candidates in oil municipalities during a bust election contains only 33% of dishonest incumbents, which means that if the voter is faced with uncertainty over the incumbent's type, he is better off choosing a random candidate from the pool. Again, the values for non-oil municipalities remain quite stable since there are no large fluctuations in the revenues, thus the distortions created by the royalties do not exist here. Figures 24 and 25 show these moments for oil and non oil municipalities and make it easier to appreciate the different latent moments which lead to the outcomes we observe.

The exercise presented in this section helps to illustrate and quantify the effects of oil

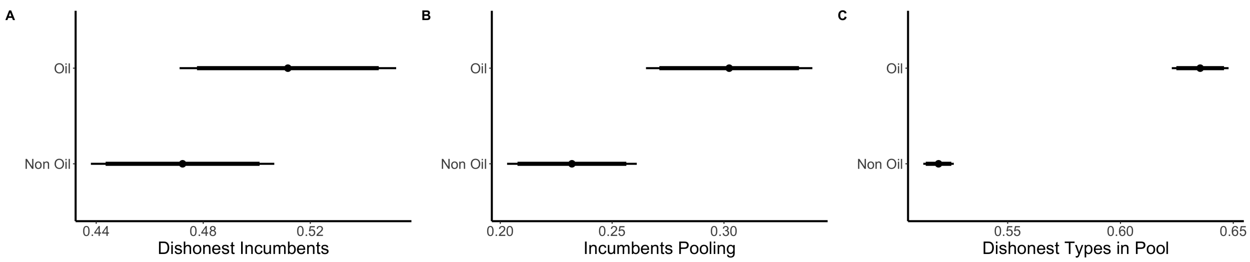

Figure 24: Recovered Latent Moments - Booms

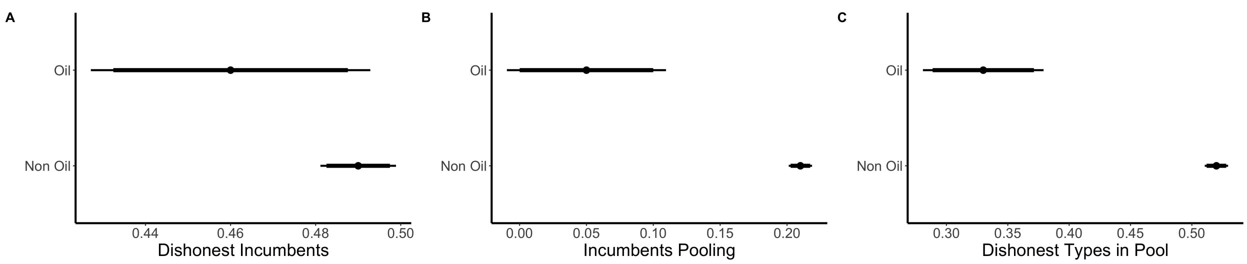

Figure 25: Recovered Latent Moments - Busts

royalties and the fluctuations of these income sources on the political outcomes. Through the model calibration, I am able to show the effects of royalties on pooling (hidden action) and endogenous entry (hidden type), which together lead to the corruption and reelection cycles we observe in the data. During booms, more dishonest candidates pool, more dishonest candidates enter into politics and therefore more dishonest candidates get reelected into office. Together, these mechanisms lead to higher corruption in oil municipalities, especially for second term mayors. During busts, incumbents have less incentive to pool and therefore steal more in their first term. The improvement in the quality of the pool of candidates in oil municipalities means that incumbents are more likely to get voted out, and honest candidates are more likely to be selected from the pool, which leads to lower corruption in the period following a bust election.

9 Conclusion

Oil royalties provide a substantial and volatile inflow of non tax-payer money to municipal coffers, creating dynamic incentives for politicians in office. Resource windfalls change politicians' budget constraints, generate difficulties for voters to distinguish politicians' integrity, and create incentives for corruptible candidates to enter politics, changing the pool of candidates that voters can use to replace incumbents. Oil, thus, affects corruption outcomes through three distinct channels: (i) ex ante selection: oil shocks affect the type of politician who decides to run for office; (ii) moral hazard, oil shocks affect the incentives politicians have while in office; and (iii) ex post selection, oil shocks can affect the capacity of voters to evaluate politician type and select honest politicians.

In Brazil, where offshore royalties are determined and allocated exogenously, oil inflows create strong opportunities for corruption. I find that a one standard deviation increase in oil royalties produces about a 29% increase in the percentage of funds being used in corrupt ways. This is an important finding, especially considering that municipalities which face new offshore oil fields are constantly exposed to shocks of this magnitude. I also provide evidence that oil has a cyclical effect on corruption. The level of corruption is lower after a fall in the price of oil, and a negative forecast for the future price of oil. In addition, oil royalties lead to a reelection cycle: when the price of oil is expected to be higher, incumbents are reelected more often than when the price of oil is expected to fall. This is independent of economic effects such as changes in GDP, indicating that economic voting is not the explanation for these cycles.

Further, I show that royalty receiving municipalities spend differently than their non royalty receiving counterparts. Spending patterns suggest that the corruption cycles are not confounded by clientelism and patronage, and that in fact, corrupt mayors in royalty receiving municipalities spend much more on areas where corruption is widespread and easy to undertake, and spend significantly less on areas that are more closely monitored by the auditing agency.

Finally, using a calibration exercise on simulated data which matches the moments observed in the data, I recover latent moments like incumbent type, pooling decisions and the honesty level of the pool of candidates, which allows me to show how the model's mechanisms play out in the data. The entry of dishonest candidates drives the cycles observed in oil municipalities.

Taken together, these results point to a strong effect of oil royalties on local level political equilibria. The findings are in line with the predictions of the model, and can easily be applied to any location where government revenue is strongly determined by exogenous shocks with a cyclical nature. Understanding how these shocks determine politicians' decisions is important for constructing policies that will help improve accountability and selection of politicians, both by reducing opportunities to steal once in office and creating more stable incentives through time. Insulating local governments from international price fluctuations could be an effective way to achieve better governance outcomes in these places.

References

Ahmadov, A. K. (2014). Oil, Democracy and Context: A Meta-Analysis. *Comparative Political Studies*, 47(9):1238–1267.

Alexander, A. C., Bågenholm, A., and Charron, N. (2019). Are women more likely to throw the rascals out? The mobilizing effect of social service spending on female voters. *Public Choice*, 184(3):235–261.

Andersen, J. J. and Aslaksen, S. (2013). Oil and political survival. *Journal of Development Economics*, 100(1):89–106.

Arezki, R. and Brückner, M. (2011). Oil Rents, Corruption, and State Stability: Evidence From Panel Data Regressions. *European Economic Review*, 55(7):955–963.

Asher, S. and Novosad, P. (2019). Rent-Seeking and Criminal Politicians : Evidence from Mining Booms.

Aslaksen, S. (2010). Oil and democracy: More than a cross-country correlation? *Journal of Peace Research*, 47(4):421–431.

Avis, E., Ferraz, C., and Finan, F. (2018). Do Government Audits Reduce Corruption? Estimating the Impacts of Exposing Corrupt Politicians. *Journal of Political Economy*.

Besley, T. (2004). Joseph Schumpeter Lecture: Paying Politicians : Theory and Evidence. *Journal of the European Economic Association*, 2(May):193–215.

Bhattacharyya, S. and Hodler, R. (2010). Natural resources, democracy and corruption. *European Economic Review*, 54(4):608–621.

Bhavnani, R. R. and Lupu, N. (2016). Oil Windfalls and the Political Resource Curse: Evidence from a Natural Experiment in Brazil.

Brambor, T. (2016). Local Governance in Brazilian Municipalities : Effects of Resource Royalties. (April).

Brollo, F., Nannicini, T., Perotti, R., and Tabellini, G. (2013). The Political Resource Curse The Political Resource Curse. *American Economic Review*, 103(5):1759–1796.

Busse, M. and Gröning, S. (2013). The resource curse revisited: Governance and natural resources. *Public Choice*, 154(1):1–20.

Carnes, N. and Lupu, N. (2016). What good is a college degree? Education and leader quality reconsidered. *Journal of Politics*, 78(1):35–49.

Carreri, M. and Dube, O. (2017). Do Natural Resources In fl uence Who Comes to Power, and How? *Journal of Politics*, 79(2):502–518.

Caselli, F. and Cunningham, T. (2009). Leader behaviour and the natural resource curse. *Oxford Economic Papers*, 61(4):628–650.

Caselli, F. and Michaels, G. (2013). Do oil windfalls improve living standards? Evidence from brazil. *American Economic Journal: Applied Economics*, 5(1):208–238.

Caselli, F. and Tesei, A. (2011). Resource Windfalls, Political Regimes, and Political Stability. *National Bureau of Economic Research Working Paper Series*, (March 2010).

Cavalcanti, T., Da Mata, D., and Toscani, F. (2019). *Winning the oil lottery: the impact of natural resource extraction on growth*, volume 24. Springer US.

Corden, P. J. and Neary, M. W. (1982). Booming Sector and De-Industrialisation in a Small Open Economy Author (s): W . Max Corden and J . Peter Neary Published by : Wiley on behalf of the Royal Economic Society Stable URL : http://www.jstor.org/stable/2232670 Accessed : 05-04-2016 11 : 46 UT. *The Economic Journal*, 92(368):825–848.

Cuaresma, J. C., Oberhofer, H., and Raschky, P. A. (2011). Oil and the duration of dictatorships. *Public Choice*, 148(3/4):505–530.

De Mesquita, B. B. and Smith, A. (2010). Leader Survival, Revolutions, and the Nature of Government Finance. *American Journal of Political Science*, 54(4):936–950.

Deacon, R. T. and Rode, A. (2012). Rent seeking and the resource curse.

Dollar, D., Fisman, R., and Gatti, R. (2001). Are women really the "fairer" sex? Corruption and women in government. *Journal of Economic Behavior and Organization*, 46(4):423–429.

Dube, O. and Vargas, J. F. (2013). Commodity price shocks and civil conflict: Evidence from Colombia. *Review of Economic Studies*, 80(4):1384–1421.

Dunning, T. (2008). *Crude Democracy*. Cambridge University Press.

Egorov, G., Guriev, S., and Sonin, K. (2009). Why resource-poor dictators allow freer media: A theory and evidence from panel data. *American Political Science Review*, 103(4):645–668.

Esarey, J. and Chirillo, G. (2013). Fairer sex or purity myth? Corruption, gender, and institutional context. *Politics and Gender*, 9(4):361–389.

Esarey, J. and Schwindt-Bayer, L. A. (2019). Estimating Causal Relationships Between Women's Representation in Government and Corruption. *Comparative Political Studies*, 52(11):1713–1741.

Ferraz, C. and Finan, F. (2011). Electoral accountability and corruption in local governments: evidence from audit reports. *American Economic Review*, 101(June):1274–1311.

Gandhi, J. and Przeworski, A. (2007). Authoritarian Institutions and the Survuval of Autocrats. *Comparative Political Studies*, 40(11):1279–1301.

Gassebner, M., Lamla, M. J., and Vreeland, J. R. (2013). Extreme Bounds of Democracy. *Journal of Conflict Resolution*, 57(2):171–197.

Golden, M. A. and Fisman, R. (2017). *Corruption: What everybody needs to know*. Oxford University Press, Oxford.

Isham, J., Woolcock, M., Pritchett, L., and Busby, G. (2005). The varieties of resource experience: Natural resource export structures and the political economy of economic growth. *World Bank Economic Review*, 19(2):141–174.

Karl, T. L. (1997). *The Paradox of Plenty: Oil Booms and Petro-States*. University of California Press.

Lane, P. and Tornell, A. (1999). The Voracity Effect. *American Economic Review*, 89(1992):22–46.

Leite, C. A. D. C. and Weidmann, J. (1999). Does mother nature corrupt? Natural resources, corruption, and economic growth.

Maldonado, S. (2014). The Political Effects of Resource Booms : Political Outcomes , Clientelism and Public Goods Provision in Peru *.

Martinez, L. R. (2016). Sources of Revenue and Government Performance : Theory and Evidence from Colombia.

Mehlum, H., Moene, K., and Torvik, R. (2006). Cursed by Resources or Institutions? *The World Economy*, 29(8):1117–1131.

Monteiro, J. and Ferraz, C. (2012). Does Oil Make Leaders Unaccountable ? Evidence from Brazil ' s offshore oil boom.

Morrison, K. M. (2009). Oil, nontax revenue, and the redistributional foundations of regime stability. *International Organization*, 63(1):107–138.

Neary, J. P. and van Wijnbergen, S. (1985). Natural resources and the macroeconomy: a theoretical framework. Working Papers 198536, School of Economics, University College Dublin.

Postali, F. A. S. (2009). Petroleum royalties and regional development in Brazil: The economic growth of recipient towns. *Resources Policy*, 34(4):205–213.

Roemer, M. (1983). *No Title*. Harvard Institute for International Development.

Ross, M. L. (2001). Does Oil Hinder Democracy? *World Politics*, 53(03):325–361.

Ross, M. L. (2015). What Have We Learned about the Resource Curse? *Annual Review of Political Science*, 18(1):239–259.

Sachs, J. D. and Warner, A. M. (1995). Natural Resource Abundance and Economic Growth. *NBER Working Paper Series*, 3:54.

Sachs, J. D. and Warner, A. M. (1999). The big push, natural resource booms and growth. *Journal of Development Economics*, 59(1):43–76.

Smith, B. (2004). Oil Wealth and Regime Survival in the Developing World, 1960-1999. *American Journal of Political Science*, 48(2):232–246.

Svensson, J. (2005). Eight Questions about Corruption. *Journal of Economic Perspectives*, 19(3):19–42.

Treisman, D. (2007). What Have We Learned About the Causes of Corruption from Ten Years of Cross-National Empirical Research? *Annual Review of Political Science*, 10(1):211–244.

Tsui, K. K. (2011). More Oil, Less Democracy: Evidence from Worldwide Crude Oil Discoveries. *Economic Journal*, 121(551):89–115.

Velasco, A. (1999). A Model of Endogenous Fiscal Deficits and Delayed Fiscal Reforms. In *Fiscal Institutions and Fiscal Performance*, pages 37–58. National Bureau of Economic Research, Inc.

Vicente, P. C. (2010). Does oil corrupt? Evidence from a natural experiment in West Africa. *Journal of Development Economics*.

Wiens, D., Poast, P., and Clark, W. R. (2014). The Political Resource Curse: An Empirical Re-evaluation. *Political Research Quarterly*, 67(4):783–794.

Wright, J., Frantz, E., and Geddes, B. (2013). Oil and Autocratic Regime Survival. *British Journal of Political Science*, 45(02):287–306.

A Appendix

A.1 Entry of Candidates

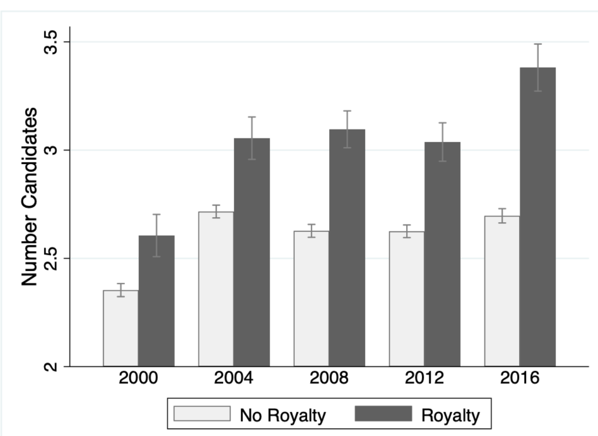

Figure 26: Number of Candidates by Election, Royalty vs Non Royalty Municipalities

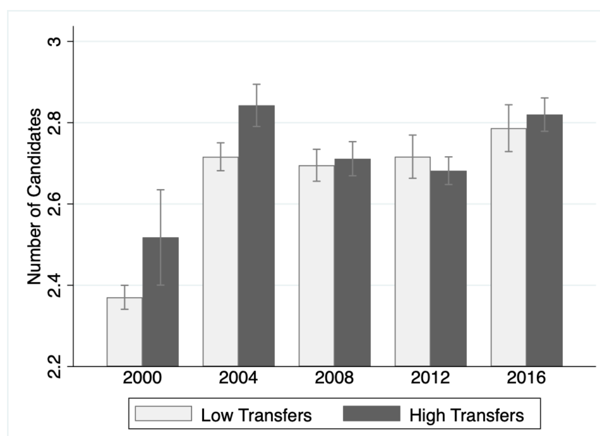

Figure 27: Number of Candidates by Election, High Fed Transfer vs Low Fed Transfer Municipalities

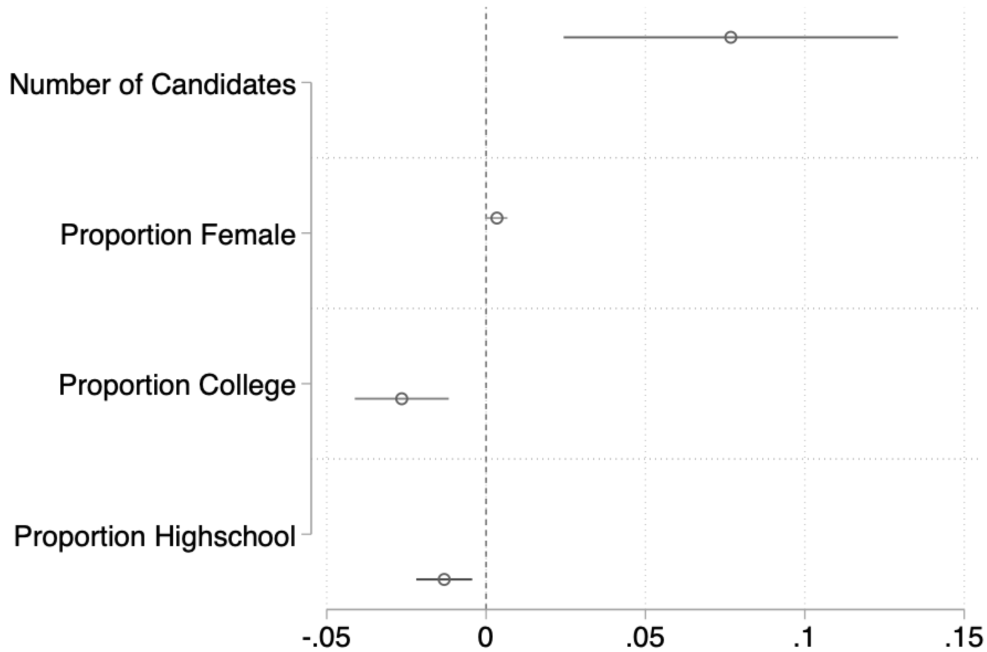

Figure 28: Effects of Royalties on Entry of Candidates

A.2 Robustness: Entropy Balancing

One concern might be the fact that royalty receiving municipalities are richer, larger and more populous than the average municipality in Brazil. We can see that this is somewhat true in Table 2. Although the exogenous allocation of royalties through the geographic rule and the use of controls such as GDP and population should be enough to put away these concerns, in this section I run an extra robustness test by using entropy balancing in order to ensure that the effects are robust to choosing controls which are similar to the treated units. The results are presented below, and most results hold up and remain significant.

Table A.2 shows the results of balancing on the mean of the control variables. We see that the Post balance control groups are very similar to the Treatment groups. Figures 29 - 31 show the results, which are mostly robust to the entropy balancing exercise.

Table 7: Entropy Balancing

	Treat			Control: Pre Balance			Control: Post Balance		
	mean	variance	skewness	mean	variance	skewness	mean	variance	skewness
GDP	.0744	3.809	23.46	-.05348	.02304	9.325	.07456	.1519	2.546
Population	.1571	4.464	19.9	-.05093	.1338	8.891	.1576	.4731	3.454
Rural	.3554	.05105	.2318	.4236	.05767	.04303	.3554	.06505	.2604
Total Revenue	.07929	3.814	23.33	-.04933	.0335	9.742	.07945	.1807	2.584
Taxes	.07229	4.55	24.08	-.03927	.008162	10.96	.07235	.1293	2.869
Federal Transfers	.1089	1.678	13.57	-.07014	.266	11.32	.1094	.5014	3.134
Term Limited	.2843	.2038	.9564	.2537	.1895	1.132	.2843	.2036	.9565
Highschool	.8215	.1469	-1.679	.7723	.1759	-1.299	.8215	.1467	-1.679
College	.5041	.2504	-.01653	.4566	.2483	.1744	.5041	.2504	-.01653
Female	.09752	.08816	2.713	.06638	.06201	3.484	.09751	.08805	2.714

Table presents results from entropy balancing. Left panel represents moments for treated units.
Middle panel represents moments for control units before balancing is performed, while right panel presents moments after entropy balancing is performed.

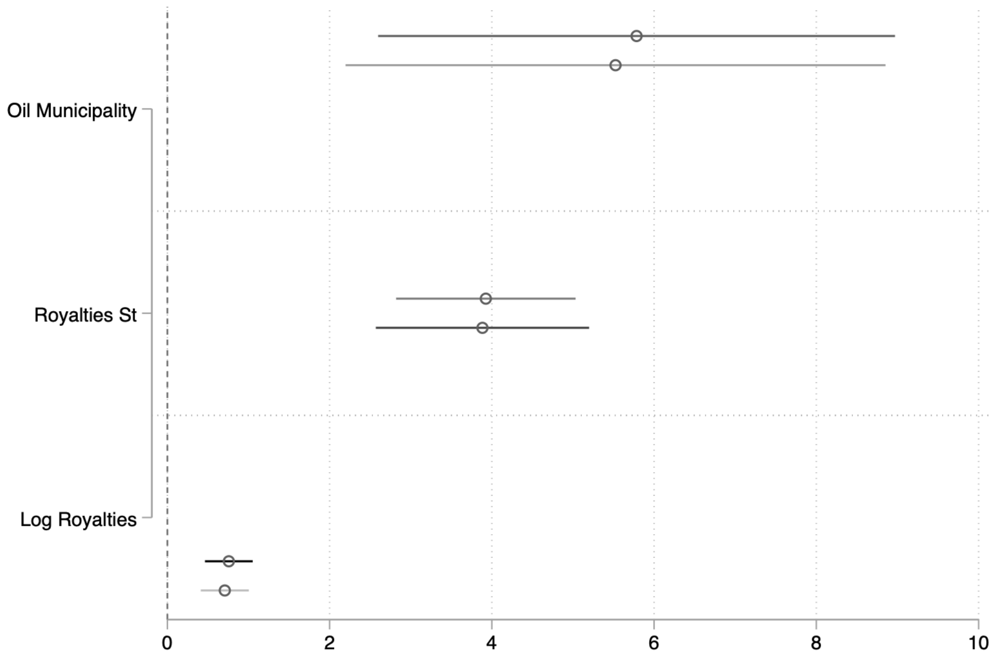

Figure 29: Entropy Balanced: Effects of Royalties on Corruption

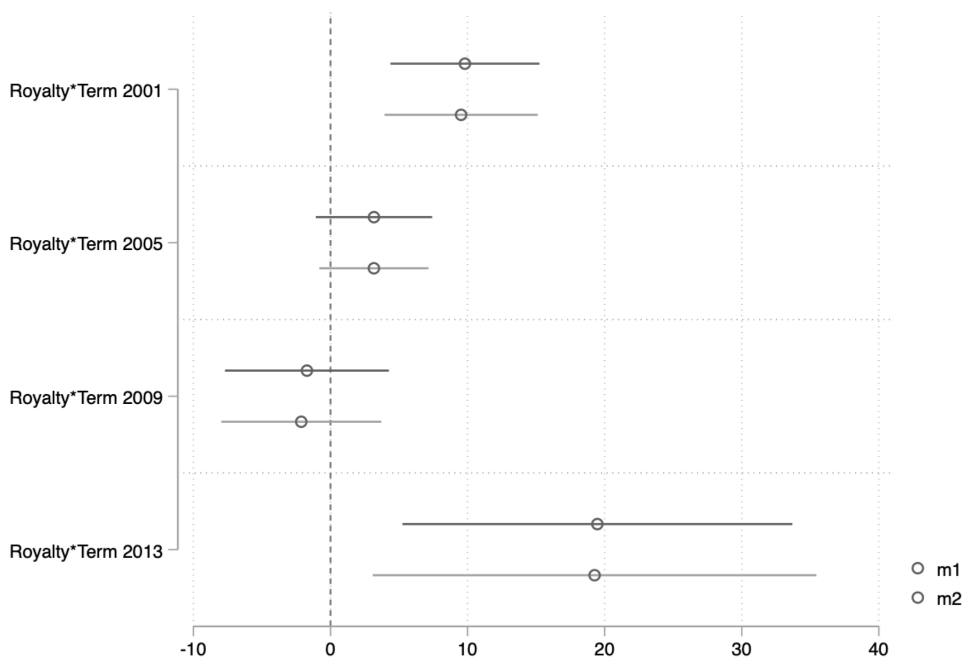

Figure 30: Entropy Balanced: Effects of Royalties on Corruption By Term

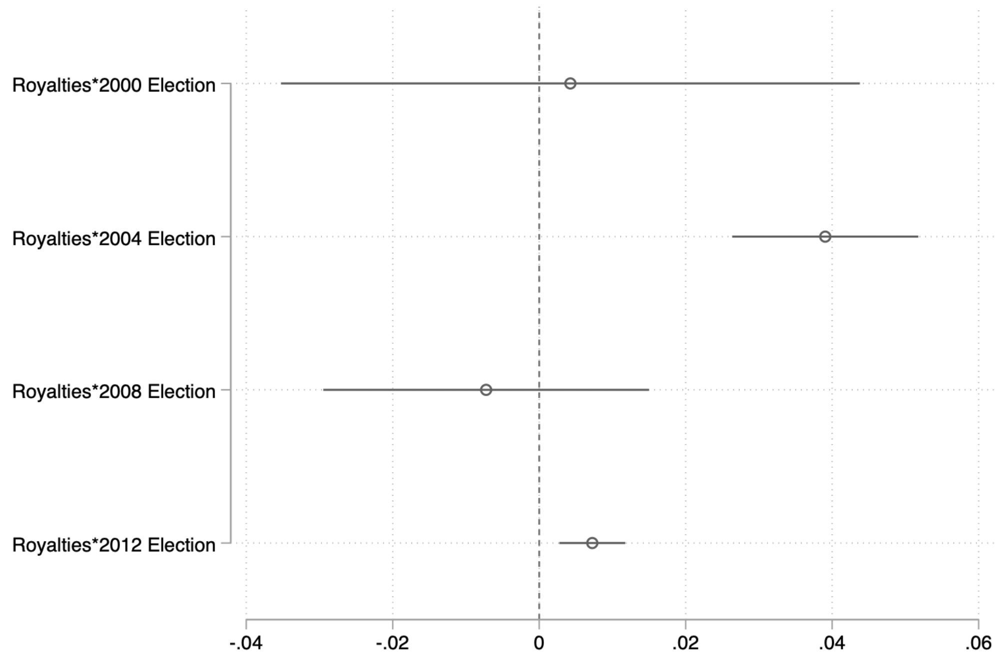

Figure 31: Entropy Balanced: Effects of Royalties on Reelection By Term

A.3 Placebo Tests

In this section, I run a series of placebo tests in order to ensure that the results I am getting are not spurious correlations. The results are presented in Table 8. In columns 1 and 2, I create a randomized corruption variable with the same distribution as the real corruption variable, but assigning values randomly to municipalities. I run the regressions on this variable to test whether the correlations I find are spurious. If the correlations were spurious and a product of data structure, we might find significant effects in this placebo test which would invalidate the results obtained above. However, I find no effects of any variable on this "Placebo Corruption" variable, indicating that the correlations found above are not just a product of the data structure.

Columns 2 and 3 present the results of a similar exercise. Instead of randomizing the corruption variable, I now randomize the royalties variable, using the same distribution as the real royalties variable. Again, I see no effects of the placebo royalties variable on corruption, indicating that the effects found above are not spurious.

As a final placebo test, I run the same regression as the one in Table 8 but using the mayor's gender as the dependent variable. There is no reason to expect female candidates to be elected more often in places with more royalties, so this serves as a test of reliability of the data. Again, we find no correlation between royalties and female mayors, as expected. Interestingly, female mayors are more likely to be college educated, and less likely to be term limited, indicating that they were less likely to be reelected in the previous election.

Table 8: Placebo Test: Randomly assigning corruption and royalty values to check for spurious correlations

	(1) Placebo Corrupt	(2) Placebo Corrupt	(3) Corruption	(4) Corruption	(5) Female	(6) Female
Royalties	0.00104	-0.00109			0.0000233	-0.0000136
Royalty Placebo			-0.000673	-0.000462		
PIB		-0.00938		-0.740*		-0.0155
PIB Capita		-0.00229		0.0407		0.000531
PMDB		-0.0551		0.0183		0.00198
PSDB		0.257		-0.651		-0.00135
PT		-0.287		-0.314		-0.0114
College Educ		0.183		-0.458		0.0479***
Term Limited		0.258		1.027**		-0.0223***
Industry		-0.0327		0.943		0.0156*
Services		-0.0547		0.489		0.0151
Proportion Urban		-0.116		0.325		0.0113
Taxes		0.0168		0.604		0.0119
Total Revenue		0.00136		-0.00655		-0.00000504
Federal Transfers		0.00205		-0.00339		0.00000705
Total Expenditure		-0.00141		0.00896		0.000000837
Administrative Exp.		0.00181		-0.00370		-0.00000895
Observations	2257	2133	2293	2016	15536	11887
R-Squared	0.00722	0.0122	0.0262	0.0510	0.0143	0.0259

Regressions include state, lottery and term fixed effects. SEs clustered at State level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A.4 Model Fit

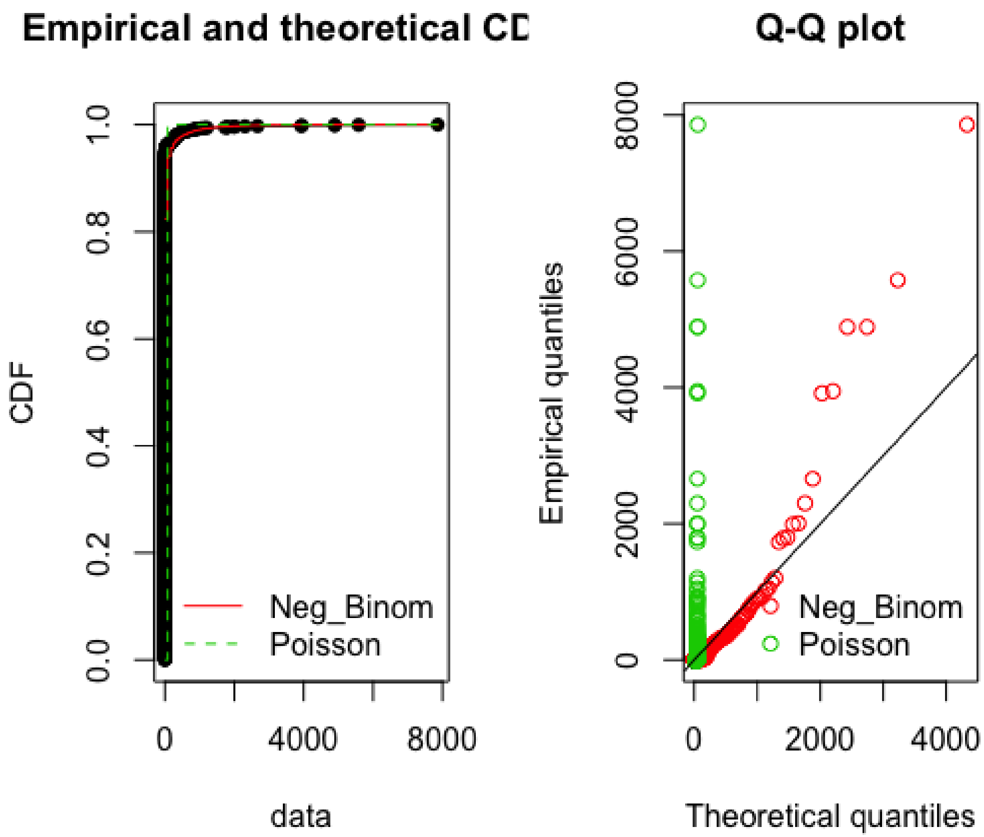

Figure 32: Distribution Fit: Royalties

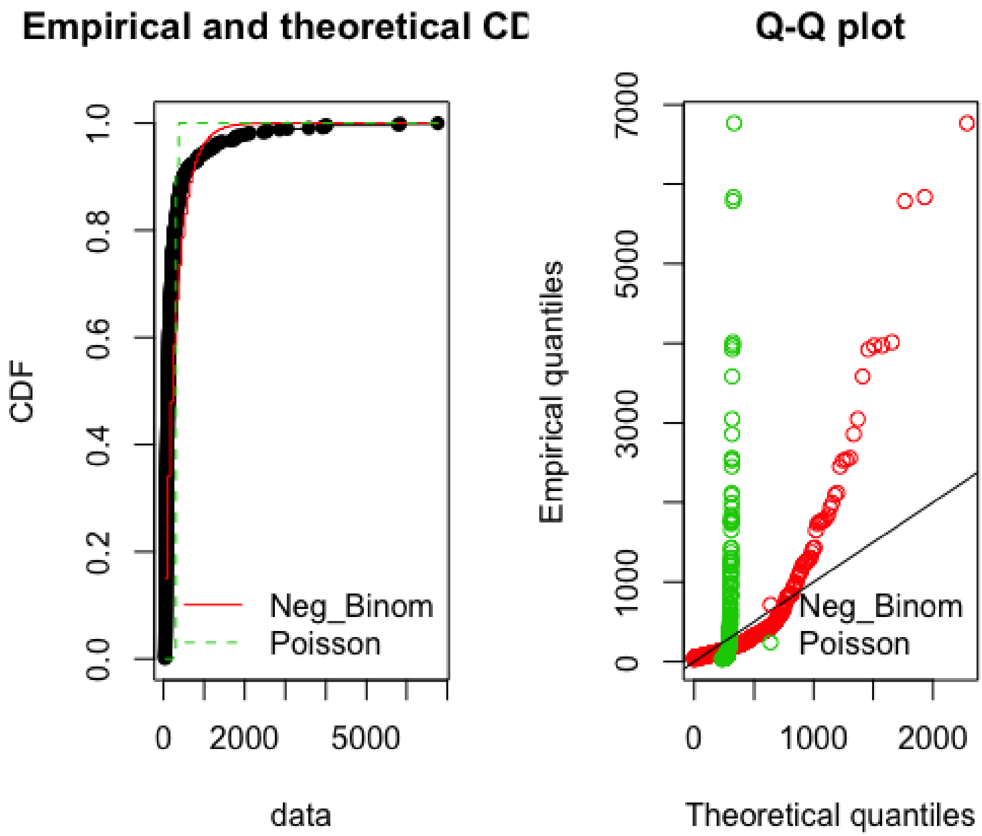

Figure 33: Distribution Fit: Tax Revenue

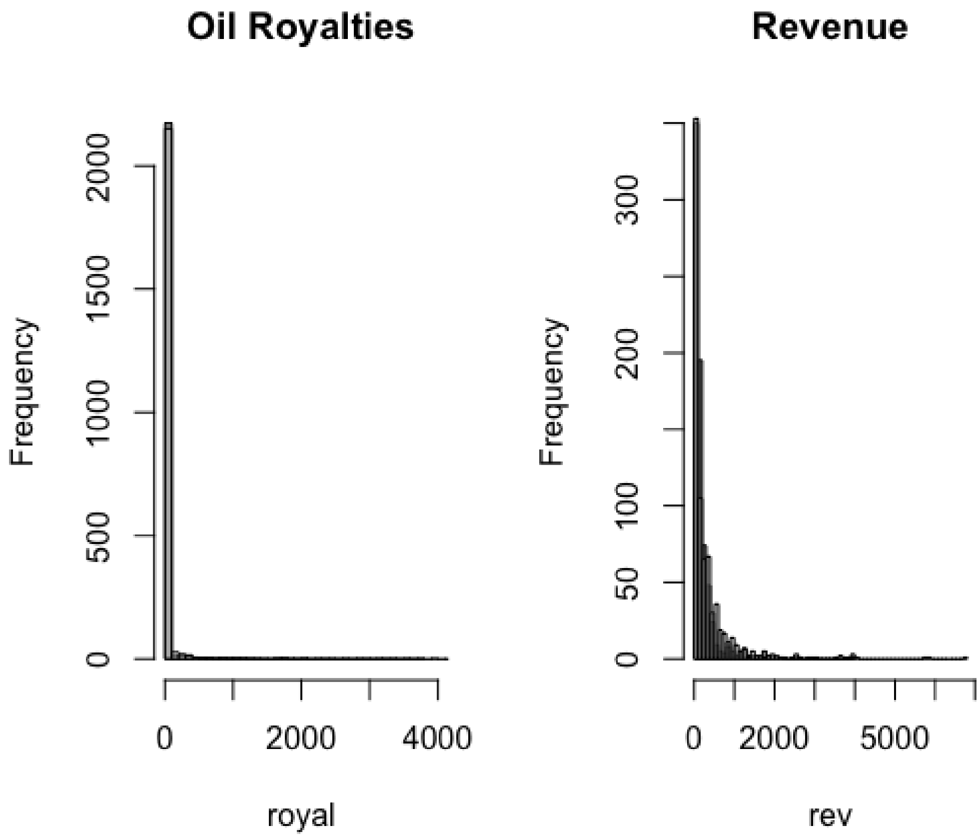

Figure 34: Histograms: Simulated versus observed Data

A.5 Tables

Table 9: Regressions of Royalties On Corruption Levels: Dependent Variable is Corruption

	(1) Indicator	(2) Indicator	(3) Std Royalties	(4) Std Royalties	(5) Log Royalties	(6) Log Royalties
Oil Municipality	3.583*	3.620*				
	(2.82)	(2.62)				
Royalties St			3.664***	3.672***		
			(9.43)	(6.36)		
Log Royalties					0.479**	0.461**
					(3.47)	(3.51)
Population		-4.001		0.229		-4.075
		(-1.19)		(0.07)		(-1.23)
Municipal GDP		5.436		-3.855		5.314
		(0.98)		(-0.54)		(1.02)
Federal Transfers		5.153		2.569		5.008
		(1.90)		(1.20)		(1.92)
Taxes		-3.528		2.274		-3.326
		(-0.80)		(0.43)		(-0.81)
College Education		-0.0747		0.136		-0.0592
		(-0.11)		(0.18)		(-0.08)
Female		-2.298		-2.634		-2.412
		(-0.96)		(-1.13)		(-1.00)
Term Limited		1.812*		1.457		1.782*
		(2.29)		(1.98)		(2.25)
PT		0.400		0.540		0.339
		(0.20)		(0.28)		(0.17)
PSDB		-3.001		-3.094		-3.054
		(-1.35)		(-1.39)		(-1.36)
PMDB		-0.967		-0.883		-1.037
		(-0.82)		(-0.77)		(-0.89)
Observations	2600	2224	2600	2224	2600	2224
R-Squared	0.289	0.274	0.313	0.294	0.292	0.276

t statistics in parentheses

Regressions include state and term fixed effects. SEs clustered at State level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Regressions of Royalties On Corruption Levels: Dependent Variable is Corruption Indicator

	(1) Indicator	(2) Indicator	(3) Std Royalties	(4) Std Royalties	(5) Log Royalties	(6) Log Royalties
Oil Municipality	0.378***	0.353***				
	(6.62)	(7.63)				
Royalties St			0.0126*	0.00968		
			(2.63)	(1.62)		
Log Royalties					0.0315***	0.0292***
					(6.99)	(7.79)
Population		0.0529		0.0999		0.0611
		(0.97)		(1.57)		(1.02)
Municipal GDP		0.0426		0.127		0.0742
		(0.55)		(1.23)		(0.69)
Federal Transfers		-0.0290		-0.0572		-0.0459
		(-0.87)		(-1.49)		(-1.20)
Taxes		-0.0734		-0.174		-0.103
		(-1.16)		(-1.85)		(-1.07)
College Education		-0.0165		-0.0114		-0.0139
		(-1.12)		(-0.66)		(-0.96)
Female		-0.0296		-0.0160		-0.0316
		(-1.28)		(-0.62)		(-1.37)
Term Limited		0.0103		0.0177		0.0114
		(0.69)		(1.15)		(0.79)
PT		-0.00633		0.00770		-0.00528
		(-0.21)		(0.25)		(-0.18)
PSDB		-0.0306		-0.0339		-0.0350
		(-0.67)		(-0.67)		(-0.75)
PMDB		0.00711		0.0132		0.00480
		(0.32)		(0.57)		(0.22)
Observations	2600	2224	2600	2224	2600	2224
R-Squared	0.331	0.326	0.254	0.263	0.320	0.316

t statistics in parentheses

Regressions include state and term fixed effects. SEs clustered at State level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Regressions of Royalties On Corruption Levels: Dependent Variable is Corruption Indicator

	(1) Indicator	(2) Indicator
Royalty*Term 2001	6.802**	9.197**
	(3.23)	(3.23)
Royalty*Term 2005	3.440*	3.692*
	(2.68)	(2.39)
Royalty*Term 2009	-5.669*	-5.987*
	(-2.35)	(-2.63)
Royalty*Term 2013	11.44	10.89
	(1.82)	(1.65)
Population		-4.364
		(-1.29)
Municipal GDP		5.943
		(1.05)
Federal Transfers		5.435
		(2.00)
Taxes		-3.877
		(-0.93)
College Education		-0.0955
		(-0.13)
Female		-1.858
		(-0.74)
Term Limited		1.736*
		(2.31)
PT		0.481
		(0.26)
PSDB		-2.984
		(-1.44)
PMDB		-0.750
		(-0.62)
Observations	2600	2224
R-Squared	0.302	0.287

t statistics in parentheses

Regressions include state and term fixed effects. SEs clustered at State level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Regressions of Royalties On Corruption Levels: Dependent Variable is Corruption

	(1) First Term	(2) Second Term	(3) First Term	(4) Second Term	(5) First Term	(6) Second Term
Oil Municipality	2.060	6.627*				
	(1.35)	(2.57)				
Royalties St			3.144*	4.513***		
			(2.67)	(5.61)		
Log Royalties					0.264	0.890**
					(1.88)	(3.23)
Population	2.310	-0.497	14.49	4.310	2.240	-0.670
	(0.89)	(-0.04)	(1.17)	(1.48)	(0.89)	(-0.05)
Municipal GDP	3.315	30.74	1.213	-1.012	3.319	28.87
	(0.85)	(1.58)	(0.06)	(-0.15)	(0.89)	(1.55)
Federal Transfers	1.740	14.51*	3.523	0.360	1.685	13.64*
	(0.75)	(2.23)	(0.83)	(0.16)	(0.75)	(2.31)
Taxes	-5.760	-103.4	-86.89	-3.003	-5.700	-98.80
	(-1.92)	(-1.91)	(-1.64)	(-0.61)	(-2.03)	(-1.94)
College Education	-0.159	-1.324	-0.711	0.0152	-0.141	-1.330
	(-0.20)	(-1.03)	(-0.52)	(0.02)	(-0.18)	(-1.05)
Female	-1.362	-6.697*	-7.311**	-1.631	-1.424	-7.026*
	(-0.52)	(-2.76)	(-3.09)	(-0.64)	(-0.54)	(-2.82)
PT	0.794	-2.394	-2.165	0.952	0.772	-2.605
	(0.36)	(-0.56)	(-0.58)	(0.43)	(0.36)	(-0.62)
PSDB	-3.081	-3.253	-4.009	-2.936	-3.123	-3.273
	(-1.30)	(-1.23)	(-1.44)	(-1.24)	(-1.31)	(-1.26)
PMDB	-1.787	1.280	0.988	-1.691	-1.829	1.123
	(-1.49)	(0.65)	(0.48)	(-1.46)	(-1.53)	(0.58)
Observations	1643	581	581	1643	1643	581
R-Squared	0.290	0.272	0.288	0.309	0.291	0.279

t statistics in parentheses

Regressions include state and term fixed effects. SEs clustered at State level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 13: Regressions of Royalties On Reelection Rates By Year: Dependent Variable is 1 if Incumbent Won Reelection

	(1) 2000 Election	(2) 2004 Election	(3) 2008 Election	(4) 2012 Election	(5) 2016 Election
Royalties St	0.0613**	0.0352*	-0.0411*	0.0165	-0.0307*
	(3.23)	(2.38)	(-2.57)	(1.25)	(-2.44)
Population	0.0133	-0.0783	0.0202	-0.0841	0.0324
	(0.22)	(-1.06)	(0.27)	(-1.50)	(0.55)
Municipal GDP	0.0806	0.145	-0.246	0.115	-0.0469
	(0.10)	(0.70)	(-1.68)	(1.27)	(-0.67)
Federal Transfers	-0.0334	-0.0387	0.112*	-0.0114	0.0243
	(-0.65)	(-0.45)	(2.50)	(-0.41)	(1.14)
Taxes	0.143	0.00779	0.176	-0.0423	0.00917
	(0.89)	(0.03)	(1.08)	(-0.46)	(0.14)
College Educated	0.0164	0.0122	0.0104	-0.00298	0.0190
	(0.78)	(1.07)	(0.76)	(-0.25)	(1.63)
Female	-0.0528**	-0.0623**	-0.0735**	-0.0563**	-0.00699
	(-2.87)	(-2.92)	(-3.17)	(-3.10)	(-0.39)
PT	-0.00683	-0.0413	-0.00313	0.0124	0.139***
	(-0.97)	(-1.90)	(-0.14)	(0.66)	(5.08)
PSDB	0.0230**	0.0490**	0.0355	-0.00700	0.0466**
	(2.98)	(3.12)	(1.77)	(-0.39)	(2.76)
PMDB	0.0242	0.0118	0.0466**	0.0263	0.0142
	(0.92)	(0.81)	(2.75)	(1.70)	(0.94)
Observations	4310	5278	5248	5484	5349
R-Squared	0.00330	0.00661	0.00719	0.00368	0.00841

t statistics in parentheses

Regressions include state. SEs clustered at State level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: Regressions of Royalties On Reelection Rates: Dependent Variable is 1 if Incumbent Won Reelection

	(1)	
	Reelection	
Royalties*2000 Election	0.00474	(0.28)
Royalties*2004 Election	0.0378***	(7.96)
Royalties*2008 Election	-0.00840	(-1.01)
Royalties*2012 Election	0.00600**	(3.25)
Population	0.0330	(0.55)
Municipal GDP	-0.00883	(-0.07)
Federal Transfers	0.0346	(1.03)
Taxes	-0.0511	(-0.60)
College Education	-0.00488	(-0.17)
Female	-0.0756	(-1.39)
PT	0.0899*	(2.50)
PSDB	-0.0132	(-0.26)
PMDB	-0.0706*	(-2.15)
Observations	1463	
R-Squared	0.0566	

t statistics in parentheses

Regressions include state and term fixed effects. SEs clustered at State level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15: Regressions of Royalties On Likelihood of Running for Reelection By Year: Dependent Variable is 1 if Incumbent Ran for Reelection

	(1) 2000 Election	(2) 2004 Election	(3) 2008 Election	(4) 2012 Election	(5) 2016 Election
Royalties	0.0531***	0.00820	-0.0458**	0.0414**	-0.0287
	(24.88)	(0.47)	(-2.80)	(2.72)	(-1.91)
Population	0.0752	-0.0900	0.0568	-0.0311	0.122
	(1.12)	(-1.03)	(0.75)	(-0.48)	(1.75)
Municipal GDP	-0.399	-0.126	-0.144	0.0895	-0.0430
	(-0.42)	(-0.51)	(-0.96)	(0.86)	(-0.52)
Federal Transfers	0.0028	-0.0318	0.0447	-0.0355	-0.00714
	(0.56)	(-0.31)	(0.97)	(-1.12)	(-0.28)
Taxes	0.390	0.496	0.0338	-0.0613	-0.0266
	(0.78)	(1.64)	(0.20)	(-0.58)	(-0.35)
college	0.0375*	0.0299*	0.00346	-0.0298*	0.0102
	(2.37)	(2.21)	(0.25)	(-2.18)	(0.74)
female	-0.0485	-0.0607*	-0.0316	-0.0159	0.00123
	(-0.69)	(-2.39)	(-1.33)	(-0.76)	(0.06)
pt	0.0276	0.0144	0.00310	-0.0141	0.0592
	(0.49)	(0.55)	(0.13)	(-0.65)	(1.82)
psdb	0.0087	0.0245	0.0355	-0.00596	0.0540**
	(1.03)	(1.31)	(1.72)	(-0.28)	(2.68)
pmdb	0.00837	-0.0110	0.0311	0.00835	0.0245
	(0.38)	(-0.64)	(1.79)	(0.47)	(1.37)
Observations	4310	5278	5248	5484	5349
R-Squared	0.128	0.00382	0.00363	0.00341	0.00398

t statistics in parentheses

Regressions include state. SEs clustered at State level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 16: How are offshore_royalties affecting government expenditures?

	(1) Educ	(2) Sec	(3) Judic	(4) Assist	(5) Agro	(6) Admin	(7) Health	(8) Hab	(9) Energy
Offshore Royalties	-0.324***	0.0129	0.00589	0.0181	0.0397**	0.264*	-0.236**	0.198*	-0.0114
PIB	16.75	-0.829	0.264	-3.787	3.596**	7.184	-0.895	-21.55*	2.623
PIB Capita	-0.105	-0.0811	0.00495	-0.145	-0.0131	-0.186	-1.418*	1.202***	-0.0842
PMDB	0.182	-0.118	0.105	1.134	-0.481	-2.141	-1.366	0.213	-0.335*
PSDB	2.178	-0.404	-0.145	1.444	0.0742	-2.904	1.774	-1.191	-0.261
PT	1.861	-0.520	-0.623	2.711	-0.330	-7.012	-8.984	5.986	-1.465*
College Educ	1.924	-0.247	-0.0828	1.250	0.586	-1.483	-3.714*	1.163	-0.0844
Term Limited	-0.750	0.393	0.0505	0.254	0.310	-3.626	-1.535	2.306*	-0.153
Industry	-18.02*	1.396	-0.365	2.357	-2.826*	0.493	3.289	13.71	-1.895
Services	-35.76***	1.174	0.318	7.668	-4.326**	-9.831	14.33*	24.01**	-2.972
Proportion Urban	39.98***	0.576	-0.930	-2.821	-0.526	27.81***	-35.45*	-17.59**	0.252
Taxes	9.388	0.383	-0.511	3.050	-4.422**	-6.286	1.609	12.55	-2.555
Total Revenue	0.307***	0.0108**	-0.00218*	0.0612***	0.00365	0.0854***	0.143***	0.206***	0.000854
Federal Transfers	-0.108	-0.0220	0.00609	-0.0234	0.0129	-0.0509	0.316***	-0.0460	0.00908
Observations	1605	1605	1605	1605	1605	1533	1605	1605	1605
R-Squared	0.963	0.610	0.275	0.869	0.486	0.811	0.950	0.888	0.282

Sample includes only municipalities for which we have Corruption data. Includes state and term fixed effects. State level clustered SE.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 17: How are offshore_royalties affecting government expenditures?

	(1) Educ	(2) Sec	(3) Judic	(4) Assist	(5) Agro	(6) Admin	(7) Health	(8) Hab	(9) Energy
Offshore Royalties	-0.280***	0.00544	0.00425	0.0595	0.00959	0.404**	-0.208**	0.106	-0.00636
Corruption	0.112	-0.0203	-0.000134	-0.0175	-0.0188	0.0776	0.134	-0.0282	0.00677
Offshore Royal*Corruption	-0.00550***	0.000757**	0.000196	-0.00381**	0.00276***	-0.0121***	-0.00244	0.00679**	-0.000522*
PIB	14.64	-0.918	0.344	-3.421	3.625**	7.686	-1.373	-21.32*	2.595
PIB Capita	-0.203	-0.133	0.00176	-0.283	-0.00622	0.104	-1.195	0.957*	-0.0111
PMDB	-0.252	-0.153	0.137	0.483	-0.316	-2.034	-0.968	0.0407	-0.197
PSDB	1.975	-0.307	-0.167	1.250	0.260	-3.793	1.768	-0.901	-0.327
PT	-0.348	-1.078	-0.591	3.425	-0.488	-3.992	-10.06	5.609	-1.217*
College Educ	2.902	-0.414	-0.0943	0.985	0.395	0.429	-4.491**	1.130	-0.0323
Term Limited	-0.671	0.354	0.0286	0.480	0.206	-2.937*	-1.258	1.730	-0.106
Industry	-14.92	1.761	-0.434	3.036	-2.929*	-1.845	2.738	14.86	-2.254
Services	-34.75***	1.488	0.278	7.660	-4.189**	-11.62	15.67*	23.51*	-3.040
Proportion Urban	42.57***	0.938	-0.937	-2.259	-0.704	26.20***	-39.52**	-14.78*	-0.479
Taxes	12.38	0.643	-0.604	1.913	-4.106**	-10.64	-0.672	16.86	-3.081
Total Revenue	0.311***	0.00908*	-0.00230	0.0591***	0.00169	0.105***	0.141***	0.200***	0.00248
Federal Transfers	-0.123	-0.0255*	0.00546	-0.0324	0.0165*	-0.0577	0.344***	-0.0530	0.0141*
Observations	1516	1516	1516	1516	1516	1449	1516	1516	1516
R-Squared	0.964	0.671	0.291	0.881	0.580	0.809	0.953	0.911	0.311

Sample includes only municipalities for which we have Corruption data. Includes state and term fixed effects. State level clustered SE.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$