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Natural Resources, Democracy and Corruption

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Abstract

We study how natural resources can feed corruption and how this effect depends on the quality of the democratic institutions. Our game-theoretic model predicts that resource rents lead to an increase in corruption if the quality of the democratic institutions is relatively poor, but not otherwise. We use panel data covering the period 1980 to 2004 and 124 countries to test this theoretical prediction. Our estimates confirm that the relationship between resource rents and corruption depends on the quality of the democratic institutions. Our main results hold when we control for the effects of income, time varying common shocks, regional fixed effects and various additional covariates. They are also robust to the use of various alternative measures of natural resources, corruption and the quality of the democratic institutions, and across different samples. These findings imply that democratization might be a powerful tool to reduce corruption in resource-rich countries.

JEL classification: D7, O1

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1 Introduction

The finding that natural resources are a curse rather than a blessing may seem paradoxical at first and has led to an extensive literature.[1] One of the main hypotheses put forward is that natural resource riches breed corruption, which, in turn, lowers economic performance (e.g., Leite and Weidmann, 2002; Sala-i-Martin and Subramanian, 2003; Isham et al., 2005).[2] Figure 1 plots log resource rents per capita in 1990 from the World Bank's adjusted net savings dataset against the Political Risk Service's corruption index in 1990, which is an inverse measure of corruption.[3] It suggests that corruption does indeed tend to be higher in resource-rich countries.

In this paper, we take a closer look at the relationship between natural resources and corruption. In particular, we investigate both theoretically and empirically whether and how the quality of the democratic institutions affects this relationship.

In the theoretical part, we present a game between politicians and the people. There are some "good" politicians who primarily care about social welfare and possibly many more "bad" politicians who primarily care about the revenues they can generate by corrupt activities. The people prefer to have a good politician as their president, as such a president acts in their best interest. This provides an incentive for a bad incumbent president to mimic a good president and not to engage in corruption in order to improve the chances that he can remain in power. In equilibrium, a bad incumbent mimics a good incumbent if and only if the democratic institutions are sufficiently sound, i.e., if and only if there is a sufficiently large difference between the probability that he can stay in office when supported by the people and the probability that he can stay in office without the people's

[1] This finding goes back to Corden and Neary (1982) and has been popularized by Sachs and Warner (1995). For an overview of this literature, see, e.g., Gylfason (2001) and Sachs and Warner (2001), or van der Ploeg (2008).

[2] As discussed below, there is a closely related hypothesis that natural resources lead to various forms of rent-seeking, which then lower economic performance.

[3] See section 4 for more information on resource rents and the corruption index. A low value of this index implies a high level of corruption, and vice versa.

support. If this difference is small, a bad incumbent engages in corrupt activities. The level of corruption that he chooses in this case increases in the abundance of natural resources because resource rents are less sensitive to corruption than domestic production. Our model thus predicts that resource abundance increases corruption in countries with poor democratic institutions, but not in countries with comparatively better democratic institutions.

A brief look at the data provides some preliminary support for this theoretical prediction. In figure 2, we split the sample used in figure 1 into democratic and non-democratic countries depending on whether or not the net democracy score POLITY2 from the Polity IV database is above 0 in 1990.[4] It suggests that the negative relationship between resource rents and the corruption index prevails in the sample of non-democratic countries, but not in the sample of democratic countries. In the empirical part, we test our theoretical prediction systematically using a reduced form model and panel data covering the period 1980 to 2004 and 124 countries. Our estimates confirm that the relationship between resource rents and corruption depends on the quality of the democratic institutions. We find that resource rents are positively associated with corruption in countries that have a POLITY2 score of 8.5 or less. Our basic results hold when we control for the effects of log income, time varying common shocks, regional fixed effects and various additional covariates. It is also robust to various alternative measures of resource abundance, corruption and the quality of the democratic institutions, as well as to the instrumental variable method of estimation and across different samples.

Our contribution in this paper is twofold. First, we present a theoretical model that clearly demonstrates why we should expect the effect of resource rents on corruption to depend on the quality of the democratic institutions. We thereby also introduce a novel way of modeling the quality of democratic institutions. Second, using a reduced form

[4]See section 4 for information on the POLITY2 score.

econometric model we show that the effect of resource rents on corruption indeed depends on the level of democracy.

The literature that studies the effect of natural resources on corruption is rather small. Ades and Di Tella (1999) present a theoretical model which predicts that resource rents and rents induced by a lack of product market competition foster bureaucratic corruption, as well as evidence that corruption increases in the proportion of total exports accounted by fuel, minerals and metals. In his broad cross-country study, Treisman (2000) shows that this proportion is a robust determinant of corruption. Leite and Weidman (2002) find that natural resource exports (as shares of GNP) tend to increase corruption, and that this in turn lowers growth. Isham et al. (2005) show that this effect is most pronounced for "point source" natural resources such as oil, minerals, and plantation crops. Aslaksen (2007) also finds that oil and minerals increase corruption. She further divides her sample into countries with low, medium and high POLITY2 scores in the year 1982. Using this cardinal approach, she finds that minerals increase corruption only in the first sub-sample whereas oil increases corruption in the first two of these sub-samples. In our empirical part, we choose a different approach to investigate how the level of democracy influences the effect of natural resources on corruption. Consistent with our theoretical model, we use an ordinal measure of democracy.[5] We introduce an interaction term between natural resources and democracy and also control for the direct effect of democracy on corruption. Therefore, unlike Aslaksen, we do not split our sample into different sub-samples. Finally, Vicente (2009) presents evidence that the oil discoveries in the late 1990s increased perceived corruption in Sao Tome and Principe.[6]

Corruption can be seen as one of many forms of rent-seeking. Our paper therefore is

[5]Collier and Hoeffler (2009, pp. 298-299) argue that "[s]ince the democracy score is ordinal, all uses that treat it as cardinal are at best approximations."

[6]Sao Tome and Principe is not covered in the Polity IV database. The coup d'etat in 2003 however suggests that its democratic institutions are relatively poor. This increase in corruption is therefore consistent with the predictions of our theoretical model.

related to the literature which argues that natural resources may lower the economic performance because they foster rent-seeking activities (e.g., Lane and Tornell, 1996; Tornell and Lane, 1999; Baland and Francois, 2000; Torvik, 2002). In particular, our paper is related to the recent contributions to this literature which emphasize that whether natural resources are a curse or a blessing depends on country-specific circumstances. Mehlum et al. (2006) show that natural resources boost economic performance if institutions are producer-friendly, but dampen economic performance if institutions are grabber-friendly. Hodler (2006) shows that natural resources lead to intensive rent-seeking, poor institutions and lower incomes in ethnically fractionalized societies, but to little or no rent-seeking and higher incomes in homogeneous societies. Robinson et al. (2006) argue that natural resources can lead to inefficiently high public sector employment unless strong political institutions prevent such patronage. Bulte and Damania (2008) present a model in which entrepreneurs from the natural resource sector lobby for sector-specific public goods when there is no political competition. Collier and Hoeffler (2009) investigate whether the effect of democracy on growth is distinctive in resource-rich societies. They find that strong checks and balances, which are often missing in newly established democracies, would be of particular importance in these societies.

The remainder of the paper is structured as follows: Section 2 presents the theoretical model, and section 3 derives the equilibrium and some comparative static results. Section 4 discusses our empirical strategy and the data. Section 5 presents the empirical evidence and various robustness tests. Section 6 concludes.

2 The Model

There is an economy inhabited by an incumbent president, who is in office for exogenous reasons, a challenger and the people. The incumbent and the challenger are each a good

type $\overline{\theta}$ with probability $\alpha \in (0,1)$ and a bad type $\underline{\theta}$ with probability $1-\alpha$. Each politician's type is his private information, but α is common knowledge.[7]

There are two periods $t \in \{1,2\}$.[8] In period one, the incumbent chooses the level of corruption $c_1 \in [0,1]$. At the end of period one, the people observe c_1 and support either the incumbent or the challenger. The people's decision determines the probability of the incumbent staying in office and, hence, the probability of the challenger getting into office. In period two, the politician in office again chooses the level of corruption $c_2 \in [0,1]$.

The economy consists of a production and a natural resource sector. Total income is thus given by the sum of domestic production A_t and the resource rent Ω_t. Domestic production A_t is primarily determined by the individuals' labor-leisure choices and their decisions to accumulate physical and human capital and to invest in better technologies. Corruption lowers the private returns on productive activities and, consequently, the incentives to work hard and to invest in physical and human capital and better technologies. As a result, domestic production decreases in corruption. For simplicity, we directly assume $A_t = A(c_t)$ with $A'(c_t) \leq 0$ and $A''(c_t) < 0$.[9] Further, we assume that $A(c_t)$ is continuous, $A'(0) = 0$ and $A'(1) = -\infty$.

The resource rent Ω_t, on the other hand, depends to a large extent on a country's resource endowment, which is exogenous and hence independent of the level of corruption. Corruption should thus have smaller disincentive effects on the revenues from natural resources than on domestic production. For simplicity, we assume that $\Omega_t = \Omega \geq 0$ in each period t. This assumption is however overly restrictive; all we need is that the resource rent is less sensitive to corruption than domestic production.

[7]None of our results depends on the value of α as long as $\alpha \in (0,1)$. Hence, they hold even if good politicians are very rare.

[8]This assumption is made for simplicity only. Results would remain qualitatively unchanged if there were more than two periods, e.g., an infinite number of periods.

[9]The reason for directly assuming that production decreases in corruption rather than explicitly modeling labor-leisure choices or investment decisions is that these richer models would require more notation and additional steps of analysis without yielding additional interesting insights on the interrelations between natural resources, democracy and corruption.

The people's welfare is $W_t = W(c_t) \equiv (1-c_t)[A(c_t)+\Omega]$ in period t. Welfare unambiguously decreases in corruption c_t. When deciding which politician to support, the people maximize their expected welfare, and we assume that they support the incumbent if they are indifferent between him and his challenger.[10]

In each period t, the politician in office derives utility from different sources. On the one hand, he gets the corruption revenues $\Pi_t = \Pi(c_t) \equiv c_t[A(c_t) + \Omega]$.[11] Similar to a Laffer curve, $\Pi(c_t)$ is a hump-shaped function of c_t.[12] On the other hand, the politician in office may benefit for several reasons from high social welfare W_t. First, his salary may depend on the performance of the official economy. Second, his status and influence in the international community may depend on the people's welfare and the economy's performance. Third, he may genuinely care about the people's well-being. We therefore assume that a politician of type θ gets the utility θW_t from social welfare W_t when in office, and that $0 < \underline{\theta} < \overline{\theta}$. The reason for the first inequality is that any politician cares about his salary and his status; and the reason for the second inequality is that good politicians care more about the people's well-being than bad politicians. Consequently, the total instantaneous utility of a politician of type θ in office is

$$u_t = u(c_t; \theta) \equiv \Pi(c_t) + \theta W(c_t) = [c_t + \theta(1 - c_t)][A(c_t) + \Omega]. \tag{1}$$

We further assume $\underline{\theta} < 1 \leq \overline{\theta}$, such that good politicians in office care for all the various reasons more about social welfare than about corruption revenues while bad politicians care more about corruption revenues. For simplicity, we abstract from discounting and

[10] To motivate this tie-breaking rule, we could, e.g., assume that there is a very small probability $\epsilon \to 0$ that the challenger is a complete maniac who would set $c_2 = 1$ such that $W_2 = 0$.

[11] Our results do not hinge on the assumption that the incumbent must choose the same level of corruption across sectors. Suppose he could separately choose the levels c_t^A and c_t^Ω for the production and the resource sector, respectively. Then, all our results would be qualitatively unchanged with respect to the economy wide level of corruption $c_t = (c_t^A A_t + c_t^\Omega \Omega)/(A_t + \Omega)$.

[12] This similarity is not surprising given that we follow common practice and model grand corruption as a tax for which no public good is provided.

assume that politicians get zero utility when not in office.[13]

A key feature of the model is the democratic institutions. They determine the extent to which the people can choose their government, i.e., whether or not the incumbent is replaced by the challenger. We assume that the incumbent can remain in office with probability p if the people support him, and with probability q if the people support his challenger, where $0 \leq q \leq p \leq 1$. We measure the quality of the democratic institutions by $D \equiv p - q$. This measure suggests that the democratic institutions are of high quality when the incumbent is likely to stay in office if and only if the people want him to stay. The quality of the democratic institutions D is low if the people's vote has little impact on the chances that the incumbent can stay in office. This measure allows for different types of poor democratic institutions or democratic failures, respectively: The high q-failure that an authoritarian incumbent is likely to stay in office even without the people's support, and the low p-failure that an incumbent in an anarchic environment is likely to be overthrown even when supported by the majority.

We consider this novel approach of modeling democratic institutions to be intuitively appealing and sufficiently general to allow for various reasons why incumbents are sometimes overthrown even when supported by the people, and why they can sometimes stay in office without the people's support. In the real world, autocrats who manage to stay in power despite being disliked by the people often bribe the military or other powerful groups. In appendix A.2, we therefore study an extended version of our model in which the incumbent can bribe the military to increase the probability that he can stay in office even if the people do not support him. This extended version yields predictions that are qualitatively similar to those from our baseline model.

The appropriate solution concept for our dynamic game of incomplete information is

[13]Note that the strategies of the people and the challenger are independent of the discount factor anyway. Note further that results remain qualitatively unchanged if politicians get some utility from social welfare when not in office.

Perfect Bayesian Equilibria (PBE).

3 The Equilibrium

We use backward induction and start by solving the period two subgame. The politician who is in office in period two has no strategic incentives and simply chooses the level of corruption c_2 that maximizes his instantaneous utility $u_2 = u(c_2; \theta)$. A good politician in office benefits more from high welfare W_t than from high corruption revenues Π_t since $\overline{\theta} > 1$. He therefore chooses $c_2(\overline{\theta}) = 0$. A bad politician in office, who cares more about Π_t since $\underline{\theta} < 1$, chooses $c_2(\underline{\theta}) = \hat{c} \equiv \arg\max_{c_t} u(c_t; \underline{\theta})$. It follows:

Lemma 1 *In period two, a good politician in office chooses $c_2(\overline{\theta}) = 0$ and a bad politician in office chooses $c_2(\underline{\theta}) = \hat{c}$, where $\hat{c}$ satisfies $\hat{c} \in (0,1)$, increases in Ω and decreases in $\underline{\theta}$.*

Proof: It follows from equation (1), $\overline{\theta} > 1$ and $A'(c_t) \leq 0$ that $c_2(\overline{\theta}) = 0$. The first-order condition

$$(1 - \underline{\theta})[A(c_t) + \Omega] + [c_t + \underline{\theta}(1 - c_t)]A'(c_t) = 0$$

determines $\hat{c}$. Note that the second-order condition,

$$\Gamma(c_t) \equiv 2(1 - \underline{\theta})A'(c_t) + [c_t + \underline{\theta}(1 - c_t)]A''(c_t) < 0,$$

is satisfied since $\underline{\theta} \in (0,1)$, $A'(c_t) \leq 0$ and $A''(c_t) < 0$, and that $A'(0) = 0$ and $A'(1) = -\infty$ guarantee an interior solution $\hat{c} \in (0,1)$. The implicit function theorem implies $\frac{d\hat{c}}{d\Omega} = -\frac{1-\underline{\theta}}{\Gamma(\hat{c})}$ and $\frac{d\hat{c}}{d\underline{\theta}} = -\frac{(1-\hat{c})A'(\hat{c})-[A(\hat{c})+\Omega]}{\Gamma(\hat{c})}$. It thus follows from $\underline{\theta} < 1$, $A'(\hat{c}) \leq 0$ and $\Gamma(\hat{c}) < 0$ that $\frac{d\hat{c}}{d\Omega} > 0$ and $\frac{d\hat{c}}{d\underline{\theta}} < 0$. ■

A bad politician in office therefore chooses a higher level of corruption in period two, the less he benefits from social welfare. Moreover, the level of corruption that he chooses

increases in the resource rent Ω. To understand why, note that a higher level of corruption benefits a bad politician by allowing him to grab a higher share of the total income $A_t + \Omega$, but harms him by decreasing domestic production A_t and thereby the total income. The larger the corruption-independent resource rent Ω is, the less he cares about this decrease in A_t. The level of corruption $\hat{c}$ that maximizes his instantaneous utility thus increases in the resource rent Ω.

When deciding whom to support at the end of period one, the people know that their welfare W_2 in period two will be higher with a good politician in office than with a bad politician in office. They therefore support the incumbent if and only if they believe that he is good with a higher probability than the challenger. That is, they support the incumbent if and only if their updated belief that he is good is $\mu(\overline{\theta}|c_1) \geq \alpha$.

In period one, a good incumbent has two objectives when choosing the level of corruption c_1. First, he would like his instantaneous utility $u(c_1; \overline{\theta})$ to be high. Second, he would like to ensure the people's support. Notice that $u(c_1; \overline{\theta})$ is maximized by $c_1(\overline{\theta}) = 0$; and that in any PBE a good incumbent gets reelected whatever his equilibrium choice $c_1(\overline{\theta})$ is, because Bayes' rule implies that the people's updated beliefs must satisfy $\mu(\overline{\theta}|c_1(\overline{\theta})) \geq \alpha$ for all possible $c_1(\overline{\theta})$ and $c_1(\underline{\theta})$. Therefore, in equilibrium a good incumbent also receives the people's support when choosing his most preferred corruption level $c_1(\overline{\theta}) = 0$. It seems thus reasonable to focus on PBE in which he plays $c_1(\overline{\theta}) = 0$.[14]

Given that a good incumbent plays $c_1(\overline{\theta}) = 0$, a bad incumbent is supported by the people whenever he plays $c_1(\underline{\theta}) = 0$, as the people then believe $\mu(\overline{\theta}|0) \geq \alpha$. However, in equilibrium a bad incumbent does not get the people's support when he plays some $c_1(\underline{\theta}) > 0$, as the people then know that he must be a bad incumbent, i.e., $\mu(\overline{\theta}|c_1(\underline{\theta})) = 0$. But when he is not supported by the people anyway, it is best for him to choose the level

[14] As we show in Appendix A.1, a good incumbent plays $c_1(\overline{\theta}) = 0$ in any PBE that satisfies a plausible refinement on the people's off-equilibrium beliefs. Also a good incumbent would always choose zero corruption if we assumed that he receives a sufficiently high disutility from acting corruptly.

of corruption that maximizes his instantaneous utility $u(c_1;\underline{\theta})$. This is $c_1(\underline{\theta}) = \hat{c}$. His expected lifetime utility from choosing $c_1(\underline{\theta}) = \hat{c}$ and not being supported is

$$V(\hat{c};\underline{\theta}) = (1+q)u(\hat{c};\underline{\theta}),$$

while his expected lifetime utility from choosing $c_1(\underline{\theta}) = 0$ and getting the people's support is

$$V(0;\underline{\theta}) = u(0;\underline{\theta}) + pu(\hat{c};\underline{\theta}).$$

He therefore chooses $c_1(\underline{\theta}) = \hat{c}$ if

$$\Delta V(\underline{\theta}) \equiv V(\hat{c};\underline{\theta}) - V(0;\underline{\theta}) = (1-D)u(\hat{c};\underline{\theta}) - u(0;\underline{\theta}) > 0 \tag{2}$$

$$\Leftrightarrow \quad D < D' \equiv \frac{u(\hat{c};\underline{\theta}) - u(0;\underline{\theta})}{u(\hat{c};\underline{\theta})},$$

where $0 < D' < 1$. Otherwise, he chooses $c_1(\underline{\theta}) = 0$.[15] To summarize:

Proposition 1 *There exists a PBE in which a good incumbent chooses $c_1(\overline{\theta}) = 0$, a bad incumbent chooses $c_1(\underline{\theta}) = 0$ if $D \geq D'$ and $c_1(\underline{\theta}) = \hat{c}$ otherwise, and the people support the incumbent if and only if $c_1 = 0$. There exists no other PBE with $c_1(\overline{\theta}) = 0$.*

Appendix A.1 shows that this PBE is the unique PBE that satisfies a plausible refinement on the people's off-equilibrium beliefs. We thus focus on this PBE in the remainder of this section.

The PBE described in Proposition 1 is pooling if $D \geq D'$, and separating otherwise. The reason for the former is that a bad incumbent mimics a good incumbent to ensure the people's support if democratic institutions are sound and the people's support therefore important for staying in office. He has however little disadvantage from revealing his bad

[15] In the special case in which $D = D'$, a bad incumbent is indifferent between 0 and $\hat{c}$.

type if the people have little impact on whether or not he can stay in office. He therefore chooses the corruption level $\hat{c}$, which maximizes his instantaneous utility, if democratic institutions are poor.

We now analyze how an increase in the resource rent Ω affects corruption $c_1(\theta)$ in the PBE described above, and how this effect depends on the democratic institutions D. Since a good incumbent always chooses $c_1(\overline{\theta}) = 0$, we focus on the level of corruption $c_1(\underline{\theta})$ that a bad incumbent chooses. When democratic institutions are relatively sound, i.e., when $D \geq D'$, a bad incumbent chooses $c_1(\underline{\theta}) = 0$ and a marginal increase in Ω has therefore no effect on the level of corruption. But when $D < D'$, a bad incumbent chooses $c_1(\underline{\theta}) = \hat{c}$, which increases in Ω as we know from Lemma 1. Hence:

Proposition 2 *A marginal increase in the resource rent Ω raises corruption $c_1(\underline{\theta})$ if and only if $D < D'$, i.e., if and only if the democratic institutions are relatively poor.*

It holds even more generally that the effect of the resource rent Ω on corruption depends on the democratic institutions D. In particular, the effect of Ω on the relative attractiveness of high corruption $c_1(\underline{\theta}) = \hat{c}$, measured by $\Delta V(\underline{\theta}) \equiv V(\hat{c}; \underline{\theta}) - V(0; \underline{\theta})$, decreases in D and is positive if and only if D is sufficiently low.[16] The reasons are that the positive effect of Ω on the attractiveness of zero corruption, $V(0; \underline{\theta})$, increases in the probability p that the incumbent can stay in office when supported by the people; and that the positive effect of Ω on the attractiveness of high corruption, $V(\hat{c}; \underline{\theta})$, increases in the probability q that he can stay in office without the people's support.

Therefore, our model predicts that when looking at a sample of countries differing in various aspects including the quality of their democratic institutions, we should expect

[16] To see this, notice that the envelope theorem implies $\frac{du(\hat{c};\underline{\theta})}{d\Omega} = \hat{c} + \underline{\theta}(1-\hat{c})$, and that $\frac{du(0;\underline{\theta})}{d\Omega} = \underline{\theta}$. It then follows from equation (2) that $\frac{d\Delta V(\underline{\theta})}{d\Omega} = (1-\underline{\theta})\hat{c} - D[\hat{c} + \underline{\theta}(1-\hat{c})]$. Hence, $\frac{d^2\Delta V(\underline{\theta})}{d\Omega dD} < 0$, and $\frac{d\Delta V(\underline{\theta})}{d\Omega} > 0$ if and only if $D < \frac{(1-\underline{\theta})\hat{c}}{(1-\underline{\theta})\hat{c}+\underline{\theta}}$.

the effect of resource rents on corruption to be negative in countries with poor democratic institutions, but neutral or even positive in countries with strong democratic institutions.

4 Empirical Strategy and Data

We use panel data which covers 124 countries over the period 1980 to 2004.[17] Our basic specification uses five year averages of our measures of corruption, natural resources, democracy and income. To estimate whether the relationship between natural resources and corruption varies systematically with the quality of the democratic institutions, we use the following model:

$$CI_{srt} = \alpha_r + \beta_t + \gamma_1 RR_{srt} + \gamma_2 D_{srt-5} + \gamma_3 (D_{srt-5} \times RR_{srt}) + \phi Y_{srt} + X'_{srt}\Lambda + \varepsilon_{srt}, \quad (3)$$

where CI_{srt} is the corruption index in country s in region r averaged over the years $t-4$ to t, α_r is a region dummy variable covering seven regions of the world which controls for regional fixed effects,[18] β_t is a year dummy variable which controls for time varying common shocks, RR_{srt} is the log per capita rent from natural resources in country s in region r averaged over the years $t-4$ to t, D_{srt-5} is a measure of democracy in country s in region r averaged over the years $t-9$ to $t-5$, Y_{srt} is log per capita income in country s in region r averaged over years $t-4$ to t, and X_{srt} is a vector of other control variables.

The main variable of interest is RR_{srt}. The point estimate of the effect of a change in RR_{srt} on CI_{srt} is $\gamma_1 + \gamma_3 D_{srt-5}$. Therefore we focus on the coefficients γ_1 and γ_3. Given that high values of the corruption index CI_{srt} correspond to low levels of corruption, and that we scale our democracy measure D_{srt-5} such that it is zero for the least democratic

[17] Due to data limitations, not all specifications cover exactly 124 countries and in most specifications, the panel is unbalanced.

[18] The region dummies cover Europe and Central Asia, East Asia and the Pacific, Latin America, Western Europe and North America, the Middle East and North Africa, South Asia, and Sub Saharan Africa.

countries, we expect γ_1 to be significantly negative and γ_3 to be significantly positive. This would imply that there is a threshold level of democracy below which the effect of resource abundance on the corruption index is negative (implying more corruption), and above which this effect is positive (implying less corruption).

We use the corruption index (CI_{srt}) from the Political Risk Services (PRS). This measure is predominantly an assessment of corruption within the political system. Therefore it includes actual and potential corruption, and it covers most common forms of corruption.[19] The advantages of using this measure are threefold. First, it suits our purpose as it best captures our notion of corruption in the theoretical model in which corruption is part of the political process. Second, it covers the time period 1980 to 2004 and has the largest number of observations. This allows us to use panel data and minimizes the sample selection bias both across countries and over time. Third, it is also widely used in the literature (e.g., Knack and Keefer, 1995; Alesina and Weder, 2002). As an alternative we use the corruption perception index from Transparency International. This however reduces our sample size.[20]

The PRS corruption index varies between 0 and 6, with higher values indicating lower levels of corruption. Averaged over the sample period, the Democratic Republic of Congo was the most corrupt country with an average value of CI_{srt} of 0.6, and Finland was the least corrupt country with an average value of CI_{srt} of 6.0. The mean and the standard deviation of CI_{srt} are 3.0 and 1.4, respectively.

Our main natural resource measure RR_{srt} is the log per capita rent from natural resources including energy, minerals, and forestry taken from the World Bank's adjusted net savings dataset.[21] Hamilton and Clemens (1999) provide a detailed description of this

[19]For example, patronage, nepotism, job reservations, secret party funding, bribes connected with export and import licenses, exchange controls, tax assessments, police protection, loans etc.

[20]Even though Transparency International covers more countries than the PRS, the actual number of observations in the Transparency International dataset is roughly half that of the PRS.

[21]Energy resources are oil, gas, hard coal and soft coal. Minerals are bauxite, copper, lead, nickel,

dataset. The rent from a particular commodity is defined as the difference between its world price and the average extraction costs both expressed in current US dollars. The world price of a particular commodity is global and it only varies over time. The extraction costs however are variable over time and across countries. We calculate total rents accruing from all natural resources covered in the dataset by following a three step procedure. First, we multiply the natural resource rent per unit of output of a particular commodity by the total volume of that commodity extracted. Second, we aggregate them across commodities for a country and a particular year and we divide the aggregate resource rent by population size. Third, we average the per capita rents for five year periods and take the natural logarithm to smooth out any noise in the data. Averaged over the sample period, Madagascar has the lowest per capita resource rent with an average value of RR_{srt} of 1.6, and the United Arab Emirates the highest with an average value of RR_{srt} of 16.0. The mean and the standard deviation of RR_{srt} are 10.1 and 2.7, respectively.

We choose RR_{srt} as our preferred measure of natural resources for the following reasons. First, it is best able to capture our notion of resource abundance in the theoretical part, in which Ω_t is a resource rent. Second, it is best able to bypass the endogeneity related concerns associated with measures of primary exports as a share of GNP or total exports, such as the popular Sachs and Warner (1995) measure. These measures are likely to be endogenous as corruption negatively affects investment and production (Mauro, 1995) and, consequently, the denominator of these measures.[22] Third, RR_{srt} is fairly wide in terms of country coverage. Therefore we are able to minimize the risk of sample selection bias. It also provides a reasonably long time dimension. Fourth, this data on resource rents is used in a number of recent studies (e.g., Ross, 2006; Collier and Hoeffler, 2009). Nevertheless,

phosphate, tin, zinc, gold, silver and iron ore.

[22]Another potential source of endogeneity is reverse causality between CI_{srt} and RR_{srt}. The average extraction costs which are a component of RR_{srt} include transportation costs. Corruption in year t could affect transportation costs in year t, which raises concerns of endogeneity. However, corruption in year t may not affect transportation costs in year $t-5$. Therefore, to address this endogeneity concern we also used lagged resource rents. Our main results remained highly significant. (Results available upon request.)

we also use various alternative measures of resource abundance. We exclude the rent from forestry from RR_{srt} since there is a concern that this rent might be endogenous. We also use the rents from energy and minerals separately. In addition, we use the Sachs and Warner primary exports measure, natural capital, and subsoil wealth.

Our democracy measure D_{srt-5} is calculated using the Polity IV database, which is described by Marshall and Jaggers (2002). This database reports democracy and autocracy scores, which both vary between 0 and 10 with 10 being the most democratic or most autocratic, respectively. The democracy score measures competition and openness in the electoral process, and the autocracy score measures suppression of competitiveness over executive recruitment, lack of constraints on the executive, and regulation of participation. Note that the democracy and autocracy scores do not have any categories in common. The POLITY2 score is the difference between the democracy and autocracy scores. We average the POLITY2 scores over the period $t-9$ to $t-4$, and we scale these averages such that our democracy measure D_{srt-5} ranges from 0 to 1, with higher values implying better democratic institutions.[23] Averaged over the sample period, Qatar and Saudia Arabia are the least democratic countries with average values of D_{srt-5} of 0. There are various countries with an average value of 1 including the resource-rich democracies Australia and Norway.

The democracy measure D_{srt-5} suits our purpose for the following reasons. First, as a net measure of democracy it is best able to capture our notion of democracy in the theoretical model. There, democracy is defined as the difference between p and q which is an indicator of net democracy. Nevertheless, we check the robustness of our results using the democracy score from the Polity IV database without subtracting the autocracy score. Second, D_{srt-5} is perhaps able to address the endogeneity related concerns better

[23] In particular, $D_{srt-5} = 0$ if the averaged POLITY2 score is -10, and $D_{srt-5} = 1$ if the averaged POLITY2 score is 10. Having $D_{srt-5} = 0$ for the least democratic countries allows to test the prediction that resource rents raise corruption in countries with poor democratic institutions in a straightforward manner.

than any other measure of democracy since it is a lagged measure. Even though less corrupt countries are likely to be more democratic, it is less likely that corruption in time t will affect democracy in time $t-5$. One might however argue that institutions are persistent, such that corruption today is very similar to corruption in 1980 or even earlier. Even though this may be the case with other measures of institutions,[24] the corruption index is not persistent enough to cause alarm. A simple correlation between corruption in 1980 and 2000 is 0.64. Nevertheless, we also employ the instrumental variable method of estimation. Third, D_{srt-5} is ordinal and therefore allows us to distinguish between different shades of democracy. Alternatively, there is also a strong view that a simple dichotomy between democracy and non-democracy is the most appropriate empirical definition (e.g., Przeworski et al., 2000). However, the latter certainly involves approximation and may bias estimates (Collier and Hoeffler, 2009). A related view is that democratic capital or longer-lived democratic experience is important (e.g., Treisman, 2000; Persson and Tabellini, 2006; Keefer, 2007). We therefore check the robustness of our main results by using dichotomous and long-run measures of democracy. We also use the democracy scores from Freedom House as an alternative measure.

Log per capita income, legal origin dummies, and several other additional control variables are also used in our study. Detailed definitions and sources of all variables are available in Appendix B.1. Table 1 reports descriptive statistics of the major variables used.

Finally, there are concerns of multi-collinearity and omitted variables that we need to address in our estimation. First, there is a possibility that a high correlation between RR_{srt} and D_{srt-5} could inflate the standard errors of our estimates. Ross (2001) documents that natural resource abundance and oil in particular has antidemocratic properties. This may

[24]There is however little consensus on institutional persistence. See, e.g., Glaeser et al. (2004) and Acemolgu et al. (2005) for opposing views. Also see Bhattacharyya (2008) for a discussion on institutional persistence and the difficulties associated with capturing it in an empirical model.

raise issues of multi-collinearity in our specification. We find that the correlation between RR_{srt} and D_{srt-5} is -0.03, and the correlation between RR_{srt} and $D_{srt-5} \times RR_{srt}$ 0.24. The magnitudes of these correlations are not large enough to cause any serious problem of multi-collinearity. Second, we tackle the issue of omitted variables by controlling for unobserved region specific heterogeneity, time varying common shocks and additional covariates that are expected to influence the level of corruption.

5 Empirical Evidence

Table 2 reports the estimate of equation (3). In column 1 we start by looking at the effects of natural resources and income on the corruption index CI_{srt}. We notice a statistically significant negative effect of the resource rent RR_{srt}. This suggests that natural resources are associated with higher levels of corruption.[25] But this association may be driven by omitted factors influencing both natural resources and corruption. To tackle this issue in columns 2 and 3 we add legal origin dummies, regional dummies, year dummies, and the lagged democracy measure D_{srt-5}. We notice that the negative relationship survives but the magnitude of the coefficient falls. In column 4 we present our baseline regression. We add the interaction term $D_{srt-5} \times RR_{srt}$ to estimate how the effect of natural resources on corruption depends on the quality of the democratic institutions. We notice that the coefficient on RR_{srt} is negative and statistically significant, and the coefficient on the interaction term positive and statistically significant. This confirms the predictions of our theoretical model. In an average country, natural resources feed corruption unless the net democracy score D_{srt-5} is above the threshold level of 0.93, which corresponds to an average POLITY2 score of 8.6. In 2004 the resource-rich countries Bolivia and Mexico had a POLITY2 score of 8, and resource-rich Botswana a POLITY2 score of 9. To put the re-

[25]Note that higher values of the corruption index imply less corruption.

sults from our baseline regression into perspective, let us focus on Angola – a resource-rich country ($RR_{AGO2004} = 14.20$) with poor democratic institutions ($D_{AGO2004} = 0.35$, i.e. a POLITY2 score of -3) and high corruption ($CI_{AGO2004} = 2$). Suppose first that Angola's resource rent dropped to zero (while all other explanatory variables remained unchanged). Our model predicts that Angola's corruption index would then increase by one standard deviation from 2.0 to almost 3.5. Suppose second that the quality of Angola's democratic institutions increased to match the quality of Botswana's democratic institutions (while all other explanatory variables remained unchanged). Our model predicts that Angola's corruption index would then increase to a value even slightly above 3.5.[26] These simple examples illustrate that resource rents tend to raise corruption unless the democratic institutions are sufficiently sound.

In column 5 we analyze whether our results are mainly driven by variations across or within countries. We do this by using country fixed effects and time varying common shocks as control variables. The coefficients of interest are close to zero and completely insignificant (while income enters significantly but with the "wrong" sign). Therefore, our results are mainly driven by cross-country variations, and within-country variations play a minor role. This result is not surprising given that the explanatory variables D_{srt-5} and RR_{srt} change only slowly over time, and that the time dimension of our data matrix is much smaller (only a few time periods per country) relative to the cross-section dimension (124 countries in our baseline regression). Also note that it is standard in the resource curse literature (e.g., Sachs and Warner 1995, 2001; Gylfason, 2001; Leite and Weidmann, 2002; Isham et al., 2005; Mehlum et al., 2006; Hodler, 2006; Brunnschweiler and Bulte, 2008) as well as in the literature on the determinants of corruption and governance (e.g., La Porta et al., 1999; Treisman, 2000) that empirical findings are based on cross-country variations. Even though this crucial role of cross-country variations is not surprising, insignificance in

[26] These results follow from $(-0.168 + 0.181 \times D_{AGO2004}) \times RR_{AGO2004} = -1.486$ and $(-0.168 + 0.181 \times D_{BWA2004}) \times RR_{AGO2004} = 0.056$.

the presence of country fixed effects could also result from omitting country-specific factors that affect the divergent corruption levels across countries. To address this concern, we show below that our main results remain significant when even controlling for various additional covariates.

Another potential concern is that our democracy measure D_{srt-5} could be endogenous. However, the endogeneity problem should not be too serious because D_{srt-5} is a lagged democracy measure and therefore less likely to be endogenous than contemporary measures.[27] Moreover, as we show in table 6 below, our results also hold when we use long-run measures of democracy, which are even less likely to be endogenous. Nevertheless, we address the potential endogeneity of our democracy measure D_{srt-5} and the interaction term $D_{srt-5} \times RR_{srt}$ by employing the instrumental variable approach. The instruments need to be correlated to D_{srt-5} and $D_{srt-5} \times RR_{srt}$, respectively, and also orthogonal to the error term. As it is often the case, finding strong and valid instruments is not an easy task. In column 6 we use the twice lagged democracy measure D_{srt-10} and the interaction term $D_{srt-10} \times RR_{srt}$ as instruments. These instruments are highly correlated to D_{srt-5} and $D_{srt-5} \times RR_{srt}$, and it is plausible that they are orthogonal to the error term. We notice that the coefficients of interest remain highly significant when we use these instruments. In column 7 we alternatively use settler mortality and its interaction term with RR_{srt} as instruments. Acemoglu et al. (2001) show that settler mortality is a valid instrument for property rights institutions, such as constraints on the executive. In their more recent work they show that better property rights institutions led to expansion of the franchise and better democratic institutions (Acemoglu et al., 2008). Therefore, it is reasonable to follow some recent studies (e.g., Collier and Hoeffler, 2009) and to use settler mortality (and its interaction with RR_{srt}) to instrument for democracy measures such as D_{srt-5} (and

[27] Harrison (2008) shows that the bias of OLS is reduced when an endogenous variable is interacted with a continuous exogenous variable. The bias of the coefficient on $D_{srt-5} \times RR_{srt}$ should thus be rather small even if D_{srt-5} is endogenous.

its interaction with RR_{srt}). There are however various drawbacks associated with the use of settler mortality as an instrument. First, it eliminates all countries that were not subject to European colonization from the sample. This leads to a drastic reduction in the sample size and the exclusion of most established democracies among the resource-rich countries. Furthermore, settler mortality is only available as a cross-section, which magnifies the problem of multi-collinearity at the second stage. It is therefore not surprising that the standard errors become so large that the coefficients of interest are no longer statistically significant, while still showing the predicted signs.[28]

Table 3 asks the question of where this nonlinear effect of natural resources on corruption comes from. In column 1 we test whether the effect is driven by a particular time period. We do this by allowing the interaction term $D_{srt-5} \times RR_{srt}$ to be different across time and we estimate separate year effects. We notice that the effect is uniform in terms of statistical significance over the period 1980 to 2004, while its magnitude tends to decline over time. In column 2 we test whether the effect is predominant among any particular country group. Again we do this by allowing the effect to vary across different country groups based on income. We notice that the effect is uniform across all country-income groups. In column 3 we show that the same holds true if we allow the interaction term to differ for OECD and non-OECD countries.

In table 4 we add additional covariates into our specification to address the issue of omitted variables. In column 1 we add ethnic fractionalization as an additional control because ethnically fractionalized countries tend to be more corrupt (Mauro, 1995) and because the effects of natural resources may depend on ethnic fractionalization (Hodler, 2006). The negative coefficient on RR_{srt} and the positive coefficient on $D_{srt-5} \times RR_{srt}$ survive. In columns 2-8 we control for official development assistance (ODA), real exchange rate distortions, black market premium, FDI, the Sachs and Warner trade liberalization

[28]The coefficients of interest remain statistically significant if we only use the interaction term of settler mortality and RR_{srt} to instrument for $D_{srt-5} \times RR_{srt}$.

index, trade shares, and media freedom to check whether these omitted variables might be driving our results. Our basic results survive in all instances except that the positive coefficient on $D_{srt-5} \times RR_{srt}$ becomes insignificant when we control for ODA. The coefficient on RR_{srt} however is still negative and statistically significant. This is not surprising as controlling for aid inflows eliminates all the resource-rich developed democracies from the sample and the residual resource-rich countries are mainly non-democracies. In column 10 we control for the statistically significant additional control variables (which are the Sachs and Warner trade liberalization index and media freedom) and our basic results survive this test. We also notice that barring column 2, the estimated threshold levels of democracy for a positive effect of resource rents on the corruption index vary within the range of 0.86 and 0.99 which is not significantly different from our preferred estimate of 0.93. Formal F-tests are reported in table 4.

Table 5 presents robustness results with alternative samples. Columns 1-5 check whether our results are influenced by any particular continent. We take out Africa, Neo-Europe[29], Asia, the Americas, and Europe one at a time from our base sample. Our results remain highly significant except that the positive coefficient on $D_{srt-5} \times RR_{srt}$ becomes marginally insignificant (with a p-value of 0.11) when European countries are excluded. This may be because omitting European countries from the base sample automatically eliminates some of the major resource-rich developed democracies. Therefore we get a more conventional resource curse result in a sample dominated by resource-rich non-democracies. In columns 6-8 we omit former British colonies, former French colonies, and former Spanish colonies one at a time. Our basic results remain again unaffected. In columns 9-11 we also omit influential observations using Cook's distance, DFITS, and Welsch distance formulas respectively. Our results survive these tests.

In table 6 we subject our results to further scrutiny by using alternative measures of

[29]Neo-Europe includes all Anglo-Saxon countries outside Europe: Australia, Canada, New Zealand, and the United States.

democracy and corruption. In columns 1 and 2 we replace our net democracy measure with alternative ordinal measures of democracy. These measures are the lagged democracy index DI_{srt-5} from the Polity IV dataset (i.e. the democracy score without subtracting the autocracy score), and the lagged Freedom House democracy index DF_{srt-5}. We scale both indices such that they range from 0 to 1, with higher values again implying better democratic institutions. We notice that our main results remain unchanged except that the coefficient on RR_{srt} is close to zero when using DF_{srt-5}. In column 3 we use a cardinal measure of democracy DD_{srt-5}. DD_{srt-5} is a dummy variable taking values 0 and 1. A value of 1 signifies a country to be democratic and corresponds to a positive POLITY2 score in the year $t-5$, and a value of 0 implies that the country was undemocratic in $t-5$. Our main results survive. As Treisman (2000), Persson and Tabellini (2006), and Keefer (2007) argue that longer-lived democracy is important, we also test the robustness of our results using long-run measures of democracy. In column 4 we use the fraction of years a country has been democratic between 1950 and the year $t-5$.[30] This measure d_{srt-5} counts democratic years in, say, the 1970s even if the country became undemocratic later on. In column 5 we use as an alternative the democracy measure δ_{srt-5} which is defined as the number of consecutive years after 1950 but right before $t-5$ in which a country has been democratic, divided by the number of years from 1950 to $t-5$.[31] Our main results remain highly significant for both these long-run measures of democracy. In column 6 we illustrate that our main results also survive when we use time independent democracy measures such as the fraction of years a country was democratic between 1950 and 1975. Finally, in column 7 we replace the corruption index from PRS by the corruption perception index from Transparency International. Our results also survive this test. Therefore, it is

[30]The year 1950 is chosen as a reference year since many former colonies became independent around that time (i.e., in-between 1945 and 1965). Treisman (2000) also uses 1950 as a reference year.

[31]The case of Zimbabwe illustrates the difference between these two long-run democracy measures. Zimbabwe had positive POLITY2 scores only from 1970 to 1986. Hence, $d_{ZWE1985} = \delta_{ZWE1985} = 16/36$, but $d_{ZWE2000} = 17/51$ and $\delta_{ZWE2000} = 0$.

fair to conclude that our basic result is robust to alternative measures of corruption and democracy.

In table 7 we check the robustness of our results by using alternative measures of resource abundance. In column 1 we use the log per capita rents from energy and minerals. That is, we exclude the rents from forestry, which might be endogenous because forestry is a renewable resource and hence involves production. The main results are unchanged. In columns 2-4 we look at the log per capita rents from energy and minerals separately. We find evidence that our results are due to rents from both energy and minerals. In column 5 we use the well-known Sachs and Warner primary exports share, and we find that our main results survive. In columns 5 and 6 we use log natural capital per capita and log subsoil wealth per capita, which are both used by Brunnschweiler and Bulte (2008).[32] The coefficients of interest have the expected signs in both columns, but they are only statistically significant when natural capital is used. The latter may be due to a reduction in sample size (from 643 to 178) when using subsoil wealth.

Overall these empirical findings support our theoretical prediction that natural resources foster corruption in countries with poor democratic institutions, and they suggest that natural resources even tend to reduce corruption in strong democracies.

6 Conclusions

We study the mechanism through which natural resources feed corruption and the role of democratic institutions in this process. Using a game-theoretic model we show that resource rents increase corruption if and only if the quality of the democratic institutions is below a certain threshold level. To test this prediction, we use a reduced form model and panel data covering the period 1980 to 2004 and 124 countries. We notice that our

[32]Natural capital was first used as a proxy measure of natural resources by Gylfason (2001).

theoretical prediction is supported by the data. In particular, resource rents are positively associated with corruption only in countries that have POLITY2 scores of around 8.5 or less. Our main results hold when we control for the effects of income, time varying common shocks, regional fixed effects, legal origin and various additional covariates. It is also robust to various alternative measures of natural resources, corruption and the quality of the democratic institutions.

These findings imply that resource-rich countries have a tendency to be corrupt because resource windfalls encourage their governments to engage in rent-seeking. But this tendency can be checked if the governments are accountable to the people. Political accountability without doubt is higher in countries with strong democratic institutions; for example, in the resource-rich democracies Australia and Norway. Democratization might therefore be a powerful tool for reducing corruption in resource-rich countries.

Appendix A

A.1 Uniqueness

This appendix introduces a plausible refinement on the people's off equilibrium beliefs and shows that this refinement guarantees the uniqueness of the PBE characterized in Proposition 1.

Definition *The PSE refinement is satisfied when the people's belief after observing some* $c_1 = \tilde{c}$ *which no incumbent* $\theta \in \{\overline{\theta}, \underline{\theta}\}$ *should play in equilibrium is*

1. $\mu(\overline{\theta}|\tilde{c}) = 1$ *if playing* $\tilde{c}$ *is equilibrium-dominated*[33] *for* $\underline{\theta}$*, but not for* $\overline{\theta}$*; and* $\mu(\overline{\theta}|\tilde{c}) = 0$ *if playing* $\tilde{c}$ *is equilibrium-dominated for* $\overline{\theta}$*, but not for* $\underline{\theta}$*.*

2. $\mu(\overline{\theta}|\tilde{c}) = \alpha$ *if playing* $\tilde{c}$ *is not equilibrium-dominated for any* $\theta \in \{\overline{\theta}, \underline{\theta}\}$*.*

Part 1 of this refinement is the Cho-Kreps (1987) intuitive criterion. Part 2 requires that the people's posterior beliefs about the incumbent's type should be equal to their prior beliefs when both types of incumbents could potentially benefit from a deviation $c_1 = \tilde{c}$. This latter requirement relates our refinement to Grossman and Perry's (1986) concept of Perfect Sequential Equilibria.

Lemma 2 *No PBE in which a good incumbent plays* $c_1(\overline{\theta}) > 0$ *satisfies the PSE refinement.*

Proof: We prove Lemma 2 by contradiction. Therefore, suppose there exists a PBE with $c_1(\overline{\theta}) > 0$ which satisfies the PSE refinement. To prevent incumbent $\overline{\theta}$ from deviating and playing $c_1(\overline{\theta}) = 0$, it is necessary that the people support the challenger when observing $c_1 = 0$, which requires beliefs $\mu(\overline{\theta}|0) < \alpha$. But playing $c_1 = 0$ is never equilibrium-dominated for incumbent $\overline{\theta}$ (while it may or may not be equilibrium-dominated for incumbent $\underline{\theta}$). The PSE refinement thus requires $\mu(\overline{\theta}|0) \geq \alpha$. This is a contradiction. Hence, there exists no PBE with $c_1(\overline{\theta}) > 0$ which satisfies the PSE refinement. ■

Lemma 2 and Proposition 1 imply:

[33] Playing $\tilde{c}$ is equilibrium-dominated for type θ if his equilibrium payoff strictly exceeds the highest possible payoff that he could possibly get after playing $\tilde{c}$.

Proposition 3 *The PBE characterized in Proposition 1 is the unique PBE that satisfies the PSE refinement.*

Proof: It follows from Lemma 2 that no PBE with $c_1(\overline{\theta}) > 0$ satisfies the PSE refinement, and from Proposition 1 that there is no other PBE with $c_1(\overline{\theta}) = 0$. ■

A.2 Extended Model

This appendix extends our model to allow the incumbent to bribe the military or some other powerful group to increase the probability that he can stay in office even without the people's support. We assume that when the incumbent pays a bribe $b \geq B$, he can stay in office with probability p independently of whether or not the people support him. When not paying $b \geq B$, the probability that he can stay in office is p if the people support him, and q if they do not support him. We still assume $0 \leq q \leq p \leq 1$, but readers may now want to think of q as being close to zero, such that the incumbent is unlikely to stay in office without the support of the people or the military.

The new parameter B measures how reluctant the military is to support a corrupt incumbent disliked by the people. Since better institutions generally foster this reluctance, we interpret B as another measure of the quality of the democratic institutions. Countries with sound democratic institutions are thus characterized by high D as well as high B.

In this extended model, a good incumbent still chooses zero corruption and has therefore no incentive to bribe the military. A bad incumbent now considers the following three sets of actions $(c_1(\underline{\theta}), b_1(\underline{\theta}))$ in period one: $(0,0)$ to imitate an honest incumbent; $(\hat{c},0)$ to get the corruption revenues $\hat{c}$ in the short-run; and $(\hat{c},B)$ to get the corruption revenues $\hat{c}-B$ in the short-run without a decrease in the probability of staying in office. A bad incumbent's expected lifetime utility $V(c,b;\overline{\theta})$ from these three sets of actions is:

$$\begin{aligned} V(0,0;\underline{\theta}) &= u(0;\underline{\theta}) + pu(\hat{c};\underline{\theta}) \\ V(\hat{c},0;\underline{\theta}) &= (1+q)u(\hat{c};\underline{\theta}) \\ V(\hat{c},B;\underline{\theta}) &= (1+p)u(\hat{c};\underline{\theta}) - B \end{aligned}$$

It directly follows that a bad incumbent chooses $(0,0)$ if $D \geq D'$ and $B \geq u(\hat{c};\underline{\theta}) - u(0;\underline{\theta})$; $(\hat{c},0)$ if $D < D'$ and $B \geq Du(\hat{c};\underline{\theta})$; and $(\hat{c},B)$ if $B < \min\{Du(\hat{c};\underline{\theta}), u(\hat{c};\underline{\theta}) - u(0;\underline{\theta})\}$.

In equilibrium, a bad incumbent therefore chooses corruption $c_1(\underline{\theta}) = \hat{c}$ if $D < D'$ or $B < u(\hat{c};\underline{\theta}) - u(0;\underline{\theta})$, and $c_1(\underline{\theta}) = 0$ otherwise. We know from Lemma 1 that a marginal increase in the resource rent Ω raises $\hat{c}$. Hence, as our baseline model, this extended model predicts that a higher resource rent raises corruption in countries with poor democratic institutions, but not in countries with sound democratic institutions.

Appendix B

B.1 Data description

Corruption index (CI_{srt}): A 7-point (0-6) index with higher values indicating less corruption. *Source:* ICRG, The PRS Group.

Corruption perception index: An 11-point (0-10) index with higher values indicating less corruption. *Source:* Transparency International.

Resource rent (RR_{srt}): Log of the per capita rent from natural resources, which include energy, minerals and forestry, averaged over the period $t-4$ to t. Rents are defined as the world market price minus the average extraction costs. The data are described in Hamilton and Clemens (1998). *Source:* Adjusted Net Savings Dataset, World Bank.

Energy and mineral rent (EMR_{srt}): Log of the per capita rent from energy and minerals, averaged over the period $t-4$ to t. The data are described in Hamilton and Clemens (1998). *Source:* Adjusted Net Savings Dataset, World Bank.

Energy rent (ER_{srt}): Log of the per capita rent from oil, gas, hard coal, and soft coal, averaged over the period $t-4$ to t. The data are described in Hamilton and Clemens (1998). *Source:* Adjusted Net Savings Dataset, World Bank.

Mineral rent (MR_{srt}): Log of the per capita rent from bauxite, copper, lead, nickel, tin, zinc, gold, silver, phosphate and iron, averaged over the period $t-4$ to t. The data are described in Hamilton and Clemens (1998). *Source:* Adjusted Net Savings Dataset, World Bank.

Primary Exports (SXP_{sr}): Primary Exports over GNP in 1970. *Source:* Sachs and Warner (1995).

Natural Capital (NC_{sr}): Log of average total natural capital in 1994 and 2000 estimated in US$ per capita. *Source:* WDI Online.

Subsoil Wealth (SW_{sr}): Log of average subsoil assets in 1994 and 2000 estimated in US$ per capita. *Source:* WDI Online.

Democracy (D_{srt-5}): POLITY2 scores from the Polity IV dataset, averaged over the period $t-9$ to $t-5$ and scaled such that it ranges from 0 to 1 with higher values indicating better democratic institutions. POLITY2 is defined as the difference between democracy and autocracy scores. It is an ordinal measure of democracy. *Source:* Polity IV.

Democracy Index (DI_{srt-5}): Democracy score from the Polity IV dataset, averaged over the period $t-9$ to $t-5$ and scaled such that it ranges from 0 to 1 with higher values indicating better democratic institutions. It is an ordinal measure of democracy. *Source:* Polity IV.

Democracy Freedom House (DF_{srt-5}): Democracy index from Freedom House, averaged over the period $t-9$ to $t-5$ and scaled such that it ranges from 0 to 1 with higher values indicating better democratic institutions. It is an ordinal measure of democracy. *Source:* Freedom House.

Democracy Dummy (DD_{srt-5}): Generated by using the POLITY2 coding from the Polity IV dataset. This dummy is equal to 1 if the POLITY2 score is positive in $t-5$, and equal to 0 otherwise. It is a cardinal measure of democracy. *Source:* Polity IV.

Fraction of democratic years since 1950 (d_{srt-5}): Generated by using the POLITY2 coding from the Polity IV dataset. Fraction of years between 1950 to $t-5$ in which POLITY2 is positive. *Source:* Polity IV.

Fraction of consecutive democratic years since 1950 (δ_{srt-5}): Generated by using the POLITY2 coding from the Polity IV dataset. Number of consecutive years after 1950 but right before $t-5$ in which POLITY2 score is positive, divided by the number of years between 1950 and $t-5$. *Source:* Polity IV.

Per Capita Income (Y_{srt}): Log GDP per capita PPP in current international $. *Source:* WDI Online, The World Bank Group.

Legal Origins: Legal Origin dummies - British, German, Scandinavian, and Socialist with others being the omitted category. *Source:* LaPorta et al. (1999).

Ethnic Fractionalization: Probability that two randomly selected individuals from a population belong to different ethnic groups. *Source:* Alesina et al. (2003).

Trade Share: Total volume of trade as share of GDP. *Source:* WDI Online, The World Bank Group.

FDI: Net inflow of foreign direct investment as share of GDP. *Source:* WDI Online, The World Bank Group.

Official Development Assistance: Log of official development assistance per capita by all donors. *Source:* WDI Online, The World Bank Group.

Real Exchange Rate Distortions: Real overvaluation. *Source:* WDI Online, The World Bank Group.

Sachs and Warner Trade Liberalization Index: Fraction of years open between $t-4$ and t. *Source:* Wacziarg and Welch (2003).

Black Market Premium: *Source:* WDI Online, The World Bank Group.

Media Freedom: Fraction of years print and electronic media have been free since 1980. *Source:* Freedom House.

Settler Mortality (SM_{sr}). Log of estimated mortality of European settlers in colonies before 1850. *Source:* Acemoglu et al. (2001).

B.2 Sample

Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belarus, Belgium, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chile, China, Colombia, Dem. Rep. Congo, Rep. Congo, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Cyprus, Czech Rep., Denmark, Dominican Rep., Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Gabon, The Gambia, Germany, Ghana, Greece, Guatemala, Guinea, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea Dem. Rep., Rep. Korea, Kuwait, Latvia, Liberia, Libya, Lithuania, Madagascar, Malawi, Malaysia, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Papua New Guinea, Peru, The Philippines, Poland, Portugal, Qatar, Romania, Russian Fed., Saudi Arabia, Senegal, Serbia and Montenegro, Sierra Leone, Slovak Rep., Slovenia, Somalia, South Africa, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Syria, Taiwan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.

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Figure 1: Resource Rents and Corruption: All Countries

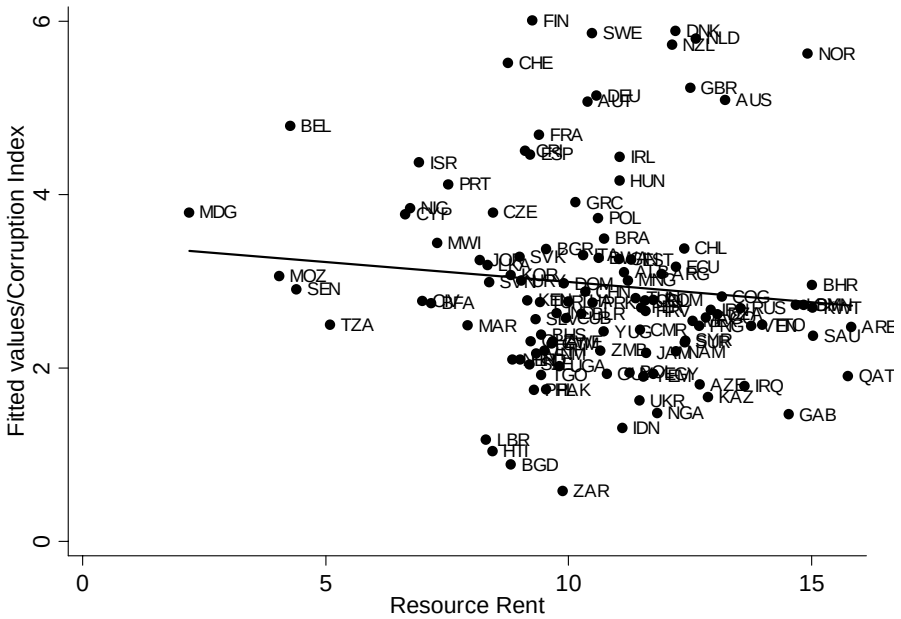

Figure 2: Resource Rents and Corruption: Democracies (left) and Non-democracies (right)

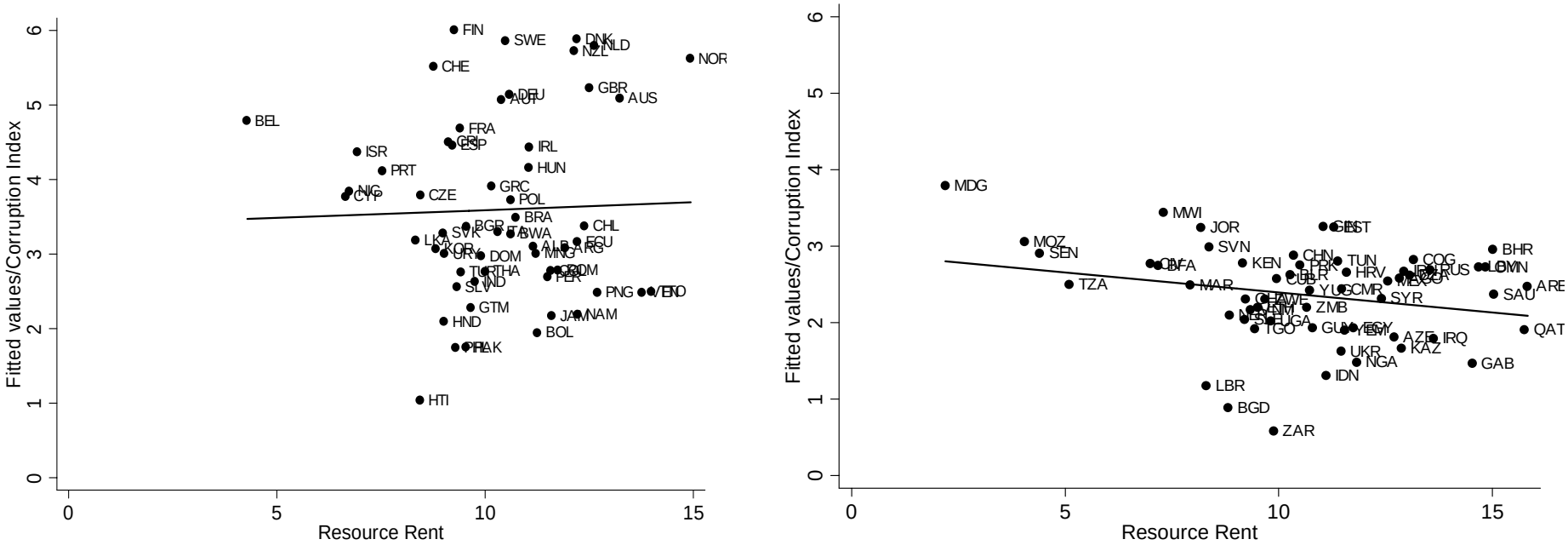

Table 1. Summary Statistics

Variable	Number of observations	Mean	Standard Deviation	Minimum	Maximum
Corruption Index (CI_{srt})	759	3.046	1.444	0	6
Natural Resources (RR_{srt})	1171	10.12	2.694	-0.911	16.93
Democracy Lagged (D_{srt-5})	1573	0.507	0.368	0	1
$D_{srt-5} * RR_{srt}$	1051	5.108	4.146	-0.164	16.28
Log Per Capita Income (Y_{srt})	1684	7.669	1.363	4.081	10.87

Table 2: Natural Resources, Democracy and Corruption

	Dependent Variable: Corruption Index (CI_{srt})						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Resource Rent (RR_{srt})	-0.158*** (0.028)	-0.092** (0.031)	-0.063** (0.030)	-0.168*** (0.046)	0.042 (0.061)	-0.199*** (0.050)	-0.919 (2.296)
Democracy lagged (D_{srt-5})			1.216*** (0.0124)	-0.740 (0.681)	0.532 (0.804)	-1.325* (0.792)	-17.04 (69.21)
D_{srt-5}*RR_{srt}				0.181*** (0.059)	-0.004 (0.072)	0.237*** (0.064)	1.648 (4.475)
Income (Y_{srt})	0.787*** (0.068)	0.591*** (0.118)	0.514*** (0.101)	0.579*** (0.094)	-0.568** (0.229)	0.593*** (0.094)	0.869 (1.950)
Controls:							
Legal Origins	NO	YES	YES	YES	NO	YES	YES
Country Dummies	NO	NO	NO	NO	YES	NO	NO
Region Dummies	NO	YES	YES	YES	NO	YES	YES
Year Dummies	NO	YES	YES	YES	YES	YES	YES
Instruments						Democracy twice lagged (D_{srt-10}), and D_{srt-10}*RR_{srt}	Settler Mortality (SM_{sr}), and SM_{sr} *RR_{srt}
Countries	130	127	124	124	126	124	58
Observations	670	658	643	643	650	641	329
Adjusted R^2	0.34	0.94	0.94	0.94	0.83	--	--

Notes: ***, **, and * indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in parentheses are clustered standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All regressions except column (1) are carried out without an intercept. Sample years are every fifth year from 1980 to 2004. In column (6) D_{srt-10} and D_{srt-10}*RR_{srt} are used as instruments for D_{srt-5} and D_{srt-5}*RR_{srt}. In column (7) SM_{sr} and SM_{sr} *RR_{srt} are used as instruments for D_{srt-5} and D_{srt-5}*RR_{srt}.

Table 3: Natural Resources, Democracy and Corruption across Time and Income

	Dependent Variable: Corruption Index (CI_{srt})		
	(1)	(2)	(3)
Resource Rent (RR_{srt})	-0.192**	-0.162***	-0.144***
	(0.044)	(0.051)	(0.044)
Democracy lagged (D_{srt-5})	-1.180*	-0.695	-0.139
	(0676)	(0.817)	(0.736)
D_{srt-5}*RR_{srt} *Year1980	0.309***		
	(0.065)		
D_{srt-5}*RR_{srt} *Year1985	0.244***		
	(0.063)		
D_{srt-5}*RR_{srt} *Year1990	0.194***		
	(0.062)		
D_{srt-5}*RR_{srt} *Year1995	0.195***		
	(0.062)		
D_{srt-5}*RR_{srt} *Year2000	0.201***		
	(0.060)		
D_{srt-5}*RR_{srt} *Year2004	0.147***		
	(0.055)		
D_{srt-5}*RR_{srt} *High Income		0.181***	
		(0.062)	
D_{srt-5}*RR_{srt} *Middle Income		0.172**	
		(0.077)	
D_{srt-5}*RR_{srt} *Low Income		0.163*	
		(0.084)	
D_{srt-5}*RR_{srt} *Very Low Income		0.199**	
		(0.090)	
D_{srt-5}*RR_{srt} *OECD			0.181***
			(0.055)
D_{srt-5}*RR_{srt} *Non-OECD			0.112*
			(0.065)
High Income		0.639	
		(0.419)	
Middle Income		0.364	
		(0.348)	
Low Income		0.292	
		(0.317)	
OECD			0.020
			(0.489)
Controls:			
Income (Y_{srt})	YES	YES	YES
Legal Origins	YES	YES	YES
Region Dummies	YES	YES	YES
Year Dummies	YES	YES	YES
Countries	124	124	124
Observations	643	643	643
Adjusted R^2	0.94	0.94	0.94

Notes: ***, **, and * indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in parentheses are clustered standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All the regressions reported above are carried out without an intercept. Sample years are every fifth year from 1980 to 2004. High Income is a dummy for per capita GDP in 2000 being 10,000 constant 1996 international dollars or more; Middle Income for between 5,000 and 10,000; Low Income for between 2,500 and 5,000; Very Low Income for less than 2,500.

Table 4: Natural Resources, Democracy and Corruption: Robustness with Additional Covariates

	Dependent Variable: Corruption Index (CI_{srt})								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Resource Rent (RR_{srt})	-0.173*** (0.046)	-0.139*** (0.043)	-0.162*** (0.061)	-0.173*** (0.056)	-0.179*** (0.057)	-0.184*** (0.049)	-0.177*** (0.051)	-0.177*** (0.049)	-0.195*** (0.0269)
Democracy lagged (D_{srt-5})	-0.757 (0.685)	0.359 (0.744)	-0.490 (0.799)	-0.823 (0.800)	-0.820 (0.786)	-1.146 (0.709)	-0.703 (0.742)	-0.615 (0.684)	-0.956 (0.727)
D_{srt-5}*RR_{srt}	0.181*** (0.059)	0.050 (0.062)	0.163** (0.074)	0.202*** (0.069)	0.188*** (0.070)	0.199*** (0.065)	0.180*** (0.063)	0.186*** (0.060)	0.202*** (0.067)
F-test (p-value) of H_0: $-\gamma_1/\gamma_3 = 0.93$	[0.90]	--	[0.79]	[0.70]	[0.91]	[0.96]	[0.79]	[0.92]	[0.84]
Controls:									
Income (Y_{srt})	YES	YES	YES	YES	YES	YES	YES	YES	YES
Legal Origins	YES	YES	YES	YES	YES	YES	YES	YES	YES
Region Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controls	Ethnic Fractional.	Official Develop. Assistance	Real Exchange Rate Distortions	Black Market Premium	FDI	S&W Trade Liberal. Index (+ ***)	Trade Share	Media Freedom (- *)	All stat. significant additional controls
Countries	122	103	87	116	116	113	122	124	113
Observations	633	499	482	448	595	587	615	641	585
Adjusted R^2	0.94	0.91	0.94	0.94	0.94	0.94	0.94	0.94	0.94

Notes: ***, **, and * indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in parentheses are clustered standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All the regressions reported above are carried out without an intercept. Sample years are every fifth year from 1980 to 2004. In column 9, we include all statistically significant additional controls which are the Sachs and Warner Trade Liberalization and Media Freedom. F-test (p-value) is the test of the null hypothesis H_0: $-\gamma_1/\gamma_3 = 0.93$ against a two sided alternative.

Table 5: Natural Resources, Democracy and Corruption: Robustness with Alternative Samples

	Dependent Variable: Corruption Index (CI_{srt})										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Resource Rent (RR_{srt})	-0.181*** (0.065)	-0.141*** (0.043)	-0.181*** (0.064)	-0.164*** (0.047)	-0.167*** (0.048)	-0.176*** (0.057)	-0.174*** (0.062)	-0.165*** (0.049)	-0.224*** (0.044)	-0.215*** (0.036)	-0.207*** (0.041)
Democracy lag. (D_{srt-5})	-0.992 (1.002)	-0.190 (0.687)	-0.985 (0.821)	-0.935 (0.728)	0.010 (0.825)	-0.252 (0.862)	-0.754 (0.865)	-0.753 (0.715)	-1.715*** (0.561)	-1.568*** (0.577)	-1.322** (0.661)
D_{srt-5}* RR_{srt}	0.201** (0.080)	0.120** (0.059)	0.167** (0.076)	0.215*** (0.063)	0.122 (0.076)	0.142** (0.072)	0.188** (0.074)	0.218*** (0.061)	0.242*** (0.049)	0.232*** (0.050)	0.227*** (0.057)
Controls	Income (Y_{srt}), Legal Origins, Region Dummies, Year Dummies										
Omitted Observations	Base sample without Africa	Base sample without Neo-Europe	Base sample without Asia	Base sample without the Americas	Base sample without Europe	Base sample without British Colonies	Base sample without French Colonies	Base sample without Spanish Colonies	Obs. Omitted using Cook's Distance	Obs. Omitted using DFITS	Obs. Omitted using Welsch Distance
Countries	90	120	95	101	89	67	86	88	124	124	124
Observations	460	619	494	508	484	374	487	492	611	614	637
Adjusted R^2	0.95	0.94	0.94	0.94	0.92	0.95	0.94	0.94	0.95	0.95	0.94

Notes: ***, **, and * indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in parentheses are clustered standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All the regressions reported above are carried out without an intercept. Sample years are every fifth year from 1980 to 2004. In column 2, Neo-Europe includes Australia, Canada, New Zealand, and the United States. In column 10, omit if $|Cooksd_i|>4/n$; in column 11, omit if $|DFITS_i|>2(k/n)^{1/2}$; and in column 12, omit if $|Welschd_i|>3k^{1/2}$ formulas are used (see Belsley et al. 1980). Here n is the number of observation and k is the number of independent variables including the intercept. The influential observations according to the DFITS formula are AUS1980, BGD1980, BGD1985, BGD1990, CYP1985, GAB1995, HTI1980, IRQ2004, IRL2000, JPN1980, JPN2000, KOR1990, LBR1990, MDG2000, MYS1980, MNG1990, NZL1980, NZL2004, NIC1990, PHL1980, PHL1985, ZAF1980, ZAF1985, ESP1980, SDN1980, SYR1995, TWN1980, TZA1980, and TTO1980. The influential observations according to the Cook's Distance formula are all of the above plus ZAR1990, NZL1985, and SDN1985. Influential observations according to the Welsch Distance formula are MDG2000, MYS1980, PHL1980, SDN1980, TWN1980, and TZA1980.

Table 6: Natural Resources, Democracy and Corruption: Robustness with Alternative Measures of Democracy and Corruption

	Dependent Variable: Corruption Index (CI_{srt})						**Corruption Perception Index**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Resource Rent (RR_{srt})	-0.149***	0.010	-0.159***	-0.179***	-0.148***	-0.178***	-0.302***
	(0.042)	(0.036)	(0.040)	(0.034)	(0.036)	(0.032)	(0.081)
Democracy lagged (D_{srt-5})							-3.015**
							(1.276)
Democracy Index lagged (DI_{srt-5})	-0.813						
	(0.634)						
Democracy Freedom House lagged (DF_{srt-5})		-0.129					
		(0.141)					
Democracy Dummy lagged (DD_{srt-5})			-1.050**				
			(0.497)				
Fraction of democratic years since 1950, lagged (d_{srt-5})				-1.555**			
				(0.641)			
Fraction of consecutive democratic years since 1950, lagged (δ_{srt-5})					-0.910		
					(0.617)		
Fraction of democratic years 1950-1975 (d_{sr1975})						-1.798***	
						(0.620)	
$D_{srt-5} * RR_{srt}$							0.347***
							(0.103)
$DI_{srt-5} * RR_{srt}$	0.168***						
	(0.055)						
$DD_{srt-5} * RR_{srt}$		0.028**					
		(0.012)					
$DF_{srt-5} * RR_{srt}$			0.161***				
			(0.047)				
$d_{srt-5} * RR_{srt}$				0.258***			
				(0.053)			
$\delta_{srt-5} * RR_{srt}$					0.199***		
					(0.056)		
$d_{sr1975} * RR_{srt}$						0.264***	
						(0.053)	
Controls	Income (Y_{srt}), Legal Origins, Region Dummies, Year Dummies						
Countries	122	126	124	124	124	123	143
Observations	628	652	643	643	643	641	295
Adjusted R^2	0.94	0.93	0.87	0.84	0.94	0.94	0.96

Notes: ***, **, and * indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in parentheses are clustered standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. Sample years are every fifth year from 1980 to 2004. The Corruption Perception Index is from Transparency International.

Table 7: Natural Resources, Democracy and Corruption: Robustness with Alternative Measures of Natural Resources

	Dependent Variable: Corruption Index (CI_{srt})						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Energy & Mineral Rent (EMR_{srt})	-0.146***						
	(0.040)						
Energy Rent (ER_{srt})		-0.115***		-0.116**			
		(0.038)		(0.050)			
Mineral Rent (MR_{srt})			-0.057	-0.077*			
			(0.043)	(0.41)			
Primary Exports (SXP_{sr})					-1.557**		
					(0.617)		
Natural Capital (NC_{sr})						-0.745***	
						(0.258)	
Subsoil Wealth (SW_{sr})							-0.129
							(0.093)
Democracy lagged (D_{srt-5})	0.772**	0.790**	1.383***	0.786**	0.879**	-7.237***	-0.165
	(0.319)	(0.304)	(0.306)	(0.330)	(0.363)	(2.611)	(0.697)
D_{srt-5}*EMR_{srt}	0.138**						
	(0.054)						
D_{srt-5}*ER_{srt}		0.135***		0.089			
		(0.050)		(0.062)			
D_{srt-5}*MR_{srt}			0.065	0.125**			
			(0.056)	(0.055)			
D_{srt-5}*SXP_{sr}					3.475**		
					(1.728)		
D_{srt-5}*NC_{sr}						1.048***	
						(0.321)	
D_{srt-5}*SW_{sr}							0.192
							(0.137)
Controls	Income (Y_{srt}), Legal Origins, Region Dummies, Year Dummies						
Countries	123	98	98	78	97	76	60
Observations	602	488	472	365	563	225	178
Adjusted R^2	0.94	0.94	0.94	0.95	0.93	0.96	0.96

Notes: ***, **, and * indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in parentheses are clustered standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. Sample years are every fifth year from 1980 to 2004. Energy includes oil, gas, hard coal, and soft coal. Minerals include bauxite, copper, lead, nickel, tin, zinc, gold, silver, phosphate, and iron.