Natural Disasters, the Price of Oil, and Democracy*

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Abstract

Recent fluctuations in the price of oil and the contemporaneous political changes in oil countries have raised an important question about the link between oil rents, political institutions, and civil liberties. This paper presents a simple model of the "no representation without taxation" argument of the resource curse literature and, using an instrumental variables approach, estimates the causal effect of shocks to oil revenues on levels of democracy. Using multiple measures of democracy and various specifications, we find that the effect of oil price shocks is larger than might be expected and on the order of the effects found from changes in Gross Domestic Product. We also observe that theory predicts these changes should have short-term components that should exist even when controlling for resource stocks. The analysis shows credible evidence for this windfall effect on political freedom, which is independent of any wealth effect associated with the political curse of resoruce wealth.

Keywords: Resource curse, oil, democracy, natural disasters.

"Go right to hell, Mr. Blair."– *Hugo Chavez, President of Venezuela*

With the sharp fluctuations in world oil prices, people are beginning to ask an interesting political question: What effect will significant increases in the price of oil, and the revenue it is generating for oil exporters, have on the political relationships between countries? Could a systematic rise in prices lead to more international conflicts? By what mechanism could these price changes influence world politics? One potentially important change that may have an affect on international relations is how the growing stream of revenues in oil producing states effects their domestic politics. In a recent article, Friedman (2006) argues for what he calls "the first law of petropolitics." Using data from various sources, Friedman claims there exists a correlation between measures of political freedom in oil producing countries and world oil prices. In particular, examining recent political events in countries like Iran, Russia, Venezuela, and Nigeria, Friedman presents evidence that increases in oil prices are correlated with decreases in political freedom. This analysis leads to his definition of the "first law": the price of oil and the pace of freedom move in opposite directions (Friedman 2006).

At some level Friedman's law is a logical extension of well-known findings in the social science literature. There exists a significant body of work in which political scientists and economists have studied the effects of resource wealth on economic growth and development (Sachs and Warner 2001). Many careful case studies also suggest there exists a causal relationship between resource wealth and political rights and show, in a variety of settings, that resource rents (revenues) and political freedom are closely related. As Clark (1998, p.65) notes, the discovery of off-shore oil in 1969, along with the boom that resulted from the production shocks of the early 1970s, were instrumental to the consolidation of Marien Ngouabi's non-democratic regime in the Republic of Congo. Similar studies of petro-politics is Venezuela, Gabon, and Cameroon suggest the same result (Van de Walle 1994, Karl 1997, Gardinier 2000) In fact, the study of when and how oil impedes democracy has long been a central research program for scholars with area specialties in the the Middle East and Africa (Mahdavy 1970, Beblawi 1987, Chaudhry 1994, Soares de Oliveira 2007).

Historically, the literature on the relationship between resource rents and politics has

been largely the domain of area specialists and social scientists working with the case study method. But recent empirical studies by Ross (2001), Wantchekon (2004), Jensen and Wantchekon (2004), and Herb (2005), among others, have taken the resource curse hypothesis out of the case-study literature and performed cross-country analysis looking for large-N evidence. These studies have found that oil income and democracy have a robust and inverse statistical association. For example, analyzing panel data across 113 countries from 1971 to 1997 Ross (2001) finds that oil revenues, measured by mineral based fuel export values as a fraction of GDP, have a statistically significant negative correlation with a country's political institutions. Similarly, Wantchekon (2004, p.2) finds that "a crucial determinant of many Third World political regimes is their level of dependence on natural resource revenues." In a second paper Wantchekon, along with Jensen, turns his attention to the subset of African nations and finds a similar result. Jensen and Wantchekon find evidence for the claim that when an executive has discretion over the distribution of resource rents, this has a significant effect on the political regime.

Along with this development of large-N empirical work on the political dimension of the resource curse, there has developed an important link between research on political development, democratization, and natural resources. In some cases, like Boix (2003) and (Acemoglu and Robinson 2001), shocks to resource wealth are parts of a theory of political transitions and regime change. For others, like Dunning (2008) and Smith (2008), the explicit role of resource income are the focus of a theory of the political economy of institutional development and change. In each case, whether coming at the question from an empirical or theoretical direction, a simple question is at the center of the authors' interest when it comes to resources: What is the relationship between having natural resource wealth and access to the flows of rents on political institutions? More specifically, like when it comes to oil, does natural resource income have a negative effect on political freedom? The starting point for the analysis below is that existing empirical results, based on cases studies and the statistical analysis of cross-country relationships, do not establish causation. Two problems are evident. First, oil prices, and as a consequence oil income, are influenced by changes in political

regimes of oil nations, possibly as much as the other way around. For example, it is surely the case that when oil rich countries become more radical (Iran), when leaders consolidate power (Russia and Venezuela), or when civil strife threatens oil delivery (Nigeria), the oil markets react. A premium is paid for oil today when political events in oil producing nations generate the perception of risk to future supplies. In addition to the market mechanism, oil revenues are also more directly influenced by political choices, and the political environment, in oil producing nations. How much to drill, how much to sell, and who to sell it to all have effects on oil revenues for these countries and, in most oil producing nations, political conditions affect the decision. This is especially the case where large portions of the oil industry are state owned and run (Norman forthcoming). Second, and equally important, there is a real possibility of omitted variable bias in previous analysis. This concern arise from our inability to measure certain covariates that are believed to be important for explaining political institutions, the recurring problem of data availability on measurable covariates in the developing world, and our limited–though improving–understanding of what determines the kinds of political institutions that arise in various developing countries. Together these issues leave much of the current literature on a weak foundation.

There are a number of strategies one might use to attempt to investigate the causal effects of changes in oil revenues on regime characteristics that address these concerns. One that is particularly appropriate, given the various limitations researchers face, is instrumental variable regression. As is well known, an explanatory variable is said to be endogenous to the equation of interest if it is correlated with the disturbance term. Such correlation can come from many places, like measurement error, omitted variable bias, and simultaneous causation (what is sometimes referred to as "endogeneity bias" in the political science literature (King, Keohane and Verba 1994)).[1] Equally well known is that in the presence of endogeneity regression estimates are inconsistent. In many cases an instrumental variable regression

[1]The distinction between these three sources of correlation between the explanatory variable and the error term are often fuzzy, at best. However, from an econometric perspective they are simply different sources for the same problem, so we will use the term endogeneity to cover them all.

approach can provide a solution to this problem, if a valid instrument for oil revenues can be found. That is, we need a variable correlated with the ups and downs of oil revenues that is not correlated with regime characteristics. In almost every instance such variables are hard to find. Our candidate instrument is the "out of region damage" done by five types of natural disasters to oil producing countries. While we discuss the instrument in more detail below, the nut-shell argument for the exogeneity of our instrument rests on the following claim: An earthquake in Tehran, for example, should have no effect on the regime characteristics of Mexico, other than through its effect on the price of oil. Similarly, a mud-slide in Columbia should have no effect on the regime characteristics of Cameroon, other than through its effect on world oil prices. So if the exclusion restriction is believable, then we can estimate the causal effect of changes in oil revenue on politics. In this instance, natural disaster damage to an out of region country provides a lever of exogenous variation in our key independent variable because it is difficult to conjecture some other pathway by which a far off natural disaster would effect the domestic politics of a given country.

Using annual data for oil producing nations between 1968 and 2002 the results from our instrumental variables analysis suggest that, within the set of oil producing nations, there is a significant causal effect of increasing oil income on regime characteristics. This effect is negative and much larger than the statistically significant association one finds with ordinary least-squares regression. If we condition on per capita GDP, past political institutions, economic growth, and a number of other variables, the effect is robust. The empirical results are consistent with that of Wantchekon (2004), a critical determinant of political regimes in many developing countries is their dependence on rents from oil income. Our result is also in contrast to a growing literature that claims this effect does not exist and that the political resource curse comes from the inappropriate comparison of oil and non-oil countries. (Alexeev and Conrad 2005, Haber and Menaldo 2009, Schubert 2006). Interestingly, the causal effect estimated is of the same magnitude as the level of economic development, i.e., of GDP per capita. That is, oil revenues are no small factor in determining political institutions. The analysis also provides credible evidence for a windfall effect on

political freedom that is independent of any wealth effect associated with the resource curse. This is interesting because short term effects are a prediction of a well know class of theories of political development.

The single closest paper to this one is Tsui (2009). Tsui is interested in the long-term effect of discovering oil and uses oil discovery as an instrument for oil wealth. Tsui's paper is close in spirit to this one, in that he is worried about the ability to identify the causal effect of oil on democracy. Our papers differ in that his is interested in the effect of having resources, but not in how the variation in oil income effects political behavior.

The paper proceeds as follows. The next section reviews the literature on resources and political regimes, fleshing out the story linking oil revenues to political change. After that we discuss our instrument, how it is measure, its strengths and weakness, as well as other variables to be used in our analysis. We then describes a series of OLS regressions and the statistical associations between our variables of interest. This is followed by our our instrumental variable results and a series of robustness exercises. We conclude with comments and discussion of the implications of these results for future research on the effect of natural resource revenues on politics.

Linking Oil Revenues and Political Freedom

The hypothesis that we put to a test is: within the set of oil producing countries, do changes in revenues from natural resource rents effect political freedom? In particular, we ask whether oil countries that face large exogenous shocks to their oil income tend to suffer decrease in the democratic nature of their politics? Before turning to the data, however, we first explain why these changes in oil revenue would lead to less political freedom.

The concept of the political resource curse has grown out of a diverse literature on resource endowments and political development. While studies vary, most focus on polities that derive a large portion of their revenues from external rents. For example, at various times, and in various places, rents that support such states have come from the sale of

copper, diamonds, coffee, and oil. Commonly these countries are called rentier states, where rentierism characterizes states where the rents are paid by foreign actors, where revenues accrue directly to the state and its leaders, and where most of society is only involved in the distribution or utilization of the profits Beblawi (1987).

In general, leaders of rentier states are often described as being autonomous or detached from the underlying political dynamics of the country they govern. But why would rents from natural resources influence political regimes? The answer comes out of a literature on taxation and representation. In short, it is argued that taxation is an important factor that leads to institutional change and democratic representation in particular. Starting with Schumpter, and continuing through Tilly (1992) and Ross (2004), scholars argue that the need for revenues by the ruling elite was an impetus behind much of the institutional change in Europe that created representative government (North and Weingast 1989). In particular, as the cost of running the state increased–largely driven by the demands of war– the leadership was forced to appropriate more and more of their subjects income. This increase in state appropriations led to calls, at least by the existing lower ranked nobles, for say in the decisions of government. Sometimes such demands led to revolution—as in the Glorious Revolution of 1688, the 1976 war of independence in America, and the 1789 Revolution in France—and eventually compromise.

Resource rich states, however, rarely face such a dilemma. In most instances the flow of revenues originates with the state and, in particular, with the leadership. Leaders either own directly the resources that generate rents or, by virtue of their control of the state apparatus, control the revenues of "state owned" enterprizes. So rather than being required to collect revenue from the citizens who own assets, these leaders are largely in the business of distributing spoils to those who support them politically. This creates a very different set of relationships between leaders and their relevant selectorate. Where leaders without revenue rents have to bargain with those that support them in order to stay in power, the selectorate in countries with large resource revenues depend more on the leader's distribution strategies and have significantly less bargaining power (Bueno de Mesquita, Smith, Siverson

and Morrow 2003).

Another important factor that lead to the development of representative nation states in the West, discussed by Spruyt (1996), is the close, and in many respects dependent, relationship between the leadership of the central state and the localities (cities). Both Spruyt and Tilly see this connection as an important factor leading to the development of nation states, and eventually political representation. Resource wealth turns this relationship upsidedown. Where in the European circumstance the central state required the cooperation of the localities, providing them with manpower, food, and money, in the rentier state leaders create a dependence on the distribution of the state's resource income among the various localities and local leaders.

The view that taxation plays an important role in the development of representative government is further investigated in the modern period, and the relationship appears robust. While Huntington (1991) views taxation as being central to the development of demand for representative government, other scholars –such as Ross (2004) and Bates and Lien (1985)– hypothesize that government spending decision, in light of the level of taxation, are important. In either case, rentierism undermines this mechanism for democratic accountability.[2]

It is worth pointing out that some have criticized the resource curse literature for, as Haber and Menaldo (2009) put it, accepting "no representation without taxation" theory uncritically. Or as Herb (1999, p.256) somewhat pointedly notes, when it comes to resource politics "...the lack of democracy is noted, oil is proffered as the culprit, 'no representation without taxation' cited as the mechanism, and the matter is closed." On its surface such

[2] Complimentary to the indirect effect of resource revenues on the political freedoms in a given country, some authors have argued there also exists a contestation or "repression" effect of resource income. As the value of being in command of the state apparatus increases, groups and individuals not part of the ruling coalition will have greater incentive to overthrow existing leaders, if they are not well protected. The value of controlling the state also creates an incentive for those in power to defend their position. Therefore, leaders are likely to be more inclined toward repressing citizens, building large armies, and maintaining strong internal police forces. Clark's (1998) research on the Republic of Congo makes such an argument. Ross (2009) suggest this relationship is weak or non-existing and can be explained by other strategic factors that lead oil countries to have large armies.

criticisms seem to have validity. But it is not as if the link between taxes, policy, and rents found in the literature do not have plausible micro-foundations that can be well described by the slogan "no representation without taxation." Such a trade-off in various forms can be found in Acemoglu and Robinson (2001), Boix (2003), Acemoglu and Robinson (2006), and Dunning (2008). In fact, some sort of substitution effect will be present in almost any decision environment where a leader is making multiple policy choices under political constraint.

To see this, consider the following simple model of politics between a leader and his citizens [3] For simplicity suppose that there is some representative citizen, so that we may analyze a game between two players. The leader is in a position of power and can choose policy that affects the citizen. Assume that the leader's choices involve the collection of taxes or "rents" from productive citizens and the choice of some policy x from a one dimensional policy space. For our purposes it is convenient to think of x as the "openness", "freedom", or "level of democracy" in the society. When we say that the leader has power, we mean that given his choice the citizen consumes their residual income–that is, productive income minus taxes–and lives under the policy x.[4]

Let us focus on the case where there is disagreement between the leader and the citizen

[3]At its core this model is a simplified version of the revolutionary constraint framework found in work like Acemoglu and Robinson (2001), Boix (2003), Dunning (2008), and Smith (2008) . It differs from these previous models in that it focuses on the incentives to respond with policy changes to changes in resource income and does so with a very stark model. The aim is to make the trade-off that leads to 'no representation without taxation' as clear as possible. Each of these other models can be build from this basic construction and the analysis here is aimed at providing a clear description of an incentive that will exist whenever a leader is making policy and transfer choices constrained by some form of consent by the governed. Dunning's (2008) model has in addition to this direct effect an indirect democratizing effect that operates through the effect of resources on the continuation value of giving control to the citizen and their optimal tax rate. While I do not disagree such an effect may exist, the data suggests the direct effect is, in fact, the larger one in the set of oil states.

[4]In this way the model here more closely resembles selectorate models of Bueno de Mesquita et al. (2003) than the various "class" models with rich and poor citizens. But this distinction is not particularly important for the analysis we are interested in here.

over how much political freedom is optimal. Even in the most democratic societies such a disagreements may not be surprising. Well intentioned social planners with a citizen's preferences at heart may believe that if they had more political power then it would be to everyone's benefit. At the same time a skeptical public may not want even the benevolent leader to have too much discretion, as such power creates powerful incentives for corruption. To capture this idea we assume that the leader has a value for policy $v_l(x)$ that is decreasing in x and the citizens, on the other hand, have a value for policy $v_c(x)$ that is increasing in x. Again, a natural interpretation for our setting is that the leader prefers more concentrated political power, where x is the level of freedom, and citizens like decentralize political power. We assume that both players' utilities for policy are concave ($v_j''(x) < 0$, $j = l, c$).

Players' utilities for income or money, $m_j(y)$, are assumed to be increasing and concave. Following Coate and Morris's (1995) construction, we will assume that taxes are a lump sum transfer paid by citizens to the government.[5] We will also assume the citizen is productive and starts with a pre-tax income $y_c > 0$ and the government has a non-tax source of revenues $R_0 \geq 0$, which represents their resource or oil income. Under this assumption a citizen's post-tax income is $y_c - t$ and a leaders income is $R_0 + t$. Finally let the leader and citizen have a total utility over policy (x) and income (y) of $u_i(x, y)$ and let the utilities of the two be additively separable i.e.:

$$u_i(x, y) = v_i(x) + m_i(y). \tag{1}$$

The problem for the leader is then to choose a profile of policy and taxes (x, t) that makes makes him best-off. First it is obvious that there must be some constraint imposed upon the policy choices of the leader by the citizen. If there were not, then the leader would simply choose the extreme policy of taxing all the citizen's income and choosing the policy that centralized all control in his hands. Therefore, our simple model must have some check on the leader's ability to choose policy profiles. In the literature this is usually done through a "revolution" or "coup" constraint (Boix 2003, Dunning 2008, Smith 2008).

[5]Whether taxes are proportional or lump sum isn't important for our results.

In particular, assume that the leader always faces an endogenous risk of revolt as the citizens need not just stand by and accept the leader's choices. We assume that for some cost, the citizens can attempt a revolution. We allow the details of this process to be arbitrary. For what follows we simply assume that a choice to revolt gives a continuation payoff of Q. The citizens choice to revolt, or not, is made after the leader has chosen and committed to a policy profile (x, t). This means that citizens cannot be swayed by unfulfilled promises of leaders and the choice to revolt is always contingent on the actually implementation of policy. Therefore, the citizen's final decision reduces to whether she prefers to live under the leader's regime or exercise her option of political control.

To close the model we must consider a leader's payoff for losing office. This payoff is known to vary across countries, regime type, and time (Goemans 2000, Bueno de Mesquita et al. 2003). For our purposes, we assume that leaders prefer staying in office to not and focus on the situations where leaders make compromises to remain in power.[6]

To discuss incentives leaders face in such a political environment, we apply the equilibrium concept of subgame perfect Nash equilibrium to the strategic interaction between the leader and the citizen. In equilibrium the citizen's choices are optimal given the actions of the leader and the leader maximizes his utility given the correctly expected response of the citizens to his policy profile. As is standard, the equilibrium is most easily understood by describing equilibrium play via backward induction. Taking the citizen's choice first, sequential rationality demands for every (x, t) pair she chooses to keep the status quo and not revolt if and only if the continuation value of revolt is less than or equal to that of the status quo. That is, the status quo prevails under a policy profile (x, t) if and only if

$$U_c(x, t) = v_c(x) + m_c(y_c - t) \geq Q. \tag{2}$$

Given this strategy by the citizen, the leader's problem is well defined whenever the leader prefers to satisfy the revolution constraint and stay in office to getting a revolution. The leader's optimal action is the solution to

[6]This is not to say that the this assumption is always true or such a focus is always appropriate, but is useful for understanding how the incentives of leaders change in response to changes in resource income.

$$\max_{x,t} v_l(x) + m_l(t + R_0) \tag{3}$$

s.t.

$$v_c(x) + m_c(y_c - t) \geq Q \tag{4}$$

$$x \in [0, 1], t \in [0, y_c].$$

This is a well defined constrained optimization problem and if a policy profile (x^*, t^*) is part of a subgame perfect Nash equilibrium, it will satisfy some well-known conditions.

So with our simple set up, we have a leader making policy and tax choices that influence the citizen's utility and citizens can revolt and get some new regime if sufficiently dissatisfied with the leader's choice. We can then observe that leader's choices reduce, in the abstract, to a constrained choice problem. We can then prove a simple result: *In any subgame perfect Nash equilibrium to the game between the leader and the citizen, if x^* is not already equal to the leader's ideal policy, when resource income increases, policy moves in the direction favored by the leader. I.e., there is less freedom.*

While we leave the proof of this result to the appendix, the logic of constrained optimization explains why so many have accepted the "no representation without taxation" logic so freely. For the leader,when the political constraint bind, he must choose some combination of taxes and policy that are not his ideal. If we then increase the leaders non-tax income the decision-maker will want to reallocated the policy-tax trade-off in the direction favoring their preferred policy, but still satisfying the revolution constraint.[7] In this model, as neither the policy nor the tax rate is the unconstrained optimum for the leader, any change in available resources will require a new balance between policy and tax transfers. In a natural setting, with leaders having concave preferences for policy and money and citizens preferring more freedom to less, we get our conclusion, that policy becomes less free as resource income increases.

In sum our simple model captures the general intuition that a constrained leader faces

[7]This is what Dunning (2008, p.99) identifies as the "direct effect" of resource income.

trade offs, and if he receives income from non-tax sources he adjust his policy (x) to be more to his liking. Plugging this into the constraint from the optimization problem is going to characterize exactly what new t will be implemented. If Q remains unchanged by the change in R_0, then the monotonicity of $m_c(y)$ means taxes will come down. We can also easily show that a prediction from this kind of constrained choice model is that policy becomes more democratic as the income of the citizen increases, which is also generally held to be a cause of increased political concessions by leaders.

To date, however, evidence for this resource effect has come from detailed case studies of single oil producing nations, or via cross-country statistical analysis of both oil producing and non-oil producing nations. What has yet to be shown is whether or not changes in the income associated with natural resources has a causal effect on regime characteristics, and if this effect exists when we restrict ourselves to look within the set of oil producing countries. This paper takes the next step in this direction.

Data

To start the empirical analysis we take the 48 countries reported by British Petroleum to have produced a non-negligable amount of oil for at least some subset of the years between 1968–2002. This defines our initial set of cases.[8] We then collected a number of economic variables for each country. The values for the GDP per capita, GDP growth, and oil income per capita used in our analysis are reported in constant 2000 US dollars. GDP per capita and

[8] At first consideration a reader may wonder: why this set of countries? Should the appropriate sample for the hypothesis include the United States, Norway, or Canada? Current research by Goldberg, Wibbels and Myukiyehe (2008) and Freeman (2009) suggest that a form of the resource curse–in both its economic and political forms–exist in the U.S. states. As such, excluding industrialized democracies from the start seems problematic. However, an important part of the analysis explores the robustness of the inferences drawn from this set of countries. A number of these tests consider the effect of excluding these possibly problematic case, and it can be said with confidence that the effects estimated are not the product of having Nigeria and Norway in the same data set.

GDP growth are from the 2005 World Bank Development Indicators. Per capita oil income for a given country are generated by the product of the average daily spot price of crude oil, as reported by BP's statistical review 2005, (in constant 2000 US dollars) and the given country's annual production for that year (in barrels) divided by the population (also take from World Bank data). The spot price time series is the yearly average for Arabian Light set at Ras Tanura from 1968–1983, then the Brent dated price from 1984–2002. This choice of measure is not without controversy. For example, Herb (2005) collects data on rents by finding reports of rent revenues as a percent of total state revenues from various sources. Haber and Menaldo (2009) also look at per capita windfall profits from resources. Each of these measures addresses some issues that arise from just looking at the value associated with oil production. But, because of non-standard accounting procedures, accounting tricks at the oil companies, the unofficial use of non-state oil revenues, and the potential to manipulate various aspects of the domestic oil market, we choose to focus on a measure of the world market value of production as the total value of a country's oil income.

In the analysis we use three different measures of political regimes. It is created by subtracting the Polity autocracy score from the democracy score, giving the variable a range from -10 to 10, with -10 being the least democratic and 10 being the most democratic. The democracy score variable is then just the 11 point democracy scale that makes up part of the Polity composite score. In our analysis, these–and other–measures of democracy are all normalized so that the scores lie between 0 and 1, with 0 being least democratic and 1 being most democratic. While the Polity IV composite democracy-autocracy score is the dependent variable we tend to focus on, results are robust to other measures, like various Freedom House scores.[9]

Our proposed instrument, out of region disaster damage for oil producing nations, which will be discussed in more detail below, is constructed from neighboring country's disasters creating a direct effect on polity. The disaster data comes from the Emergency Disaster Data Base managed by the Center for Research on the Epidemiology of Disasters at Universit

[9]This is the "polity2" variable from the Polity IV data set.

Catholique de Louvain - Ecole de Sant Publique in Brussels. The damage estimates are taken from various public sources and are deflated so that they are in constant 2000 US dollars. Included in the disaster estimate totals are 5 classes of disasters. Damage totals represent damage from earthquakes, slides, windstorms and hurricanes, volcanos, and waves and surges. While data is available on additional classes of disasters, these types of disasters were chosen for two reasons. First, unlike industrial and transportation accidents, famines, and epidemics, the damage from these classes of natural disasters unlikely to be correlated with regime type or quality. In fact, many of the most severe natural disasters in the five class considered occur in the developed world (e.g., the United States and Japan), while famines and epidemics almost never occur in these developed countries.[10]

Regression Estimates

Table 1 reports the ordinary least-squares regression of the normalized Polity IV composite score on the log of oil income per capita and a series of controls. The regression is for the equation

$$y_{it} = \alpha + \beta R_{it} + \gamma \mathbf{X}_{it} + \epsilon_{it} \tag{5}$$

where y_{it} is country i's polity score in year t, $\mathbf{X}_{it}$ is a vector of "control" covariates, and ϵ_{it} is a random disturbance. Generally, our interest will focus on the parameter β, the effect of oil income per capita on democracy.

Column 1 shows the statistical association between the log of annual oil income and

[10]Also excluded from the natural disaster estimates are damages due to floods, as they are too prevalent and difficult to geographically locate (Peduzzi, Dao and Herlod 2005). Also, unlike heat waves and insect infestations, the five classes of natural disasters included in the analysis are more likely to effect the supply chain of crude oil, and hence oil prices. The out of region nature of this variable is constructed by dividing the world into 5 regions: the Americas, Europe, Asia, North Africa and the Middle East, and sub-Saharan Africa. For each country, the out of region disaster damage is the sum of the disaster damage in that year for the four regions not containing their state.

Table 1: OLS Regression: Measures of political freedom on oil revenues

	World oil producers' political freedom measures Pooled OLS: 1968–2002			
Independent variables	Polity IV	Polity IV	Polity IV	Polity IV
Log oil income per capita	-.055	-.111	-.111	-.046
	(.006)	(.007)	(.007)	(.006)
Log GDP per capita	—	.187	.187	.066
		(.007)	(.007)	(.008)
GDP growth	—	—	-.002	-.004
			(.001)	(.001)
Polity at Entry	—	—	—	.666
				(.028)
Constant	.624	-.586	-.576	-.188
	(.074)	(.085)	(.087)	(.055)
Wu-Hausman p-value	$< .001$	$< .001$	$< .001$	$< .001$
Number of observations	1379	1277	1267	1267
R^2	.10	.414	.413	.729

	Democracy Score	Freedom House Political Rights
Log oil income per capita	-.048	-.05
	(.006)	(.006)
Log GDP per capita	.096	.115
	(.009)	(.009)
GDP growth	-.002	-.003
	(.001)	(.001)
Polity at Entry	.71	512
	(.030)	(.029)
Constant	-.522	-.415
	(.059)	(.061)
Number of observations	1249	1162
R^2	.763	.703

Note: Pooled OLS with unbalanced panel. Each regression includes year fixed effects.

the polity composite score. The negative effect is statistically significant. Many scholars, like Helliwell (1994), Geddes (1999), and Acemoglu and Robinson (2006), have argued that income, in terms of per capita income, levels of economic growth, previous political institutions, or some combination of the three have a direct effect on domestic political institutions. To control for these potential effects columns 2-4 report regression results with variables: log GDP per capita, GDP growth, and the normalized polity score for the country when they enter the data set (Polity at Entry). The coefficients on the set of control variables are consistent with prior research. Per capita GDP has a substantial positive association with higher polity scores. GDP growth has a negative statistical association, consistent with the claim that when there is strong economic growth, or lack of an economic crisis, there is less demand for accountability for the leadership. There is also a substantial positive correlation between previous regime characteristics, captured by the measure of the polity score at entry into the data set, and the current characteristics of political institutions. The inclusion of the Polity at Entry variable also ensures that there is within country variation over the time series to be explained.[11] The statistical association between log oil income per capita and political institutions remains significant, negative, and in each case the sign and size of the coefficients in the control set are consistent with previous research. Finally, columns 5 and 6 in the lower panel of Table 1 replicate the results in the upper panel using the alternative measure of political institutions, i.e., the normalized 10 point democracy score and the normalized Freedom House measure of political rights.[12] The direction and magnitude of the effects are consistent with the coefficients found in the upper panel.

It is interesting to note that the results in Table 1 show a weak correlation between oil revenues and polity scores within the set of oil producing nations, particularly when controlling for past institutions. This is a finding that would be consistent with some criticisms of the political resource curse literature–especially the argument that the large effects found in previous studies comes from comparing oil and non-oil countries, not actual variation in

[11] Descriptive statistics for the within country variation in regime measures can be provided by the author.

[12] In fact, all results in this paper can be replicated on the Freedom House political rights and the Freedom House civil liberties data.

the political institutions across the set of oil producers. There are, however, a number of important reasons for being skeptical of this causal inference. First, less democratic countries often are less stable both in terms of domestic policy and the possibility of political unrest. This risk can affect oil markets, and in expectation of these risks, oil markets often react by bidding up the price of oil. If this were in fact the case, increases in oil income–as a result of increasing crude oil prices–could proceed political change, attenuating any real effect. Evidence of this simultaneous causation is shown in the Wu-Hausman test. The p-value, reported at the bottom of panel A rejects the null hypothesis of the exogeniety of oil income at levels far beyond normal significance tests. Equally important, there are likely many omitted variables that determine the political environment in a country that are correlated with their oil income, such as economic inequality.[13] In a world with these characteristics it is difficult to know what to make of these results. Both of these problems could be solved, however, if we had a credible source of exogenous variation in oil revenues. That is, we need a variable relevant for determining oil revenues, but having no direct effect on a country's polity score. We argue that the out of region disaster damage from 5 classes of natural disasters is a plausible instrument for our problem in the case of oil revenues. When the instrument is applied to the analysis we find the larger effect of oil rents consistent with theory.[14]

1 Instrumental Variable Results: Natural Disasters and Oil Revenues

Given the potential for simultaneous causation and omitted variable bias in our (or any) OLS regression analysis of resource rents on political institutions, we need a source of exogenous variation in oil revenues to estimate the causal effect. A useful strategy to try to identify

[13] In fact, we know from Boix (2003) that inequality has been shown to have important effects.

[14] While a full exposition of instrumental variables is beyond the scope of this paper, Manski (1995) gives a gentle introduction to the issues of identification in the social science.

the effect of oil revenues is through instrumental variable analysis. For the rest of this paper we propose that certain types of natural disasters provide such an instrument. The validity of this source of exogenous variation rests on the premise that: (1) Some natural disasters are relevant for oil revenues. This means that natural disasters in oil producing countries influence the price of oil and, therefore, oil revenues. (2) There exist natural disasters, which are possibly 'far away"– i.e., that occur in countries outside of a country's home region– that have no independent (direct) effect on a country's political institutions, other than possibly through increases in returns from the resulting changes in world oil prices.

Based on these criteria, we use the out of region disaster damage estimates for 5 classes of natural disasters as an instrument for oil revenues. The choice of which types of disasters to count as part our instrument was made with attention to the the exclusion restriction described above. That is, the instrument must be constructed such that we are confident it can be an excluded variable in the regression of polity on oil revenues. First, we are concerned that the disaster be as easy as possible to identify and locate geographically. For this reasons we focused on earthquakes, volcanos, slides, waves and surges, and windstorms (e.g., hurricanes, typhoons, etc.). To satisfy the exclusion restriction, we need to worry about possible direct effects of these 5 types of natural disasters. Obviously one would not want to include a country's own natural disaster damages in the instrument, as disasters at home can lead to the declaration of a state of emergency, with the executive's emergency powers being invoked. This is clearly a direct effect. Next we may worry about the direct effect of geographically "near by disasters." For example, a disaster in a country might produce a significant population of displaced persons. In the search for shelter, food, and water these displaced people may flow across one or multiple boarders in search of relief. This could lead other states in the region to tighten boarder controls, increase internal policing, or activate the military in response. So with the exclusion restriction in mind, we only consider the effects of natural disasters that occur "far enough" away. We operationalize "far away" by dividing the world into 5 regions: Europe, the Middle East and North Africa, sub-Saharan Africa, Asia, and the Americas.

Last, we require that our instrument is relevant. Intuitively the instrument seems relevant and for large scale natural disasters, like Hurricane Katrina, the effect is obvious as at least 113 off-shore platforms were reported destroyed by the Mineral Management Service in May of 2006. More importantly we can quantitatively characterize the revelance of the instrument with the first stage regression, shown below. Analysis finds a statistically significant correlation between the out of region disaster damage estimates and oil income. There is, however, a more technical requirement for relevance. That is, we will need to verify that our disaster damage instrument is not "weak," in the statistical sense.

In the analysis we present statistics to test the strength of our proposed instrument. In most cases the instrument satisfies the Stock and Yogo (2002) criteria for strong instrumentation.[15] As the Stock and Yogo criteria for weak instruments are not sharp statistical tests, an alternative means for exploring the strength of the instrument is a simple proxy, or reduced form, regression of the democracy measure on the proposed instrumental variable. It is reassuring that the reduced form regression of the polity composition score on our out of region disaster measure produces coefficients that are significant and consistent with the story motivating its use. The results are presented in Table 2. The relationship between disaster damage and polity scores is as expected, negative and statistically significant. What we are seeing here is that our instrumental variable's mechanism linking disaster damage to polity scores is working as our argument requires. Our identification strategy is capturing the effect of changes in oil revenues on political institutions. The relationship in the reduced form equation is robust to conditioning on other controls, but as it is just a reduced form, we will need to use the two-stage least squares approach to estimate the parameter on the appropriate scale. That is, while the unit size of the effect of oil is not estimated in the reduced form, the significance of the proxy regression shows that the instrument is sufficiently strong to make reliable estimates.

[15]Our results, however, are often close to the threshold. This is likely because the disaster data is aggregated at the country level, and there is no guarantee that the damage in question affected the oil supply chain. This suggest that it may be useful, in future work, to improve the instrument by geographically locating the disaster data and only including damage estimates for events influencing oil regions of a country.

Table 2: Reduced Form OLS

	World oil producers political freedom measures Reduced form regression with HAC standard errors			
Independent variables	Polity IV	Polity IV	Polity IV	Polity IV
Log out of region disaster damage	-.112	-.087	-.037	-.042
	(.012)	(.012)	(.008)	(.007)
Log GDP per capita	—	.010	.102	.021
		(.011)	(.011)	(.006)
GDP growth	—	—	.003	-.002
			(.002)	(.001)
Polity at Entry	—	—	—	.744
				(.025)
Constant	1.96	.861	.826	.520
	(.185)	(.218)	(.217)	(.010)
Number of observations	1379	1277	1267	1267
R^2	.104	.220	.225	.708

Note: Pooled OLS with unbalanced panel. Each regression includes year fixed effects.

For coefficient estimates of the average-treatment effect of oil income changes on polity, we now turn to our instrumental variable analysis. In Table 3, the first stage regression, presented in the lower panel, shows that our instrument is working in the way we suggest. The coefficient is positive, statistically significant, and robust to various controls. Also reported at the bottom of the upper panel is the Cragg-Donald statistic for weak instrumentation. Stock and Yogo (2002) derive a set of critical values for the Cragg-Donald statistic that tests when the nominal 5% TSLS t-test for the hypothesis that $\beta = 0$ has the size potentially exceeding 15%. The value for a single endogenous righthand side variable that is exactly identified is 8.96. In most TSLS regression reported in Table 3, the Cragg-Donald statistic exceeds this critical value and we can reject the null hypothesis. The regressions in columns (2) and (3) exceeds the critical value for the possibility of exceeding the 10% level.[16]

[16]Using a conditional likelihood ratio test, which is robust to weak instruments (Murray 2004), asymptotic 95% intervals and t-tests were performed and in every case the lower bound of the confidence interval was further from zero (in the negative direction) than the one implied by inverting the t-test in Table 3. The

Table 3: 2SLS: Polity IV scores on oil income

	World oil producers political freedom measure			
	Second stage 2SLS: HAC standard errors			
	Polity IV	Polity IV	Polity IV	Polity IV
Independent variables	(1)	(2)	(3)	(4)
Log oil income per capita	-.633	-.356	-.356	-357
	(.206)	(.077)	(.077)	(.167)
Log GDP per capita	—	.361	.355	.355
		(.056)	(.053)	(.155)
GDP growth	—	—	-.012	-.012
			(.004)	(.005)
Polity at Entry	—	—	—	-.001
				(.371)
Constant	2.92	-.992	-.891	-.892
	(.859)	(.203)	(.190)	(.408)
Cragg-Donald Statistic	10.65	26.54	26.73	7.47
	Log oil revenues per capita			
	First Stage			
	(1)	(2)	(3)	(4)
Log out of region disaster estimates	.178	.245	.244	.117
	(.056)	(.055)	(.054)	(.037)
Log GDP per capita	—	.733	.710	.937
		(.055)	(.054)	(.040)
GDP growth	—	—	-.354	-.027
			(.010)	(.008)
Polity at Entry	—	—	—	-2.09
				(.173)
Constant	1.52	5.054	-4.82	-3.96
	(.852)	(.687)	(.977)	(.938)
Number of observations	1379	1277	1267	1267
R^2	.112	.220	.362	.488

Note: All results are two-stage least squares with unbalanced panels. Each regression includes year dummies and reports the Newey-West heterosketastistic and autocorrelation consistent standard errors with the standard Bartlett kernel, bandwith=2.

The TSLS estimates of equation (1) are also presented in the upper panel of Table 3. Log oil income (R_{it}) is treated as endogenous and modeled by

$$R_{it} = \mu + \theta log D_{it} + \delta \mathbf{X}_{it} + \nu_{it} \tag{6}$$

where D_{it} is the out of region disaster damage for country i at time t, $\mathbf{X}_{it}$ is a set of control variables from equation (1). The exclusion restriction implies that D_{it} does not appear in equation (1), i.e.,

$$Cov(D_{it}, \epsilon_{it} | \mathbf{X}_{it}) = 0 \tag{7}$$

The top panel reports coefficients on log oil income per capita, as well as those on the control variables, with heterosketastistic and autocorrelation consistent (HAC) standard errors (Newey and West 1987). The effect of log oil income, reported in column (1), is -.633 and is much larger than the association found in the OLS regression in Table 1. Columns (2) and (3) show that, controlling per capita GDP and GDP growth, the coefficient on log oil revenues is still negative and significant with an estimated effect of -.356. Finally column (4) shows that when controlling for institutional legacy, using the Polity at Entry variable, the effect of log oil income is negative, significant and stable.[17]

In each of these cases, the effect of changes in oil income is on the order of the association found between polity scores and per capita GDP. Interestingly, it is also easy to show from the simple model described above that the decision-maker's equilibrium policy -tax trade off changes in favor of more political freedom as income increases. We find this to be robust in our analysis. We also note that, while GDP growth has a negative sign–as found in other research (Helliwell 1994)–its effect is consistently small compared to GDP per capita and log oil income.

Anderson-Rubin statistic, which is also heterosketastistic and autocorrelation consistent, but has poorer coverage than the CLR, produced the same significance results.

[17]The reader might wonder how the results change if oil revenues were differenced out of GDP. Technically, as the first stage conditions on GDP, it is not necessary, but using Ross's (2001) data on mineral exports one can generate a GDP measure without oil exports and produce the same results we have found here. We also ran the model lagging per capita GDP by a year, with no substantive effect on the results.

Table 4: 2SLS: Measures of regimes on oil income

	World oil producers political freedom measures			
	Second stage 2SLS			
Independent variables	Democracy Score	Freedom House Civil Liberties	Constraint on Executive	Freedom House Political Rights
Log oil income per capita	-.326	-.318	-.292	-.312
	(.161)	(.125)	(.156)	(.125)
Log GDP per capita	.353	.365	.307	.355
	(.151)	(.114)	(.145)	(.114)
GDP growth	-.009	-.010	-.008	-. 011
	(.005)	(.004)	(.005)	(.004)
Polity at Entry	.124	-.136	.117	-.016
	(.357)	(.266)	(.342)	(.263)
Constant	-.287	-.191	-.039	-. 957
	(.143)	(.142)	(.141)	(.266)
Cragg-Donald Statistic	6.66	8.01	6.66	8.69
	Log oil revenues per capita			
	First Stage			
Log out of region disaster estimates	.112	.128	.112	.132
	(.057)	(.056)	(.057)	(.055)
Log GDP per capita	.943	.919	.943	.919
	(.04)	(.041)	(.040)	(.041)
GDP growth	-.026	-.029	-.026	-. 030
	(.009)	(.008)	(.009)	(.008)
Polity at Entry	-2.09	-1.96	-2.09	-1.96
	(.174)	(.177)	(.174)	(.175)
Constant	-1.82	-1.96	-1.82	-3.71
	(1.17)	(1.12)	(1.17)	(.911)
Number of observations	1249	1119	1249	1162
R^2	.490	.464	.490	.465

Note: All results are two-stage least squares with unbalanced panels. Each regression includes year dummies and reports the Newey-West heterosketastistic and autocorrelation consistent standard errors with the standard Bartlett kernel, bandwith=2.

1.1 Robustness

Moving from a stark theoretical world where modeling assumptions and incentives clearly drive a decision to implement various policies in response to levels of oil income and changes in GDP to the messier empirical world of countries, leaders, and data requires a number of steps. One important step is coming up with data, a set of variables, and instruments such that we might believe we have stable ground upon which to make causal inferences. Here the shocks to oil markets created by natural disasters has been proposed as such a tool. Table 3 provides a series of estimates and diagnostics that provide evidence for the causal relationship between oil rents and political freedom. The validity of the inferences from two instrumental variable analysis, however, depend on the assumption that out of region disaster estimates have no direct effect on political institutions, that is they are exogenous. Although this working hypothesis has face validity, here we substantiate it further by controlling for other variables that could plausibly be correlated with natural disasters and political institutions and verify that the results are robust to these changes. We further examine the quality of the TSLS results by considering alternative measures of institutional legacy, by running the analysis on subsamples of the population of oil producing countries and controlling for levels of oil income using log of known oil reserves and annual oil production. This last result is important because the theory we are considering expects there to exist a relationship between changes in income and polity, not just wealth. Overall, our results change remarkably little.

First we check the robustness of our initial results against four different measures of political freedom and democracy. Table 4 reports the results for regressions of Polity IV democracy scores, Freedom House Civil Liberty scores, measures of the constraints on the executive, and Freedom House Political Rights scores. In every instance results are consistent with the initial instrumental variable estimates.

Next we focus on a few variables that could be correlated with disasters and politics. The first such variable is latitude. Given the prevalence of topical storms in disaster data sets, one may worry that a particularly active storm year could induce correlation between the out of region disaster damage estimates and the number and severity of such disasters in

the ones home region. Though this is an important reason to group the Americas together, this could still be problematic, particularly in the tropics. We also present results where we control for the top 5 oil producers, measured as having the highest average annual oil output between 1968 and 2002, to verify that the results are not driven by these largest oil countries. We also include a set of results with a Cold War dummy to account for the change in the geopolitical climate after 1989.

Another possible problem for our analysis is the measure of institutional legacy. Recall that we constructed the relevant variable by using the country's polity score upon entering the data set. As scholars, like Engerman and Sokoloff (2004), argue: the most important institutional legacy may not be related to such a score. To explore the possibility that different measures of institutional legacy may influence our results, we present a number of specifications of our model. First, we use a dummy for the "West," defined to be the United States, Canada, Norway, Denmark, Great Britain, and Russia, and then include dummy variables for Sub-Saharan Africa and OPEC to capture broad differences in the political histories of oil rich nations. Because LaPorta, de Silanes, Shleifer and Vishny (1996) argue for the importance of colonial origin, we also specify models where we use a country's colonial experience as a measure of institutional legacy.[18] Contrary to Englebert's (2000) conjecture, colonial origin does not make the effect go away. Controls for the experience of being an excolony and the identity of colonial powers are used and have no substantial effect on our previous results. Table 5 reports these results. In this table we also include a specification with the polity score lagged by 5 years, as in Ross (2001).

One might also believe that the results are driven by the particularly broad set of oil countries included in the data set. First, it is important to point out in that unlike many studies, we have excluded non-oil producers. This means that the concern that our results are coming from identification off pairs of countries like Switzerland and Nigeria do not apply. That does not mean, however, that the set of countries in our data set are considered by all

[18]The inclusion or non-inclusion of Russia in the the West is immaterial. The effects of oil are robust to both specifications.

Table 5: IV regression with additional controls

	World oil producers political freedom measure:Polity IV						
	Second stage 2SLS						
	Original IV estimates	Latitude	Top 5	Cold War	Top 5 & Latitude	West	West & Africa
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log oil income per capita	-.357	-.261	-.357	-.357	-.259	-. 357	-.438
	(.167)	(.084)	(.166)	(.167)	(.083)	(.077)	(.121)
Log GDP per capita	.355	.299	.349	.355	.294	.371	.477
	(.155)	(.092)	(.150)	(.155)	(.088)	(.077)	(.128)
GDP growth	-.012	-.009	-.012	-.007	-.009	-.011	-.012
	(.005)	(.003)	(.005)	(.004)	(.003)	(.004)	(.004)
Polity at Entry	-.001	.228	.011	.078	.240	—	—
	(.371)	(.185)	(.362)	(.023)	(.177)		
"West" dummy	—	—	—	—	—	-.101	-.241
						.165	(.241)
Sub-Saharan Africa dummy	—	—	—	—	—	—	.452
							(.179)
"Top 5" oil producer	—	—	.127	—	.104	—	—
			(.095)		(.063)		
Latitude (absolute value)	—	-.006	—	—	-.006	—	—
		(.002)			(.002)		
Cold war dummy	—	—	—	.246	—	—	—
				(.199)			
Constant	1.084	-.799	-.858	-.176	-.769	-1.00	-1.52
	(.618)	(.265)	(.387)	(.163)	(.252)	(.311)	(.535)
Number of observations	1267	1267	1267	1267	1267	1267	1267
Cragg-Donald Statistic	7.47	15.68	7.51	7.47	16.04	29.35	17.54
	OPEC	French Colony	British Colony	5 year Lag	British & French Colony	Colonies & Latitude	Excolony
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Log oil income per capita	-.618	-.370	-.340	-.336	-.361	-. 298	-.302
	(.259)	(.097)	(.074)	(.277)	(.093)	(.058)	(.050)
Log GDP per capita	.527	.370	.343	.329	.362	.354	.327
	(.170)	(.070)	(.052)	(.266)	(.067)	(.053)	(.039)
GDP growth	-.013	-.012	-.012	-.103	-.013	-.009	-.008
	(.007)	(.005)	(.004)	(.009)	(.005)	(.003)	(.003)
5 year Lag polity score	—	—	—	.074	—	—	—
				(.671)			
French Colonial dummy	—	.071	—	—	.116	.011	—
		(.108)			(.100)	(.055)	
British Colonial dummy	—	—	.188	—	.198	.204	—
			(.053)		(.052)	(.043)	
Latitude (absolute value)	—	—	—	—	—	-.007	—
						(.002)	
Excolony dummy	—	—	—	—	—	—	.316
							(.094)
OPEC	.981	—	—	—	—	—	—
	(.557)						
Constant	-1.47	-.938	-.920	.108	-.997	-1.02	-1.18
	(.534)	(.232)	(.177)	(.150)	(.220)	(.180)	(.198)
Number of observations	1267	1267	1267	1102	1267	1267	1267
Cragg-Donald Statistic	6.91	18.49	25.17	2.06	18.14	31.10	49.99

Note: All results are two-stage least squares with unbalanced panels. Each regression includes year dummies and reports the Newey-West heterosketastistic and autocorrelation consistent standard errors with the standard Bartlett kernel, bandwith=2.

Table 6: IV Regression in Subpopulations

	World oil producers political freedom measures 1968–2002			
Independent variables	World w/o West	State oil companies	World w/o top oil producers	Excolonies
Log oil income per capita	-.244	-.151	-.397	-.190
	(.073)	(.037)	(.210)	(.037)
Log GDP per capita	.264	.191	.388	.215
	(.072)	(.052)	(.189)	(.041)
GDP growth	-.009	-.007	-.014	-. 006
	(.003)	(.002)	(.007)	(.002)
Polity at Entry	.307	.595	-.313	.482
	(.159)	(.056)	(.424)	(.069)
Constant	-.703	-.594	-1.00	-. 632
	(.212)	(.216)	(.499)	(.156)
Number of observations	1055	625	1170	967
Cragg-Donald Statistic	21.95	46.21	5.58	59.25

Note: All results are two-stage least squares with unbalanced panels. Each regression includes year dummies and reports the Newey-West heterosketastistic and autocorrelation consistent standard errors with the standard Bartlett kernel, bandwith=2.

naturally comparable. To address this issue Table 6 illustrates the robustness of our result by running the analysis on subsamples of the data. In the subsamples the effect of oil revenues is consistently negative. As one would expect, the standard errors in the subsamples are larger and in the case of the world without the top 5 oil producers the instrument is weak. The weakness of the instrument in these cases has two effects. First, if there is even a small amount of correlation between our instrument and the disturbance term in the structural equation the coefficients will be biased in the direction of the OLS estimates(Bound, Jaeger and Baker 1995). Second, the weakness of the instrument can effect the actual size of the $t-$tests under the normal approximation. While the instrument is not as weak as others, for example the F-statistic[19] on the first stage regression in Acemoglu, Johnson and Robinson (2001) is 4 for the important specification including current health conditions, the estimates in these columns should be viewed as less reliable than the others.

In addition to the results in Table 6, we ran our analysis on only non-democracies–that is, countries with polity scores of 6 or less when they entered the data set–and estimates of the effect of oil income where negative, significant, and rejected the hypothesis of a weak

[19]Cragg-Donald and first stage F-Statistics for the excluded instruments are the same for exactly identified models.

instrument in the subsample. While there are many combinations of characteristics and sub-populations one may wish to explore, another one worth mentioning is Karl's (1997) set of capital constrained countries. Contrary to what might be expected, even with strong instrument statistics, the negative effect of oil income is substantially smaller and only marginally significant under our standard specification for Karl's 13 countries. The results also are robust evidence that, among the set of oil countries, the direct "authoritarian" effect of oil outweighs Dunning's (2008) proposed democratizing effects.

1.2 Wealth and windfall?

In many ways the results conform to the existing view in the literaure: larger revenues from oil lead to decreases in democracy and political freedoms. As described above, these results are also consistent with the line of argument found in many works on political development and democratization. The choice of instrument, however, presents an opportunity to disentangle two different mechanisms that may lead to this change in politics. In most of the literature, Karl (1997) being an important exception, it is never clear what leads to less democracy– oil wealth or the "windfalls" and booms. The resource wealth curse seems to suggest that deep structural problems, both economic and political, perverse incentives for agents to pursue the easy rents associated with the extraction and sale of natural resources (Sachs and Warner 2001). The "boom" mechanism, on the other hand, suggests less of a commodity specific distortion, but that specific incentives and problems arise when leaders have to manage large inflows of new cash. Or if we were to be less generous, when decision-makers are facing many binding political constraints, they may ease in the face of more spending or corruption. Our simple theoretical model of this problem implies exogenous increases in revenues that result form price shifts are then open to being exploited in this way.

The natural disaster instrument is one that varies exactly this price shifting portion of the revenues. That is, we can identify the part that is exogenous to production choices or newly found reserves. In principle, then, with measures of production and known reserves we can explore whether the windfall mechanism is present in the data. Table 7 presents results

that are consistent with most of the negative effect of oil on democracy coming from the effects of booms, or exogenous shocks to market price, rather than the various implications of large levels of oil production or oil wealth itself.

Column (1) of Table 7 substitutes a measure of oil wealth–known oil reserves–for previous measure of revenues. Data for known oil reserves run from 1980 to 2004 and come from BP's Annual Statistical Review (2005). Here we get the usual picture, a significant effect that might be called the (a) resource curse. Looking at column (2) we have replaced the wealth measure with a production measure, where oil production data comes from the same source and covers the entire time series. Here we see no effect of production on polity. Not only is the effect not statistically significant, but to the third place right of the decimal point the effect is zero. Column (3) includes both oil production and known oil reserves as variables. Production has a positive and significant effect, while known reserves has a significant and negative effect. The result for know reserves is not surprising, given the literature. The positive effect of production, within a sample of oil states, is also not surprising, as many of the most democratic states pull more barrels out of the ground per year than other states in the sample (see data in Table 8). The United States, Canada, Mexico, and Norway, all find them selves consistently in the list of top 10 oil producers, where only Canada–with its large oil sands deposits–makes the list of top reserve holders.

Column (4) of Table 8 includes our measure of oil revenues, oil production, and our instrument. Here we see a robust estimate of the effect of oil revenues, consistent with the earlier findings, a positive effect of production, but no significant effect for known reserves. This suggests that windfalls are an important source of the political economy problems of oil countries. The relationship is also consistent with the more casual observation that oil countries' politics change in predicable ways with shocks to oil prices. Interestingly, this result can be replicated on the subset of non-democracies, those countries with state-oil companies and Karl's capital deficient countries. We can also get this result controlling for OPEC membership or latitude.

Table 7: 2SLS with known oil reserves and oil production

	World oil producers political freedom measure			
	Second stage 2SLS			
	Polity IV	Polity IV	Polity IV	Polity IV
Independent variables	(1)	(2)	(3)	(4)
Log oil revenues per capita	—	—	—	-.380
				(.098)
Log GDP per capita	.043	.023	.031	.310
	(.011)	(.007)	(.009)	(.072)
GDP growth	-.003	-.002	-.004	-.018
	(.002)	(.001)	(.001)	(.005)
Polity at Entry	.652	.764	.657	.121
	(.036)	(.024)	(.035)	(.146)
Log known oil reserves	-.016	—	-.082	-.029
	(.006)		(.014)	(.033)
Log oil production	—	0.00	.093	.186
		(.005)	(.017)	(.053)
Constant	.072	-.059	-.007	-.803
	(.088)	(.052)	(.087)	(.272)
Cragg-Dolanld Statistic	—	—	—	11.68
	Log oil income			
	First Stage			
	(1)	(2)	(3)	(4)
Log out of region disaster estimates	—	—	—	.266
				(.078)
Log GDP per capita	—	—	—	.744
				(.050)
GDP growth	—	—	—	.037
				(.01)
Polity at Entry	—	—	—	-1.31
				(.185)
Log known oil reserves	—	—	—	.126
				(.077)
Log oil production	—	—	—	.269
				(.111)
Constant	—	—	—	-7.93
				(.078)
Number of observations	870	1267	857	857

Note: All results are two-stage least squares with unbalanced panels. Each regression includes year dummies and reports the Newey-West heterosketastistic and autocorrelation consistent standard errors with the standard Bartlett kernel, bandwith=2.

Table 8: Top Oil Countries by Production and Resreves

Top Oil Producers		Largest Known Reserves	
1.	Saudi Arabia	1.	Saudi Arabia
2.	Russia	2.	Canada
3.	United States	3.	Iran
4.	Iran	4.	Iraq
5.	China	5.	Kuwait
6.	Mexico	6.	United Arab Emirates
7.	Canada	7.	Venezuela
8.	United Arab Emirates	8.	Russia
9.	Venezuela	9.	Libya
10.	Norway	10	Nigeria

Source: US Energy Information Administration, 2006 statistics.

2 Conclusion

Many economists and political science have argued that natural resource income has a detrimental affect on political institutions. Several careful case studies and fewer cross-national studies have documented this statistical association. In this paper, we attempt to address two problems that exist in previous work. The first problem is that oil revenues can be influenced, through changes in oil prices, by actual or expected changes in the political institutions of oil producing nations. This "simultaneous causation" makes identifying the effects of changes in the rents associated with oil on polity and democracy difficult. Second, there is little agreement in the existing literature about what determines institutional configurations within countries. In this paper, we investigate one part of the institutional story–the relationship between taxation, and political institutions–in an attempt to understand how natural resource income might influence the political development in resource rich countries. With a simple model we illustrate an incentive and present an intuition for the relationship between resource wealth and political freedom. But clearly, there are many other parts to the institutional story and factors that influence which institutions develop in various countries. Thus, there is a real risk that any standard statistical analysis might include bias induced

by one or more omitted variables.

The instrumental variable approach taken in this paper addresses both problems by concentrating on one well defined relationship and a very specific hypothesis: increases in oil income have negative effects on the political institutions of oil producing nations. As such, we test a specific causal hypothesis that should be true–even among the set of oil producing nations–if changes in oil income leads to changes in the democratic nature of political institutions. With this narrow focus it is then possible to find believable sources of exogenous variation in oil revenues that allow us to identify the causal effect in question. The analysis suggests that there is a negative relationship between oil rents and political institutions that is significant in the set of oil producing nations. Conditioning on various other variables, such as GDP per capita, GDP growth, colonial history, previous regimes scores, and latitude, the relationship is robust.

Perhaps the most interesting finding in this analysis is that regarding booms and windfalls. Without an instrument like natural disasters it would be very hard to separate the effects of changes in revenue due to price shocks and those that might be a function of production decisions or political and economic distortions created by the presence of resource wealth. The importance of the windfall result is it suggest a much more dynamic and short-run interaction between oil revenues and politics than one might expect. In fact, much of the focus of previous work has been on the long-run implications of resource wealth. Here we have credible evidence of short-run impacts of windfalls on political freedom. Now, while it is not particularly surprising that in the analysis above the short term shocks have larger effects on year to year changes in polities than wealth variables like known reserves, the question remains open of which is the bigger issue, volatility of income from oil or oil wealth?

A Formal analysis

Normalize the policy space such that the leader's ideal policy is 0 and the citizen's is 1.

Proposition 1 *If there exists a subgame perfect Nash equilibrium to our game where the revolt constraint binds and $x^* \neq 0$, then if resource income (R_0) increases, policy (x^*) decreases.*

Proof: Suppose there is a subgame perfect Nash equilibrium to our game where the revolt constraint binds and $x^* \neq 0$. then by the Karush-Kuhn-Tucker Theorem the policy profile necessarily satisfies

$$v_l'(x) + \lambda v_c'(x) = 0, \tag{8}$$

$$m_l'(t + R_0) - \lambda m_c(y_c - t) = 0, \tag{9}$$

$$\lambda(v_c(x) + m_c(y_c - t) - Q) = 0, \tag{10}$$

with the final equation holding with complementary slackness. Furthermore, $\lambda \geq 0$ because the revolution constraint binds. From equation 9 we conclude

$$\lambda = \frac{m_l'(t + R_0)}{m_c'(y_c - t)} > 0. \tag{11}$$

From equation 8 we then get

$$v_l'(x) + \frac{m_l'(t + R_0)}{m_c'(y_c - t)} v_c'(x) = 0. \tag{12}$$

Next, apply the Implicit Function Theorem to get

$$x'^*(R_0) = -\frac{\frac{m_l''(t+R_0)}{m_c'(y_c-t)} v_c'(x)}{v_l''(x) + \frac{m_l'(t+R_0)}{m_c'(y_c-t)} v_c''(x)}. \tag{13}$$

As m_j is concave and increasing for $j = l, c$ and $v_c'(x) > 0$, we conclude that $x'(R_0) < 0$, proving the result. ∎

Proposition 2 *If there exists a subgame perfect Nash equilibrium to our game where the revolt constraint binds and $x^* \neq 0$, then if citizen income (y_c) increases, policy (x^*) increases.*

Proof: Suppose there is a subgame perfect Nash equilibrium to our game where the revolt constraint binds and $x^* \neq 0$. Taking the solution to the optimization problem described above and applying the Implicit Function Theorem, it is immediate that x^* is increasing in y_c. ∎

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B Reviewer's Appendix

COUNTRY_NAMES

Algeria Angola Argentina Australia Azerbaijan Brazil Brunei Cameroon Canada Chad China Colombia Denmark Ecuador Egypt Gabon India Indonesia Iran Iraq Italy Kazakhstan Kuwait Libya Malaysia Mexico Nigeria Norway Oman Peru Qatar Rep. of Congo (Brazzaville) Romania Russian Federation Saudi Arabia Sudan Syria Thailand Trinidad & Tobago Tunisia Turkmenistan USA United Arab Emirates United Kingdom Uzbekistan Venezuela Vietnam Yemen

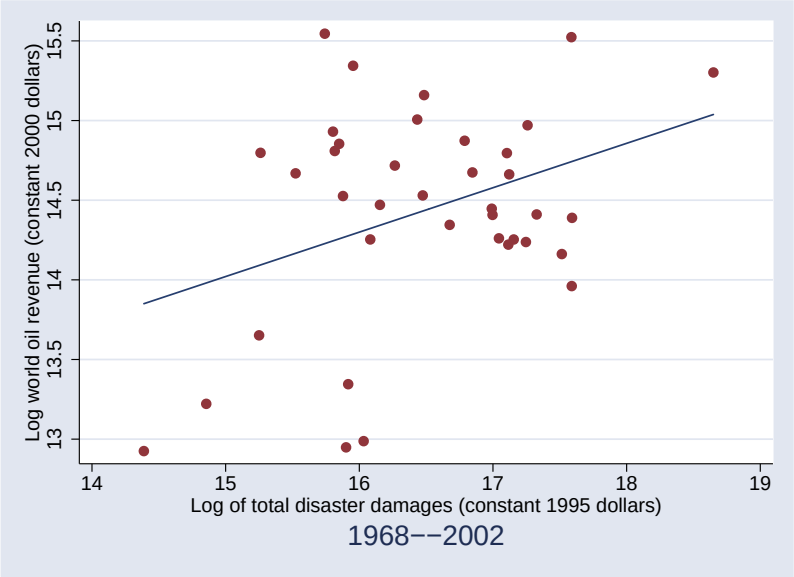

Figure 1: Estimated disaster damage and Log world oil revenues.

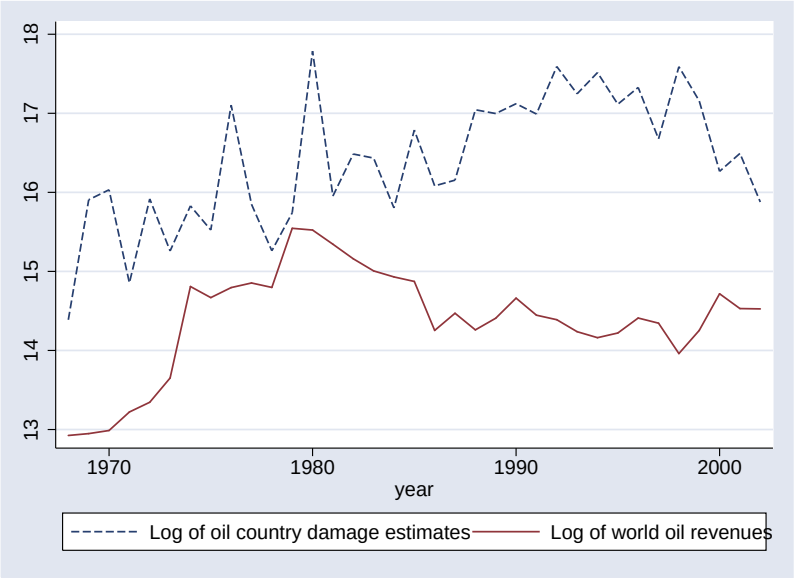

Figure 2: Estimated disaster damage and Log world oil revenues.

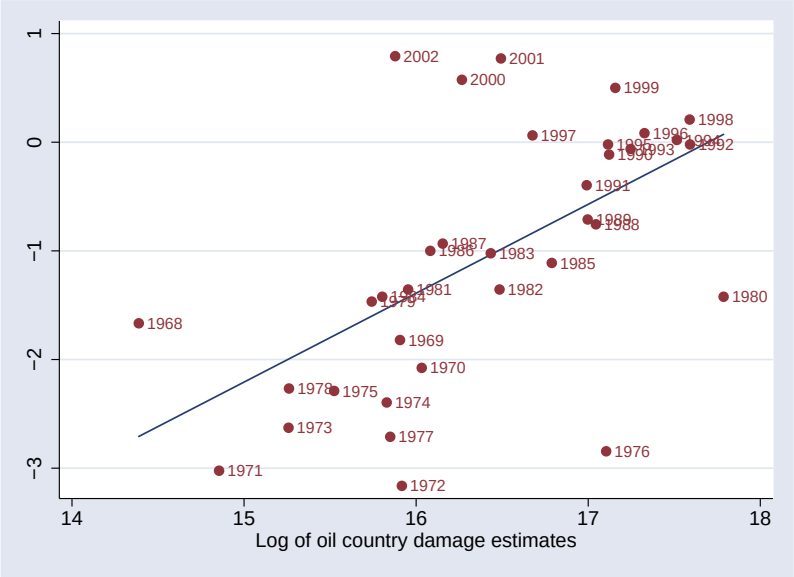

Figure 3: Scatter plot: Average oil producing nation's polity score and log of total disaster damage.

Table 9: Descriptive Statistics

Variable	Mean	σ	Min	Max	Observation
Log oil income per capita (constant 2000 US dollars)	5.83	2.23	-2.07	11.215	1610
GDP growth	1.82	6.48	-27.099	76.563	1459
Log GDP per capita (constant 2000 US dollars)	7.81	1.48	4.528	10.877	1447
Polity IV	-.99	7.75	-10	10	1513
Democracy score	3.45	4.22	0	10	1480
Constrain on Executive	3.67	2.37	1	7	1480
Log out of region damage estimates (constant 2000 US dollars)	15.39	1.44	8.202	17.751	1534
Latitude (absolute value)	25.916	17.767	.650	67.470	1824