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Revisiting the Oil Curse: Does Ownership Matter?

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Abstract

A large body of scholarship finds a negative relationship between oil abundance and economic growth. The existing empirical evidence on the oil curse, however, does not account for variations in the ownership of oil. This article investigates whether the effect of oil abundance on growth varies with ownership structures. It also investigates whether institutional quality influences the effect of different ownership structures. Using a novel database on ownership structures and employing a panel fixed-effects estimation method, it analyzes a sample of 20 oil-exporting developing countries during the period 1984-2005. The results show that different ownership structures have differential effects on growth, and that their effect is influenced by the quality of institutions. State ownership and control reduces growth when the institutional quality is poor, but increases growth when the institutional quality is good. Private ownership, on the other hand, increases growth when the institutional quality is poor, but reduces growth when the institutional quality is good. The results contrast the existing knowledge that institutional quality alone is decisive for the resource curse; the results show that the choice of ownership structure in the oil sector plays an important role in determining whether oil-exporting countries benefit from their oil wealth or suffer from the curse. The policy advice in this article is: retain state ownership and control if the institutions are strong, if the institutions are weak, transfer ownership to foreign oil companies.

Key words: oil curse, ownership, economic growth, institutional quality.

1. Introduction

One important finding in the development literature is the presence of a negative relationship between resource abundance and economic growth. This paradoxical relationship has received significant attention from both policymakers and academicians over the past few decades. While the focus was initially on resource-rich countries in general, attention started shifting in the 1970s and 1980s to oil-exporting countries in the developing world. Oil-exporting countries received unprecedented windfall profits during the oil booms of the 1970s – which led to high expectations about their future growth prospects. Yet, they grew more slowly than their oil-poor counterparts. Some of the countries even witnessed a decrease in their per capita income. Between 1980 and 2006, for instance, per capita income decreased by 85% in Iraq, 45% in Gabon, and 6% in Venezuela (Ross 2012:1).

The disappointing economic performance of oil-exporting countries has given rise to the contention that oil abundance is detrimental to growth and development. Oil abundance is, in fact, considered most detrimental as compared to the abundance of other types of resources. Few scholars, however, claim that oil abundance is not responsible for poor economic growth; rather, it is the presence of state ownership in the oil sector which causes adverse economic effects (e.g. Ross 1999, 2012; Quinn and Conway 2008). This claim, however, has not been validated through a quantitative analysis of a large set of oil-dependent countries. Most studies on the oil curse overlook ownership – that is, the right to explore and produce resources – as an explanatory variable (e.g., Karl 1997, Gelb et al 1998). The studies which focus on natural resources in general – and question the assumption that resource abundance, by itself, is an economic curse – also neglect the issue of ownership (e.g., Mehlum et al 2006a, b); they investigate only the role of institutions and claim that institutions are decisive for the resource curse – that is, countries with strong institutions benefit from their resource wealth, while countries with weak institutions suffer from the curse.

This article addresses the following questions: Is state ownership really responsible for the worse effect of oil abundance on economic growth? Does a shift away from state ownership leads to better growth outcomes? State leaders of many oil-exporting countries – such as Cameroon, Republic of the Congo, and Yemen – have transferred ownership to private oil companies (particularly foreign oil companies)[1]. Private ownership is expected to become more common in the coming years, as new developments in oil extraction (for instance, deep water offshore drilling) require complex technologies and large investments which are more forthcoming from private oil companies. Also, many new oil deposits are increasingly being discovered in poor states (see Ross 2012: 8-9), which do not have the financial and technical capacity to develop oil fields. There is currently no systematic knowledge on how private ownership in the oil sector affects economic growth. The existing knowledge is limited to the effect of private versus state ownership on firm-level efficiency and profitability indicators (e.g. Megginson et al 1994; Victor 2007; Wolf 2008).

The variations in oil-development strategies are, however, not limited to only state and private ownership; there are variations even within state ownership. Jones Luong and Weinthal (2010) find that state leaders, while assuming their ownership, do not always retain control over oil operations and management. There are many oil-exporting countries – including Angola, Brunei, United Arab Emirates, and Qatar – in which the state has transferred control to foreign oil companies, usually through production sharing contracts[2]. In fact, over the past few decades, state ownership without control has become more common than state ownership with control. Scholars who claim that state ownership is responsible for lower economic growth of oil-exporting countries, however, do not account for variations within state ownership. This raises the question whether transfer of control to foreign oil companies leads to a differential effect of state ownership on economic growth.

I use pooled time-series cross-national data of 20 oil-exporting countries between 1984 and 2005 to investigate whether the effect of oil abundance on economic growth differs across the three ownership structures – that is, state ownership with control, state ownership without control, and private ownership. I also investigate whether institutional quality – which has been found to play a decisive role in resource-rich countries – influences the growth effect of different ownership structures. The empirical analysis is based on a novel database on ownership structures developed by Jones Luong and Weinthal (2010), and uses a fixed-effects panel estimation method.

The overall results show that different ownership structures have differential effects on growth, and that their effect is influenced by the quality of institutions. The key findings are summarized as follows: First, state ownership affects growth only when the state retains operational and management control; when the state transfers control to foreign oil companies, state ownership has no significant effect on growth. Second, state ownership with control reduces growth when the institutional quality is poor; but when the institutional quality is good, it leads to higher growth. Third, transfer of ownership to foreign oil companies increases growth when the institutional quality is poor; but is detrimental to growth when the institutional quality is good.

The results suggest that the choice of ownership structure plays an important role in determining whether oil-exporting countries – with different institutional strengths – benefit from their oil wealth or suffer from the curse. The results contrast the existing knowledge that institutional quality alone is decisive for the resource curse. According to estimates in this study, during 1984-2005, Iraq – with extremely weak institutions – could have escaped the curse and witnessed 1.1% higher growth from every percent increase in oil production to GDP by choosing an appropriate ownership structure, that is, private (foreign) ownership. The policy advice in this

article is: choose state ownership and control if the institutions are strong, if the institutions are weak, transfer ownership to foreign oil companies.

This article takes forward the pioneering work of Jones Luong and Weinthal (2010) on ownership structures; they focus on five transition economies of the former Soviet Union during 1990-2005 and investigate the effect of ownership structures on taxation and expenditure institutions. This article relates to the work of Brunnschweiler (2009) who did an exploratory analysis of the effect of oil ownership on growth of transition countries of the former Soviet Union, and Central and Eastern Europe during 1990-2006. Based on the ownership data of Jones Luong and Weinthal, the author finds that all ownership structures lead to higher growth and that state ownership with control contributes most positively to growth. However, as the author herself suggests, the results are not reliable given that the sample consists of only six oil-rich countries, which have limited variability in the ownership structures adopted by them. In another article, Brunnschweiler and Valente (2013) investigate whether ownership by foreign companies and partnership arrangements in the oil sector lead to higher income vis-à-vis ownership by domestic (both state and private) companies[3]. While their study provides valuable insights, it does not address the question whether state ownership is responsible for poor economic growth and whether transfer of control and/or ownership to private companies produces different results.

Also, none of the existing studies investigate the role of institutional quality in influencing the effect of different ownership structures. Brunnschweiler and Valente did account for the effect of political regimes (i.e. whether democracy, autocracy or anocracy) on ownership-income nexus. However, the type of political regime is not indicative of the quality of institutions. In theory, we expect democratic countries to have a good institutional environment. However, there have been many instances where democracies have been appropriative and characterized by poor policies, while autocracies have followed self-restraints and adopted good policies.

In the next section, I begin by discussing the existing arguments on oil and ownership and their limitations. I then provide a more complete explanation of how different ownership structures could affect economic growth and how the effect could vary depending on the institutional circumstances of the country. Section 3 gives methodology and data, and presents results. Section 4 concludes and discusses implications for policy.

2. Oil abundance, ownership and institutions

Oil abundance produces negative consequences for the economy, as it generates a large scale of volatile revenues. The volatility of oil revenues exposes oil-exporting economies to rapid boom and bust cycles and creates uncertainty in state finances. The problems resulting from uncertainty can be countered if state leaders adopt effective fiscal policies, which entail saving a fraction of revenues during booms in order to enable adjustments during busts. However, there is considerable evidence in the literature that oil-exporting countries increase their spending significantly during booms and to an extent that it surpasses the level of oil revenues (e.g., Gelb et al 1998; Lane and Tornell 1999). The increase in spending is often facilitated by borrowing against oil revenues, which results in large debt burden on these countries. What makes the situation worse is that oil revenues are often directed towards wasteful expenditure as against building infrastructure and promoting economic diversification. Most oil-exporting countries provide their citizens with a wide array of subsidized goods and services, and invest in inefficient 'white-elephant' projects. The inefficient and unrestrained spending by state leaders during booms is the primary channel leading to lower economic growth in oil-exporting countries (see Davis 2001; Manzano and Rigbon 2003; Torres et al 2013).

The failure of oil-exporting countries to adopt effective spending and saving policies has been one of the central puzzles of the oil curse. The explanation for the seemingly irrational spending behavior of state leaders during oil booms comes from Ross (2012: 67-80); he argues that citizens in oil-exporting countries recognize their rights to benefit from their nation's oil-

wealth, and support leaders only when they believe that the spending by leaders is commensurate with the oil revenues that they receive via exports. Given that the expenditure and revenue accounts are not made public in many of the oil-exporting countries, the beliefs of the citizens are formed based on their observations about different projects and programs undertaken by the state, and the popular perception of what accrues to the state during oil booms. Thus, to remain in power and maintain political support, state leaders, both in democracies and autocracies, make expenditure which is more visible – even though inefficient.

Jones Luong and Weinthal (2010), however, argue – and systematically prove using the case studies of oil-rich countries of the former Soviet Union[4] – that citizens' perception of oil revenues and, in turn, their expectations from state leaders depend on who owns the oil sector. When the oil sector is owned by the state, citizens' expectations for distribution of benefits are large, as they believe that state leaders receive significant revenues during booms. But when ownership is transferred to private companies, citizens' expectations reduce, as they now receive a signal that state leaders are not receiving the full amount of oil proceeds. According to Jones Luong and Weinthal, these expectations are realized by state leaders and accounted for in their decision making calculus. As a result, spending and saving patterns in oil-exporting countries vary with ownership – that is, under state ownership, state leaders engage in populist-style spending that has a high degree of visibility (for instance, universal subsidies and grandiose public work projects), while under private ownership, they save and invest oil rents more efficiently.

The above argument lead us to expect that oil abundance would be most harmful to economic growth under state ownership, and less so under private ownership. However, there are two points of consideration here: First, expectations of citizens alone cannot determine how oil revenues are managed in a country. Much also depends on the degree of discretion with state leaders. Ownership structures not only affect the expectations of citizens, but also the

ability of state leaders to meet these expectations, and both these factors jointly determine spending and saving patterns, and in turn growth. Second, the effect of ownership structures on growth is unlikely to be independent of the quality of institutions. The institutional environment in the country influences both the expectations of citizens and the behavior of the state and private agents, which in turn affects spending and growth outcomes under different ownership structures. I discuss these points in detail below.

Degree of discretion with state leaders

Under state ownership, large expectations of citizens are often accompanied with the unconstrained ability of state leaders to meet these expectations – which facilitates channelization of oil rents towards wasteful expenditure. The ability of state leaders to spend with full discretion comes from the presence of national oil companies (NOCs) whose accounts are generally hidden from the public, not only in oil-rich autocracies, but also in oil-rich democracies of the developing world. The NOCs give state leaders easier and direct access to oil revenues, and are often used as the primary vehicle for dispensing subsidies, distributing patronage, and making other unproductive expenditure (see, e.g., Hults 2007; Brumberg and Ahram 2007; Lwanda 2011).

The dissipation of NOCs by the state leaders is facilitated by the absence of internal monitoring: government officials often chair the NOCs board of directors and appoint its other members on political grounds (Tordo et al 2011: 27). External monitoring mechanisms such as stock markets also fail to serve as deterrents. NOCs where the state holds 100 per cent shares are anyway not listed on the stock exchange and are opaque. There is also not much reliable information available for NOCs where the state holds majority shares (say 51 per cent) and there is an active stock market for the remaining shares; majority state ownership creates an illiquid market and reduces the incentives of stock market participants to acquire information about the company (Holmstrom and Tirole 1989). There is also no market for corporate control

as NOCs face a soft budget constraint – that is, they receive subsidies from the state and are protected from bankruptcy, takeovers and closures (Nolan and Thurber 2010: 20; Victor 2013: 449).

Private ownership in the oil sector, on the other hand, not only reduces the expectations of citizens with regard to distribution of benefits, but also the state leaders' ability to engage in unfettered distribution of oil rents. Under private ownership, NOCs either do not exist or have a marginal role. The main authorities dealing in the oil sector are the bureaucracies in charge of tax, finance, and environment related matters. These bureaucracies cannot facilitate state's control over the oil sector and its profits in a way that a NOC can (Sarbu 2014:2). Operations by private companies also bring in a certain level of transparency in the oil sector – as the financial interests of these companies are served when they disclose information about their operations to shareholders, potential investors and partners. Foreign oil companies, in particular, are also required to adhere to internationally-recognized accounting standards (particularly since the late 1980s) and are more subject to the international pressure for transparency and other norms. The relative transparency of private operations makes it difficult for state leaders to interfere in private companies and impose political obligations on them.

There could be a possibility of corrupt privatization – corrupt state leaders could transfer ownership to those who have well-established connections with them, or who offers bribes and political favors in return of access to resources. In this case, state leaders could find it easier to collude with private companies to manipulate the accounts, conceal information about the company's fundamentals, and distort operations to meet their political goals. However, there is a large literature which suggests that the value of private companies cannot be dissipated for long, as they are subject to the scrutiny of markets and face a credible threat of bankruptcy and takeovers (see Shirley and Walsch 2001).

There have been instances of corrupt privatization of the oil sector in the past, the most publicized example being that of Russia in the early 1990s, where both private companies and the state were primarily concerned with stripping oil resources for their personal and political benefits. However, there is evidence that when the private oil companies in Russia faced hard budget constraints during the financial crisis of 1998, they started investing in long term efficiency and profitability, instituted oversight mechanisms for internal monitoring, demanded clear separation from the state, and increased transparency of their operations and revenues[5]. Thus, even with corrupt privatization, the extent of state leaders' ability to distort oil operations to meet their political objectives remains limited.

Thus, on account of both the factors – expectations of citizens and discretion with state leaders – it is expected that oil abundance would have the worse growth effect under state ownership and that the effect would be better under private ownership.

When the state retains ownership but transfer control to foreign oil companies, the expectations of citizens remain large given that the state is still the owner (Jones Luong and Weinthal 2010); but the ability of state leaders to engage in unfettered distribution of benefits reduces. Under state ownership without control, NOCs produce only a fraction of oil reserves owned by the state, which reduces the scale of oil rents that accrue directly to NOCs and the amount that could be cloaked in secrecy by the state leaders for meeting their political objectives. Thus, state ownership without control is likely to lead to higher growth than state ownership with control. However, growth would not be as high as that with private ownership because, even when control is transferred, the state – by virtue of ownership – often reserves the contractual right to interfere in management decisions, which gives them the ability to distort private oil operations for political purposes (see Bindemann 1999). Private ownership is thus

expected to have the most positive effect on growth vis-à-vis state ownership with control and state ownership without control.

Institutional environment

While drawing the expectation that oil abundance would have the worse growth effect under state ownership vis-à-vis private ownership, it is implicitly assumed that the state is ruled by self-interested leaders whose only concern is retaining power, even if it is at the expense of social welfare. This assumption, however, undermines the role of constraints that could affect the state leaders' ability to pursue their utility at the expense of citizens' welfare. It also precludes the possibility of benevolent state leaders who, even in an unrestrained environment, choose to maximize social welfare as against their personal gain.

State leaders can, in fact, adopt good policies – either because of their own will or because of certain constraints on them – resulting in a good institutional environment which includes low corruption, strong rule of law, effective bureaucracy, and strong property rights protection. In the presence of strong institutions, citizens are more willing to accept restraints on the state's spending during booms, as they feel confident that the unspent oil surplus would not be squandered and would instead be saved and invested wisely[6]. State leaders, thus, do not feel obligated to immediately spend oil rents during booms – even under state ownership. Also, when the institutions are strong, NOCs do not become the vehicle for unrestrained wasteful spending. Instead, they are rationally organized along the meritocratic as against the political lines. The efficient organization of NOCs, in turn, increases the revenues available with the state (Marcel 2006: 3), which are then used for productive purposes. In this case, state ownership in the oil sector is unlikely to have the worse growth effect. In fact, with strong institutions, state ownership could even lead to higher growth than private ownership.

Under private ownership, the ability of state leaders to make productive investments in the country depends on how effectively they can tax and regulate private companies. Good state leaders with citizens' welfare as the priority are likely to adopt effective taxation policies and stringent regulations. However, even with the most effective policies, it is difficult to extract optimal tax revenues from private oil companies, as they always have incentives to hide their income and evade taxes in order to increase their profits (Stiglitz 2007). In fact, with increased vertical integration of oil companies, hiding of revenues through semi-legal means – such as transfer pricing – has become relatively easy.

Stiglitz (2007) argues that the private companies' incentives to evade taxes are higher when the expected penalties from doing so are not too great. When the institutions are weak and the property rights are insecure, the expected penalty for tax evasion is very high – as even a suspicion by state leaders that private companies are not paying the prescribed taxes could result in an outright expropriation of oil assets[7]. In this case, paying taxes is a relatively inexpensive way for private companies to secure their property rights (Jones Luong and Weinthal 2010: 68). However, when the institutions are strong and the property rights are secure, the penalty for tax evasion (usually in the form of fines) is relatively low. This increases the private companies' incentives to evade taxes. The regulation and detection of tax evasion, in turn, put enormous strain on state's resources and divert them away from productive uses. Thus, in the presence of strong institutions, state ownership would lead to higher growth vis-à-vis private ownership. State ownership with control, in particular, would have the most positive effect on growth due to the limited involvement of private companies and, hence, the minimum diversion of oil revenues away from productive investments in the country.

In sum, the discussion above suggests that the effect of oil abundance on economic growth would vary with ownership structures, and that the effect would be influenced by the quality of

institutions. When the institutional quality is poor, private ownership would have the most positive effect on growth; when the institutional quality is good, state ownership with control would have the most positive effect on growth. The next section provides a test of this hypothesis.

3. Empirical analysis

3.1. Methodology & Data

I first test whether the effect of oil abundance on economic growth varies with ownership structures. I study a sample of 20 oil-exporting developing countries during the period 1984-2005 (see appendix for the list of countries included in the sample). These countries are selected on the basis of the following criteria: oil production is at least 10% of the real GDP, and net oil exports constitute at least 50% of the total exports during the period under consideration. This is the conventional criteria used in the literature for classifying oil-dependent countries (e.g., Karl 1997; World Bank 1993:329). Data on oil production and net exports are taken from Ross (2013), and data for real GDP and merchandise exports are available from the World Development Indicators. The following model is estimated using a panel fixed-effects estimation method:

$$G_{it} = \beta_1 + \beta_2 oil_{it} + \beta_3 os_{it} + \beta_4 (oil_{it} os_{it}) + \beta_5 x'_{it} + \propto_i + \epsilon_{it} \qquad (1)$$

where i is the country and t is the year index. G is the growth rate of PPP adjusted real GDP per capita. oil refers to oil abundance and is measured as the natural log of oil production to GDP. os refers to ownership structures. Data on ownership structures are taken from a novel database developed by Jones Luong and Weinthal (2010). This database provides categorical variables for state ownership with control, state ownership without control, and private

ownership (both domestic and foreign). The categorical variables are drawn by reviewing each country's constitution, mineral laws and regulations, and (where available) oil contracts between the state and private companies (see appendix for the criteria used for coding these categories).

x is the vector of control variables which includes time dummies, openness, institutional quality, secondary school enrollment rate, and investment. The appendix gives the description of the variables along with data sources and descriptive statistics. $\propto_i$ is the country-specific error component and ϵ_{it} is the idiosyncratic error term. The use of country-specific fixed effects allows us to control for the initial level of development (which accounts for the conditional convergence effect), and other time-invariant characteristics of the country such as geography and history. All independent variables are lagged by one year to address the possibility of endogeneity arising from reverse causality.

For measuring institutional quality (*IQ*), I construct an index which is an unweighted average of the four variables obtained from the International Country Risk Guide (ICRG) database: corruption, law and order, quality of bureaucracy, and investment profile[8]. The *IQ* index ranges from 0 (lowest institutional quality) to 1 (highest institutional quality).

The ICRG based measures of institutional quality have been criticized by a few scholars (e.g., Glaeser et al 2004; Boschini et al 2013); they argue that these measures do not reflect the commonly agreed interpretation of institutions as durable rules that constrain human behavior[9]. They instead prefer to use the constraint on executive measure – available from the Polity IV database – arguing that it reflects durable constraints on states. The constraint on executive measure, however, has a limitation; it does not account for good policy choices taken by the leaders who operate relatively freely and do not face formidable constraints. ICRG indicators, on the other hand, are based on the perception of the situation in the country and reflect past policy actions taken by the state leaders. These policy actions could be the result of either the leaders'

own choice or constraints imposed on them. ICRG based measures are therefore more comprehensive in measuring the 'institutional environment', and are preferred in this study.

The sample constitutes a total of 416 observations which entail 108 county-periods for state ownership with control (S_c from here on), 204 country-periods for state ownership without control (S_{wc} from here on) and 104 country-periods for private ownership (P from here on). Private ownership here only shows the effect of private foreign ownership, as there are no observations for private domestic ownership in the sample[10]. I set S_c as the base category and evaluate the effect of S_{wc} and P in reference to that. Thus, the coefficient β_2 (or $\beta_2/100$ to be precise) in equation (1) gives the marginal growth effect of oil abundance under S_c. β_4 indicates whether alternate ownership structures lead to higher (i.e. positive coefficient) or lower (i.e. negative coefficient) growth. The marginal growth effect of oil abundance under alternate ownership structures is given by $[(\beta_2 + \beta_4)/100]$.

3.2. Results

Table 1 shows the estimation results. I start with the parsimonious specification and include only oil abundance and its interaction with ownership[11]. The results are presented in column (1). The effect of oil abundance under S_c is significant and negative, while the differential effect under P is significantly positive followed by S_{wc}. I sequentially add covariates such as time dummies, openness, and *IQ* to the baseline estimation. The results are shown in column (2), (3) and (4) of Table 1. The inclusion of *IQ* results in the loss of two countries and 26 observations from the sample. The results for the main coefficients of interest remain consistent – S_c, holding all the other variables constant, has a significantly negative effect, while the differential effects of both S_{wc} and P are significantly positive[12].

Table 1: Effect of oil abundance on growth under different ownership structures

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Oil	-18.39***	-15.76***	-22.16***	-19.05***	-31.13***	-53.69**
	(2.420)	(2.782)	(4.189)	(5.009)	(8.187)	(20.82)
Oil*S_{wc}	25.84***	22.68***	25.26***	20.02***	16.23***	31.55**
	(3.793)	(4.663)	(5.140)	(5.812)	(4.324)	(10.88)
Oil*P	38.97***	35.25***	37.77***	22.01***	35.26***	56.42**
	(4.137)	(4.233)	(3.733)	(6.221)	(11.57)	(24.51)
Openness			4.876*	2.488	17.83**	14.68
			(2.692)	(2.428)	(7.614)	(11.04)
IQ				-6.887	6.968	3.582
				(5.344)	(8.974)	(10.86)
Enrollment					-0.0211	-0.103
					(0.0746)	(0.0841)
Investment						4.524
						(2.926)
Constant	7.338***	7.334**	-9.679	5.725	-62.37*	-44.03
	(1.686)	(3.445)	(10.57)	(8.318)	(32.76)	(49.69)
Observations	358	358	358	332	225	185
R-square within	0.100	0.188	0.194	0.159	0.295	0.329
Number of countries	20	20	20	18	17	15
Time dummies	No	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is growth rate of PPP adjusted real GDP per capita. S_c is the base outcome. S_{wc} and P dummies are included in the model estimation (results not reported). Robust (country-clustered) standard errors are given in parentheses. *, **, *** indicate that the estimates are statistically significant at 10, 5 and 1 percent levels respectively.

In the subsequent columns, I add the remaining covariates, that is, secondary school enrollment rate and investment – which results in the loss of three more countries and 147 observations from the sample. The results show that oil abundance still has a significantly negative effect under S_c. The magnitude of the negative effect, in fact, increases. The differential effects of S_{wc} and P continue to be significantly positive. In the full model (column 6), 1% increase in the share of oil production to GDP leads to a 0.5% decrease in growth rate under S_c; but the growth rates under S_{wc} and P (as compared to S_c) are 0.3% and 0.6% higher respectively. There is no clear connection between growth and other covariates in the sample. None of the covariates are significant in the presence of the oil variable[13].

I now test whether the three variables – oil abundance without and with interaction – are jointly significant. Joint significance is confirmed at the 1% level of significance in all specifications except one (i.e. column 6) in which it is confirmed at the 10% level of significance.

The results could be driven by influential observations, that is, observations with high residuals and high leverage. To check for this, I use the DFITS index and exclude observations with the index value larger than the absolute value of 2(*k*/*n*)^(1/2)(where k is the number of independent variables including the constant and n is the number of observations)(Belsley, Kuh and Welsch 1980:28)[14]. The results remain robust in terms of the sign and significance of the coefficients (see Table A.1. in appendix)[15]. I also estimate the model using oil production per capita as a measure of oil abundance instead of oil production to GDP. The results mostly remain consistent (see Table A.2. in appendix).

The results could be subject to some concerns due to the presence of *IQ* in the model. *IQ* could be endogenous to oil abundance as measured by the share of oil production in GDP – oil production could have an effect on institutional quality which in turn affects growth. In this case, the main coefficients of interest – oil abundance and its interaction with ownership – would capture a part of the effect of institutional quality. The *IQ* variable could also be subject to a typical measurement error problem. In reality, we do not observe the quality of institutions directly and it is possible that the proxy measure only captures a part of the true institutional quality, leading to endogeneity concerns (see Hall and Jones 1999; Acemoglu et al 2001).

One way to address these concerns is to use instruments for institutional quality. The literature offers various instruments that could be used (see Mauro 1995; Hall and Jones 1999; Acemoglu et al 2001; Acemoglu et al 2002); however, these are time invariant and cannot be used in a fixed-effects estimation model. The common practice in the literature is to use a cross-sectional or a pooled OLS estimation, and then use instruments for the institutional variable (e.g., Boschini et al 2013). However, doing so will lead to biased estimates for the main

coefficients of interest, as both oil abundance and ownership could be correlated to time invariant variables such as geography, history, culture etc. – country's geography, for instance, could determine the level of investments and the type of technologies that is needed to develop oil fields and, hence, could affect the choice of ownership as well as the level of oil production. I, therefore, resort to other measures to address the concerns related to *IQ*.

First, I look at the correlation between *IQ*, oil abundance, and ownership. Oil abundance and ownership dummies are only modestly correlated with *IQ* suggesting that multi-collinearity is not a major concern in the sample (see Table 2). The variance inflation factor for the *IQ* variable is also low – estimated at 6.72 for the model given in column (6) of Table 1.

Second, I use constraints on executive for measuring institutional quality, as it reflects durable constraints which are less likely to be endogenous to oil production. The results mostly remain robust; but in the model which includes all the covariates, the main coefficients of interest become insignificant. This, however, results due to the elimination of countries from the sample and the shrinking of sample size (see Table A.3 in appendix). I also use another commonly adopted measure of institutional quality – the polity variable of the Polity IV database – for robustness check. The results remain consistent; although in the full model, the main coefficients of interest either assume significance at the lower levels or become insignificant due to decrease in the number of observations (see Table A.4 in appendix).

As a check for the endogeneity of *IQ* due to the measurement error problem, I use a pooled OLS (with time effects) estimation method and conduct a regression-based Hausman test using latitude (see Acemoglu et al 2001) and population density (see Acemoglu et al 2002) as instruments[16]. The test fails to reject the null hypothesis that the *IQ* variable is exogenous. Given that the endogeneity of *IQ* is not a concern in the pooled OLS specification, it is unlikely to be a concern in the fixed-effects estimation model.

Table 2: Correlation matrix

	IQ	Oil	S_c	S_{wc}	P	Openness	Enrollment
IQ	1						
Oil	**-0.26***	1					
S_c	**-0.15***	**0.15***	1				
S_{wc}	**0.29***	-0.07	**-0.58***	1			
P	**-0.19***	-0.07	**-0.34***	**-0.56***	1		
Openness	-0.01	**0.69***	0.02	0.08	**-0.12**	1	
Enrollment	**0.50***	-0.04	**0.11**	**0.24***	**-0.41***	**0.18***	1
Investment	**0.24***	-0.14	**-0.21***	**-0.23***	**0.44***	0.07	0.01

Note: * denotes significance at 1% level. Figures in bold denote significance at least at 10% level.

I now test whether the results are robust to the inclusion of other covariates. I control for population growth rate, oil price shocks as measured by terms of trade changes, and conflicts. The rationale for including conflicts is that it could be correlated to both oil production and growth. However, it is not just the presence but also the perception of violence or anticipation of conflicts that can deter investments and, in turn, reduce oil production and growth. I, therefore, use the measure of conflict available from the ICRG database. It is a perception-based measure which assesses political violence in the country. The highest rating is given when there is no armed or civil opposition to the government, and the lowest rating is given when there is an ongoing civil war in the country.

The results are presented in Table 3. Column (1) reproduces the results of column (6) from Table 1. The additional control variables are added sequentially in column (2), (3), and (4). Population growth rate is significantly and positively associated with growth although the coefficient loses significance in the full model (i.e. column 4). The coefficients for conflict and terms of trade are insignificant albeit of the expected sign. The sign and significance of the main coefficients of interest remain unaffected by the inclusion of these variables[17].

Table 3: Effect of oil abundance on growth under different ownership structures

Variables	(1)	(2)	(3)	(4)
Oil	-53.69**	-48.64**	-49.50**	-46.00**
	(20.82)	(17.15)	(17.00)	(20.67)
Oil*S_{wc}	31.55**	32.57***	33.27***	30.05***
	(10.88)	(8.334)	(8.716)	(9.811)
Oil*P	56.42**	50.33**	52.24**	52.93*
	(24.51)	(21.38)	(20.91)	(29.83)
Openness	14.68	15.98	15.83	19.38
	(11.04)	(11.39)	(11.69)	(17.10)
IQ	3.582	7.483	6.201	10.22
	(10.86)	(10.63)	(13.37)	(19.29)
Enrollment	-0.103	-0.0149	-0.0179	0.0835
	(0.0841)	(0.0660)	(0.0671)	(0.148)
Investment	4.524	3.488	3.676	3.468
	(2.926)	(2.862)	(2.662)	(3.500)
Population growth		0.509***	0.502***	0.179
		(0.0868)	(0.0920)	(1.969)
Conflict			0.143	0.126
			(0.333)	(0.412)
Terms of trade				0.0338
				(0.0380)
Constant	-44.03	-56.98	-57.05	-86.60
	(49.69)	(50.62)	(50.91)	(84.03)
Observations	185	179	179	144
R-square within	0.329	0.379	0.380	0.316
Number of countries	15	15	15	15
Time dummies	Yes	Yes	Yes	Yes

Notes: The dependent variable is growth rate of PPP adjusted real GDP per capita. S_c is the base outcome. S_{wc} and P dummies are included in the model estimation (results not reported). Huber-White robust standard errors are given in parentheses. *, **, *** indicate that the estimates are statistically significant at 10, 5 and 1 percent levels respectively.

To sum up, the results so far suggest that the effect of oil abundance on economic growth varies with ownership structures. The marginal growth effect of oil abundance under S_c is negative, while the differential effect of P is positive followed by S_{wc}. In the subsequent section, I delve into the marginal growth effect of oil abundance under S_{wc} and P and its significance, and test whether the ownership-growth nexus is influenced by the quality of institutions.

3.3. Does institutional quality matter?

To investigate the effect of institutional quality, I modify the model given in equation (1) to include a three-way interaction between oil abundance, ownership, and *IQ*. The model that is now estimated is given as follows:

$$G_{it} = \beta_1 + \beta_2 oil + \beta_3 S_{wc} + \beta_4 P + \beta_5 (oil * S_{wc}) + \beta_6 (oil * P) + \beta_7 (S_{wc} * IQ) + \beta_8 (P * IQ) +$$
$$+ \beta_9 (oil * IQ) + \beta_{10} (oil * S_{wc} * IQ) + \beta_{11} (oil * P * IQ) + \beta_{12} x' + \propto + \epsilon \qquad (2)$$

I omit the time and country subscripts from equation (2) for simplicity. x includes *IQ*, other covariates from equation (1), and also population growth rate, conflicts, and terms of trade changes. The marginal growth effect of oil abundance under different ownership structures is given in Table 4[18].

Table 4: Marginal growth effect of oil abundance

	Marginal effect
S_c	$\beta_2 + \beta_9 IQ$
S_{wc}	$\beta_2 + \beta_5 + (\beta_9 + \beta_{10}) IQ$
P	$\beta_2 + \beta_6 + (\beta_9 + \beta_{11}) IQ$

The results are presented in Table 5. The first column reproduces the results from column (4) of Table 2. The second column presents the results from including the three-way interaction in the model. The results show that the estimated coefficient for β_2 is significantly negative while that of β_9 is significantly positive. The positive coefficient for β_9 implies that as the value of *IQ* increases, the negative growth effect of oil abundance under S_c reduces. What is interesting here is that the estimated value of β_9 is not only positive, but is also greater than the estimated absolute value of β_2. This means that not only the negative effect under S_c reduces as the value of *IQ* increases, but also turns positive at a high enough value of *IQ*.

Table 5: Effect of institutional quality on the ownership-growth nexus

Variables	(1)	(2)
Oil	-46.00**	-146.6***
	(20.67)	(36.49)
Oil*S_{wc}	30.05***	122.9**
	(9.811)	(48.96)
Oil*P	52.93*	186.0***
	(29.83)	(32.69)
Openness	19.38	6.147
	(17.10)	(9.646)
IQ	10.22	-215.6**
	(19.29)	(79.07)
Enrollment	0.0835	-0.0209
	(0.148)	(0.117)
Investment	3.468	2.306
	(3.500)	(3.357)
Population growth	0.179	-0.538
	(1.969)	(1.832)
Conflict	0.126	0.201
	(0.412)	(0.472)
Terms of trade	0.0338	0.0383
	(0.0380)	(0.0332)
Oil*IQ		309.2***
		(78.33)
Oil*S_{wc}*IQ		-260.2**
		(96.73)
Oil*P*IQ		-399.0***
		(79.75)
Constant	-86.60	31.77
	(84.03)	(69.70)
Observations	144	144
R-square within	0.316	0.442
Number of countries	15	15
Time dummies	Yes	Yes

Notes: The dependent variable is growth rate of PPP adjusted real GDP per capita. S_c is the base outcome. S_{wc} and P dummies and their interaction with IQ are included in the model estimation (results not reported). Huber-white robust standard errors are given in parentheses. *, **, *** indicate that the estimates are statistically significant at 10, 5 and 1 percent levels respectively.

The marginal growth effect of oil abundance under S_{wc} is negative when the value of *IQ* is zero. However, the effect is still less negative as compared to $S_{c,}$ given that the estimated value

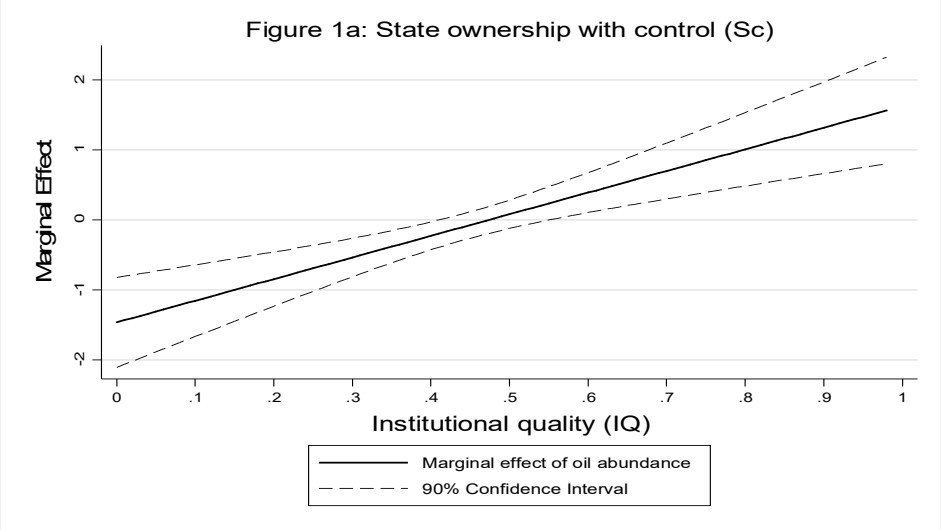
of β_5 is positive. The negative effect under S_{wc} also decreases as the value of *IQ* increases. Here also the negative effect turns positive at a high enough level of IQ, as the estimated value of $\beta_9 + \beta_{10}$ is greater than the estimated absolute value of $\beta_2 + \beta_5$.

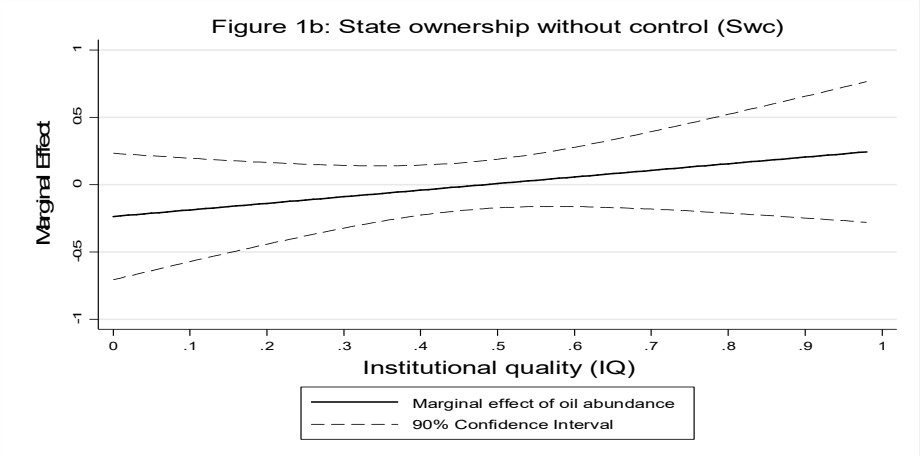
In the case of *P*, the marginal growth effect of oil abundance is positive when the value of *IQ* is zero, given that the estimated sum of β_2 and β_6 is positive. The positive effect reduces as the value of *IQ* increases. Interestingly, the effect eventually turns negative given that the estimated absolute value of $\beta_9 + \beta_{11}$ is greater than the estimated value of $\beta_2 + \beta_6$.

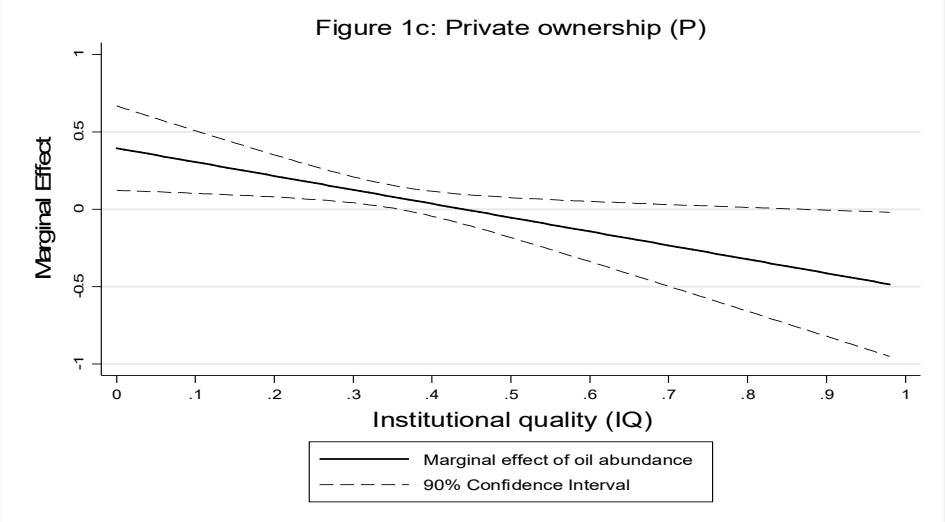
The institutional thresholds at which the negative growth effect under S_c and S_{wc} get reversed are 0.47 and 0.48 respectively[19]. The institutional threshold above which the positive growth effect under *P* turns negative is 0.44[20]. To get better clarity on the marginal effects and their significance, I use the relevant coefficients to calculate the marginal growth effect under different ownership structures across different levels of institutional quality. I also use the variance and covariance of relevant coefficients to generate the coefficient bands. The solid sloping line in Figure 1a, 1b, and 1c shows how the marginal growth effect of oil abundance changes with the increase in the value of IQ. 90% confidence intervals around the line allow us to determine whether oil abundance has a statistically significant effect on economic growth – it has a statistically significant effect whenever the upper and lower bounds of the confidence interval are in the same direction.

Figure 1a shows that the marginal growth effect under S_c is significantly negative until the *IQ* value of 0.41, and becomes significantly positive above the *IQ* value of 0.55. The marginal growth effect under S_{wc}, although improving with every unit increase in the value of *IQ*, is not significant at any level of *IQ* (see Figure 1b). The marginal growth effect under *P* is significantly positive until the *IQ* value of 0.35 and becomes significantly negative above the *IQ* value of 0.86 (see Figure 1c). Thus, while S_{wc} has no significant effect on growth, the results for S_c and *P* are consistent with the hypothesis.

Figure 1: Effect of oil abundance on growth across different levels of institutional quality







The results suggest that, to avoid the oil curse, countries with strong institutions (i.e. with the *IQ* value greater than 0.55) should choose state ownership and control, while countries with weak institutions (i.e. with the *IQ* value less than 0.36) should choose private ownership. The results contrast the claim of Mehlum et al (2006) and Boschini et al (2007) that institutions alone are decisive for the resource (or minerals) curse. As we see here, the choice of ownership structure also plays a decisive role; oil-exporting countries, even the ones with weak institutions, can avoid the curse by choosing an appropriate ownership structure.

To put the results into perspective, I list the countries from the sample that have adopted state ownership with control and private ownership during the time period analyzed, and the corresponding institutional quality (see Table 6). Countries that fall within the region of significance (in Figure 1) are marked with an asterisk. The results suggest that Saudi Arabia – with the *IQ* value greater than 0.55 – benefits from retaining state ownership and control. Other countries such as Iraq, Nigeria, Iran, and Venezuela (2001-2005) – with the IQ value less than 0.36 – would have witnessed higher growth by choosing private ownership. In Iraq, for instance, every percent increase in oil production to GDP reduced the growth by 0.9% during 1984-2005. However, if it would have adopted private ownership, a percent increase in oil production to GDP would have increased the growth by 0.2%. Similarly, in Nigeria, under private ownership, every percent increase in oil production to GDP would have contributed to 0.2% increase in growth. This stands in contrast to the 0.7% decrease that it witnessed under state ownership with control during 1984-1990.

4. Concluding remarks

Many countries in Africa such as Kenya, Tanzania, Uganda, and Mozambique have recently discovered large amounts of oil, and are expected to soon become the major oil-exporting countries of the continent. The sentiment in these countries with regard to oil discoveries and expected revenues is euphoric. However, skeptics believe that these countries would not be

Table 6: Ownership structures and institutional quality

Ownership	Institutional quality
State ownership with control (S_c)	
Ecuador (1990-2005)	0.50
Iran (1984-1986)	0.33*
Iraq (1984-2005)	0.18*
Kuwait (1984-2005)	0.55
Nigeria (1984-1990)	0.25*
Saudi Arabia (1984-2005)	0.58*
Venezuela (1984-1994)	0.52
Venezuela (2001-2005)	0.29*
Private ownership (P)	
Cameroon (1984-2005)	0.45
Equatorial Guinea (1984-2005)	-- @
Gabon (1984-2005)	0.41
Congo, Republic of (1984-2005)	0.36
Yemen (1990-2005)	0.43

*Countries that fall within the region of significance in Figure 1.

@ Data are not available

able to escape the oil curse unless they strengthen their institutions (e.g., Ross Olanya 2012, Manyak 2015). This belief stems from the existing knowledge that institutional quality alone is decisive for the resource curse and that countries with weak institutions always witness lower growth from their resource wealth. This article shows that, for oil-exporting countries, the choice of ownership structure in the oil sector also plays a decisive role. The results suggest that in countries with weak institutions, if state leaders choose their ownership and control in the oil sector, then the way to escape the curse is indeed by strengthening institutions before developing oil; on the other hand, if state leaders transfer ownership to foreign oil companies, then they can witness higher growth despite the presence of weak institutions.

This paper focuses on economic growth as the outcome variable, which is only a subset of the overall well-being and development of the country. It is therefore important to also analyze the effect of different ownership structures on human welfare, environment, local communities, and political and institutional dynamics within the country. These are important areas for future research.

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Notes

1. The transfer of ownership is mainly done through the signing of concessionary contracts between the state and private companies. These contracts give private companies the exclusive right to explore and produce oil over a tract of land for a limited number of years (generally 20-40 years). In return, these companies pay royalty and taxes to the state.

2. Under these contracts, foreign oil companies explore and produce oil on behalf of the state and, in return, receive a share of the oil produced as payment.

3. Brunnschweiler and Valente (2013) use the term ‘control rights’ instead of ‘ownership’ but conceptually it implies the same.

4. These include Azerbaijan, Kazakhstan, Russia, Turkmenistan, and Uzbekistan.

5. Interviews conducted by Pauline Jones Luong and Erika Weinthal with oil companies and other stakeholders in Russia (see Jones Luong and Weinthal 2010: 173-175)

6. This argument is consistent with the research of Alesina et al (2008), who find that citizens/voters demand higher spending from the state during booms when they see corruption in the political system.

7. Modern oil contracts do contain “stability” and “international arbitration” clauses to protect private companies against expropriation (Smith and Dzienkowski 1989). However, these clauses are hardly effective in limiting the state (Brunnschweiler and Valente 2013).

8. This method of measuring *IQ* is similar to the method used in previous studies (see Mehlum et al 2006a; Boschini et al 2007) and is drawn from Keefer and Knack (2002).

9. The conceptualization of institutions as durable constraints on human behavior comes from the work of North (1981), Rodrik et al (2004), and Easterly and Levine (2003).

10. Among private players, foreign oil companies assume a dominant role in the oil sector of developing countries. The presence of private domestic companies has been quite rare. Over the course of the 20th century, only four developing countries have adopted private domestic ownership: Brazil (1891-1937), Venezuela (1904-1906), Romania (1924-1944), and Guatemala (1949-1982). In the more recent time period, only Russia adopted private domestic ownership from 1993 to 2004 (Jones Luong and Weinthal 2010).

11. S_{wc} and *P* dummies are included in the model estimation, but the results are not shown for simplicity. Also, during 1984-2005, most of the variation in the dummy variable *P* is cross-sectional rather than over time. Hence, it is not possible to get the estimates for *P* in a fixed-effects estimation model.

12. I also estimate the model using the individual components of the IQ measure. The results (not reported) do not differ across the four variables.

13. In the model given in Table-1, robust clustered errors at the panel (i.e. country) level are used to deal with the problem of serial correlation {present in specifications (2)-(5)} along with heteroskedasticity. The model, however, does not have a large number of clusters. This could create a downward bias in the estimated standard errors. Cameroon and Miller (2013) suggests that one can reduce the downward bias by scaling the residuals by $\sqrt{c}$ (where $c = \frac{G}{G-1} * \frac{N-1}{N-k}$; G is the number of clusters, N is the number of observations, and k is the number of regressors) and using critical values from T distribution with degrees of freedom equal to $G - 1$. STATA already makes small-cluster adjustments in residuals; but the xtreg command (as used in the model estimation) continues to use standard normal critical values. I, therefore, also estimate the model using T $(G - 1)$ critical values. The results (not reported) remain consistent.

14. $\mathrm{DFITS_i} = \mathrm{r_i}\sqrt{\mathrm{h_i}/(1-\mathrm{h_i})}$; where $\mathrm{r_i}$ are the studentized residuals, and $\mathrm{h_i}$ is the leverage.

15. I also test the robustness of results by increasing the lag size of explanatory variables. The results (not reported) for the main coefficients of interest remain robust up to the lag size of three years. Beyond that, the sample size becomes too small to draw meaningful inferences – particularly when covariates such as *IQ,* enrollment and investment are added to the model.

16. The structural model is $\mathrm{G_{it}} = \beta_1 + \beta_2\mathrm{oil_{it}} + \beta_3\mathrm{os_{it}} + \beta_4(\mathrm{oil_{it}os_{it}}) + \beta_5\mathrm{IQ_{it}} + \beta_6\mathrm{x'_{it}} + \mathrm{w_{it}}$, where $\mathrm{x'}$ is now the vector of covariates which includes time dummies, openness, enrollment and investment. I suspect IQ to be endogenous. I run the first stage reduced form regression, $\mathrm{IQ_{it}} = \beta_1 + \beta_2\mathrm{oil_{it}} + \beta_3\mathrm{os_{it}} + \beta_4(\mathrm{oil_{it}os_{it}}) + \beta_5\mathrm{Z'_{it}} + \beta_6\mathrm{x'_{it}} + \mathrm{v_{it}}$, where $\mathrm{Z'}$ is the set of instruments. Then, I include least square residuals i.e. $\tilde{\mathrm{v}}_{\mathrm{it}}$ in the structural equation, and conduct a standard t test of significance for $\tilde{\mathrm{v}}_{\mathrm{it}}$.

17. The results also remain robust to controlling for foreign direct investment and inflation (results not reported). Note that the model does not control for technologies available for oil extraction – which is an important determinant of the choice of ownership – due to difficulties in observing the variable. This, however, does not bias the results as oil-extraction technologies are unlikely to have any direct effect on economic growth; they are likely to affect growth only through their effect on the choice of ownership and the level of oil production. This is particularly true given that oil extraction takes place in an economic enclave and does not have linkages with the rest of the economy (which otherwise could have affected economic growth directly through, for instance, technical spillovers) (see Ross 2012: 44-45).

18. The estimated coefficients need to be scaled by 100 to get their precise effect on growth.

19 The threshold for S_c is given by β_2/β_9 and that for S_{wc} is given by $(\beta_2 + \beta_5)/(\beta_9 + \beta_{10})$.

20. The threshold for P is given by $(\beta_2 + \beta_6)/(\beta_9 + \beta_{11})$.

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Appendix

Countries in the sample*

Angola	Gabon	Qatar
Brunei	Iran	Republic of the Congo
Cameroon	Iraq	Saudi Arabia
East Timor	Kuwait	United Arab Emirates
Ecuador	Libya	Venezuela
Egypt	Nigeria	Yemen
Equatorial Guinea	Oman	

*The period of analysis for all countries is 1984-2005 except for East Timor (2002-2005) and Yemen (1990-2005).

Data and sources

Growth: growth rate of PPP adjusted GDP per capita (chain series) at 2005 constant prices (annual %). The growth rates are computed from the rgdpch variable (i.e. the PPP converted GDP per capita at 2005 constant prices) available from Heston et al (2012). For China, version 2 is used. The formula used for computing growth rate is $G_{it} = \{(rgdpch_t - rgdpch_{t-1}) * 100/rgdpch_{t-1}\}$

Oil: natural log (*log)* of oil production to GDP. Source: oil production (in metric tonnes) is obtained from Ross (2013). GDP (in constant 2005 US$) is available from the World Development Indicators, World Bank.

Ownership structure: 0-1 dummy for three types of ownership structures: state ownership with control (S_c), state ownership without control (S_{wc}) and private ownership (P). The criteria used for coding is as follows: S_c: the state holds the rights to develop majority of oil deposits and hold majority of shares (i.e. >50%) in the oil sector. Foreign involvement is limited either to operating as service subcontractors or participating in other forms that restrict managerial and operational control; S_{wc}: the state holds the rights to develop majority of oil deposits and hold majority of shares in the oil sector. Foreign investors are allowed to participate in contracts which grant

them considerable managerial and operational control (for instance, in production sharing contracts); *P*: private companies hold the rights to develop majority of oil deposits and hold majority of shares in the oil sector. Source: Jones Luong and Weinthal (2010). Note that Jones Luong and Weinthal distinguish between private domestic ownership (wherein private domestic companies assume ownership) and private foreign ownership (wherein foreign oil companies assume ownership). In this study, *P* only shows the effect of private foreign ownership, as there are no observations for private domestic ownership in the sample.

Openness: (*log*) ratio of imports plus exports divided by GDP (at 2005 constant prices). Source: Heston et al (2012). China version 2 is used.

Institutional quality (IQ): the IQ index is constructed from the four indices available from the International Country Risk Guide (ICRG) database: 1) corruption: it is an assessment of corruption within the political system. It is measured on a 6 point scale, with 0 indicating higher risk from corruption and 6 indicating lower risk, 2) law and order: it is an assessment of strength and impartiality of legal system and popular observance of the law. It is measured on a 6 point scale, with higher score indicating low risk, 3) bureaucratic quality: it is an assessment of the institutional strength and quality of the bureaucracy. It is measured on a 4 point scale, with higher score indicating low risk, 4) investment profile: it is a sum of risk ratings assigned to three variables: contract viability/expropriation, profits repatriation, and payment delays. It is measured on a 12 point scale, with higher score indicating lower risk. I first normalize the four indices to 0-1 scale, and then calculate their unweighted average.

Enrollment: gross secondary school enrollment rate (in %). Source: World Development Indicators, World Bank

Investment: (*log*) share of gross fixed capital formation to GDP (in %). Source: World Development Indicators, World Bank

Oilpc: (*log*) ratio of oil production to population. Source: oil production (in metric tonnes) is obtained from Ross (2013). Population (in thousands) is obtained from Heston et al (2012); for China, version 2 is used.

Executive constraints: it measures the extent of institutionalized constraints on the decision making power of chief executive. It is concerned with the checks and balances between the various parts of the decision making process. The measure ranges from 1 (unlimited authority) to 7 (executive parity or subordination). I have purged out the periods of foreign interruptions, transitions, interregnum or anarchy (with scores -66, -77, -88) from the sample (i.e. declared it as missing data), and have normalized the variable to 0-1 scale. Source: Polity IV database, Marshall et al 2014.

Polity: it is computed by subtracting autocracy score from democracy score and ranges from 10 (strongly democratic) to -10 (strongly autocratic). The instances of 'standardized authority scores' (i.e. -66,-77,-88) are converted to conventional polity scores (i.e. within the range -10 to +10) by applying simple treatment or 'fix'. I use the normalized (to 0-1 scale) variable for the estimation. Source: Polity IV database, Marshall et al 2014.

Population growth: population growth rate (annual %). It is computed from population data available from Heston et al (2012) (i.e. the *pop* variable). For China, version 2 is used. The formula used for computation is as follows: $\{(pop_t - pop_{t-1}) * 100/pop_{t-1}\}$

Conflict: It is an assessment of political violence in the country and its actual and potential impact on governance. The highest rating (i.e.12) is given when there is no armed or civil opposition to the government and when the government does not engage in arbitrary violence against its people. The lowest rating (i.e. 0) is given when there is an ongoing civil war. The risk ratings assigned is a sum of three subcomponents with a maximum score of 4 points and a minimum score of 0 points: civil war/coup threat, terrorism/political violence and civil disorder. Source: International Country Risk Guide (ICRG)

Terms of trade: It is calculated as the percentage ratio of the export unit value indexes to the import unit value indexes measured relative to the base year 2000. Source: World Development Indicators, World Bank.

Descriptive statistics

Variable	N	Mean	Std. Dev.	Std.Dev. within	Min	Max
Growth	388	2.14	12.68	11.87	-64.41	115.4
Oil	382	0.83	0.32	0.22	0	2.36
Openness	408	4.29	0.44	0.26	2.17	5.86
IQ	387	0.47	0.16	0.09	0	0.92
Enrollment	272	58.8	25.17	10.75	11.05	114.87
Investment	335	3.01	0.58	0.27	1.07	5.39
Oilpc	416	8.45	2.03	1.13	0	11.1
Executive constraints	378	0.26	0.28	0.11	0	1
Polity	390	0.27	0.28	0.11	0	0.95
Population growth	398	2.87	3.94	3.84	-55.85	49.08
Conflict	387	8.15	2.67	2.03	1.17	12
Terms of trade	258	98.07	34	28.02	31.6	282.4

Table A.1: Effect of oil abundance on growth under different ownership structures (excluding outliers)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Oil	-16.72***	-14.30***	-15.74***	-14.64***	-21.91***	-57.09***
	(2.180)	(3.618)	(5.136)	(4.484)	(3.970)	(12.86)
Oil*S_{wc}	18.50***	19.75***	15.72***	15.59***	19.53***	42.87***
	(3.626)	(5.167)	(4.196)	(4.830)	(4.060)	(8.915)
Oil*P	33.97***	30.92***	29.52***	16.57**	17.11**	51.60***
	(4.045)	(5.532)	(4.015)	(5.784)	(6.944)	(12.70)
Openness			5.803	1.203	6.983	6.487
			(3.865)	(2.904)	(5.350)	(6.523)
IQ				-7.767**	1.062	-0.898
				(3.547)	(4.505)	(3.797)
Enrollment					0.0340	-0.0595*
					(0.0344)	(0.0332)
Investment						2.165
						(2.536)
Constant	6.325***	7.712***	-16.26	8.945	-20.01	1.279
	(1.495)	(2.302)	(13.90)	(10.69)	(22.48)	(22.53)
Observations	338	337	337	316	207	168
R-square within	0.175	0.314	0.323	0.260	0.380	0.445
Number of countries	20	20	20	18	16	14
Time dummies	No	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is growth rate of PPP adjusted real GDP per capita. S_c is the base outcome. S_{wc} and P dummies are included in the model estimation (results not reported). Outliers are excluded using the DFITS index. Robust (country-clustered) standard errors are given in parentheses. *, **, *** indicate that the estimates are statistically significant at 10, 5 and 1 percent levels respectively.

Table A.2: Effect of oil abundance on growth under different ownership structures (using oil production per capita)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Oilpc	-9.803**	-8.833**	-10.25*	-14.48**	-18.90***	-25.57**
	(4.105)	(3.864)	(5.321)	(5.144)	(4.352)	(10.52)
Oilpc*S_{wc}	10.20**	9.165*	9.934*	4.899	3.243	4.715
	(4.499)	(4.392)	(5.371)	(3.643)	(2.916)	(5.003)
Oilpc*P	12.70***	11.50***	12.51**	13.47**	20.21***	25.14*
	(4.108)	(3.827)	(5.015)	(5.118)	(6.602)	(12.02)
Openness			3.342	5.903	17.92***	14.67
			(2.649)	(3.535)	(6.020)	(9.353)
IQ				-3.920	11.43*	8.650
				(5.665)	(5.995)	(8.772)
Enrollment					-0.0736	-0.128
					(0.0748)	(0.0849)
Investment						3.410
						(2.413)
Constant	54.82**	51.52**	46.57*	78.72***	51.59***	88.51*
	(24.17)	(22.84)	(24.00)	(19.39)	(14.09)	(47.28)
Observations	386	386	386	360	240	185
R-square within	0.102	0.188	0.191	0.182	0.305	0.377
Number of countries	20	20	20	18	17	15
Time dummies	No	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is growth rate of PPP adjusted real GDP per capita. S_c is the base outcome. S_{wc} and P dummies are included in the model estimation (results not reported). Huber-White robust standard errors are given in parentheses. *, **, *** indicate that the estimates are statistically significant at 10, 5 and 1 percent levels respectively. The estimated coefficient for Oilpc*S_{wc} becomes insignificant from model (4) onwards due to the elimination of countries from the sample and the shrinking of sample size.

Table A.3: Effect of oil abundance on growth under different ownership structures (using constraints on executive)

Variables	(1)	(2)	(3)	(4)
Oil	-22.16***	-18.72***	-21.13***	-23.63
	(4.189)	(4.947)	(5.449)	(19.16)
Oil* S_{wc}	25.26***	22.98***	21.39***	24.51
	(5.140)	(4.528)	(4.621)	(18.56)
Oil*P	37.77***	35.84***	31.56***	32.86
	(3.733)	(3.827)	(7.674)	(20.11)
Openness	4.876*	2.804	12.52**	10.21*
	(2.692)	(4.080)	(4.321)	(5.637)
Executive constraints		4.753	1.930	1.248
		(3.664)	(3.599)	(6.551)
Enrollment			-0.00119	-0.0683
			(0.0626)	(0.0824)
Investment				0.776
				(4.585)
Constant	-9.679	-3.761	-42.56**	-29.42
	(10.57)	(16.02)	(16.75)	(29.91)
Observations	358	323	217	179
R-square within	0.194	0.203	0.263	0.310
Number of countries	20	19	18	16
Time dummies	Yes	Yes	Yes	Yes

Notes: The dependent variable is growth rate of PPP adjusted real GDP per capita. S_c is the base outcome. S_{wc} and P dummies are included in the model estimation (results not reported). Robust (country-clustered) standard errors are given in parentheses. *, **, *** indicate that the estimates are statistically significant at 10, 5 and 1 percent levels respectively. The main coefficients of interest become insignificant in model (4) due to the shrinking of sample size.

Table A.4: Effect of oil abundance on growth under different ownership structures (using polity)

Variables	(1)	(2)	(3)	(4)
Oil	-22.16***	-19.88***	-21.34***	-24.33
	(4.189)	(4.728)	(5.499)	(15.40)
Oil*S_{wc}	25.26***	23.67***	21.16***	25.77*
	(5.140)	(4.498)	(4.804)	(14.37)
Oil*P	37.77***	36.97***	31.45***	32.95*
	(3.733)	(3.808)	(7.577)	(16.41)
Openness	4.876*	3.245	12.21**	8.283
	(2.692)	(3.848)	(4.458)	(6.802)
Polity		6.590	3.921	3.806
		(3.857)	(3.617)	(4.653)
Enrollment			-0.00507	-0.0813
			(0.0668)	(0.0862)
Investment				3.427
				(4.042)
Constant	-9.679	-5.906	-41.41**	-28.80
	(10.57)	(15.19)	(18.29)	(30.80)
Observations	358	335	220	182
R-square within	0.194	0.197	0.256	0.312
Number of countries	20	19	18	16
Time dummies	Yes	Yes	Yes	Yes

Notes: The dependent variable is growth rate of PPP adjusted real GDP per capita. S_c is the base outcome. S_{wc} and P dummies are included in the model estimation (results not reported). Robust (country-clustered) standard errors are given in parentheses. *, **, *** indicates that the estimates are statistically significant at 10, 5 and 1 percent levels respectively. In model (4), the estimated coefficient for the oil variable becomes insignificant and other coefficients of interest assume significance at lower levels due to decrease in the sample size.