Oil, Taxation and Transparency*

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Abstract

Evidence suggests that petroleum wealth is strongly associated with reduced government transparency. But the reason why this happens remains poorly understood. The attached article proposes a theory that explains this. In it public officials make trade-offs between improved tax compliance, which requires greater transparency, and gains from corruption, which are aided by reduced transparency. Oil windfalls diminish the government's need for tax revenue and hence tax compliance, causing public officials to choose less transparency. Our empirical analysis of oil wealth and taxation in a panel of countries over 30 years is consistent with the model's deep structure and its implications.

Keywords: resource curse, transparency, taxation, public goods, oil
JEL codes: H1, P26, O13, O17

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1 Introduction

Natural resource wealth has been linked to a wide range of adverse economic and political outcomes[1], particularly when institutional quality is low (Mehlum, Moene, and Torvik 2006). But can resource wealth itself influence the quality of the institutions in the first place? We address this question by focusing on government transparency. The relationship between resource wealth and government transparency, however, remains both highly salient and poorly-understood. Academic studies suggest that petroleum wealth is associated with reduced transparency, meaning fewer public disclosures about government policies, institutions, and activities (Egorov, et. al.2009, Ross 2011, Williams 2011)[2] (see figure 1). In the policy world several international initiatives are based on the belief that heightened transparency can improve the governance of resource wealth and avert a "resource curse."[3] It is not well-established, however, why resource wealth might reduce transparency, and the conditions under which this relationship is observed.

We seek to bring clarity to this issue with a formal model focused on the link between oil revenues and transparency. In it public officials make trade-offs between improved tax compliance, which requires greater transparency, and gains from corruption, which are aided by reduced transparency. Oil windfalls diminish the government's need for tax revenue and hence tax compliance, causing public officials to choose less transparency. Our empirical analysis of oil wealth and taxation in a panel of countries over 40 years is consistent with the model's deep structure and its implications.

The issue of resource wealth and transparency is particularly salient in the oil-rich Middle East and North Africa (MENA) region. Our analysis of the region is constrained by the paucity of taxation data, but we show that the oil-rich MENA countries have exceptionally low taxes and low transparency,

[1] For summaries of this voluminous literature, see Ross 1999, Stevens and Dietsche 2008, Wick and Bulte 2009, Frankel 2010, and Ross 2015.

[2] Transparency may be viewed as the clarity of the channels through which such aspects of social order such as the exercise of law and order, the abuse of power, the incidence of corruption, and economic policy are communicated to citizens, and from which citizen cooperation in social order is elicited. Admittedly, the line between transparency and democracy is fuzzy, but a strict logical statement might be that democracy entails transparency but not vice versa. Similarly, corruption and transparency are sometimes confused with one another or interchangeably used. While lack of transparency might pave the way for corruption, the two are not the same thing. For this reason it is important to define what is meant by transparency. Our measure of transparency is close to a fiscal definition of transparency provided by the International Monetary Fund (2012), The International Monetary Fund (2012) refers to fiscal transparency as "the clarity, reliability, frequency, timeliness, and relevance of public reporting and the openness to the public of the government's fiscal policy-making process."

[3] These initiatives include the Extractive Industries Transparency Initiative, the IMF's Fiscal Transparency Code, the UNDP's Strategy for Supporting Sustainable and Equitable Management of the Extractive Industries, and the mandatory disclosure laws adopted by the US and EU for extractive industry firms operating abroad.

while the non-oil MENA states have tax and transparency levels similar to the rest of the developing world. From this we infer that low transparency levels in the MENA region may be largely a function of the region's concentration of oil wealth, rather than cultural or historical traits.

Our work builds on several bodies of earlier research. Mohtadi, Ross and Ruediger (2014) estimate the relationship between petroleum wealth and transparency, finding oil is associated with the subversion of transparency when it constitutes a significant share of national income (representing a country's dependence on oil), but not when it merely contributes to a higher average wealth of the country (an indicator of oil abundance). Williams (2011) finds a similar correlation between resource wealth and reduced transparency in a smaller panel of countries over a briefer span of time.

A theoretical model developed by Egorov, Guriev, and Sonin (2009) suggests that resource windfalls may reduce freedom of information by diminishing the incentive for political leaders to use the media to curtail bureaucratic malfeasance. Among authoritarian states, they report a strong correlation between oil revenues and reduced media freedom. Ross (2011) reports a cross-national correlation between oil wealth and lower scores on the Open Budget Index, but only among authoritarian states.

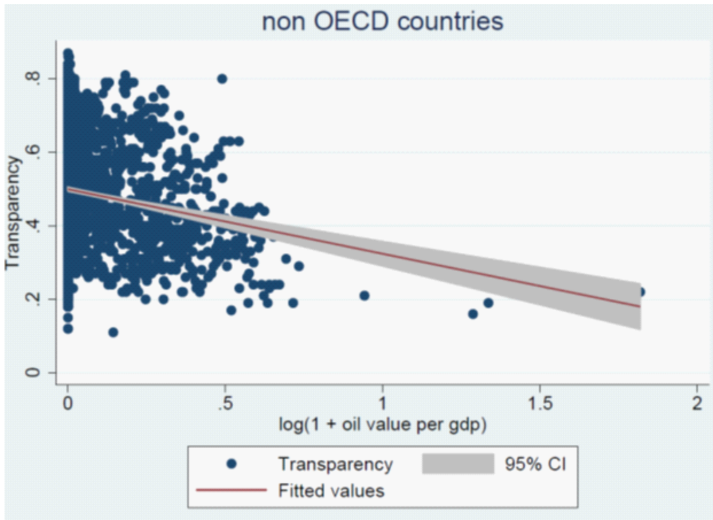
Our argument about the role of tax compliance extends prior research on the relationship between direct taxation and political accountability found in both historical settings (North 1990, North and Weingast 1989, Hoffman and Norberg 1994) and contemporary ones (Ross 2004, Brautigam et al. 2008, McGuirk 2010)[4].

Devarajan et. al. (2011) develop a related argument where taxation induces citizens to scrutinize public expenditures, thereby increasing the cost effectiveness of public expenditures. Tanzi and Zee (2000) link citizens' tax evasion to their perception of government corruption, reporting that "If people begin to feel that what they pay the government is wasted or ends up in somebody's pocket, then the attitude toward taxes is not very good." Corruption can also influence tax evasion by lax enforcement. Mohtadi, Polasky and Roe (2014) find a negative association between corruption and law and order, an underlying basis for tax enforcement, while Andres (2002) reports that citizens' subjective beliefs about being caught is the main driver of their decision to evade or not evade taxes.

In the remainder of this paper, section 2 presents our model illustrating these linkages, section 3 offers an extension to the model that illustrates a somewhat different mechanism focusing on government efficiency, section 4 provides empirical evidence using new data on both taxation and transparency, and section 5 offers concluding remarks.

Figure 1: Oil and Transparency

[4] These studies are also consistent with many anecdotes about oil and tax enforcement. Juan Pardinas, the General Director of the Mexican Institute for Competitiveness stated in the New York Times (September 9, 2013) "We collect few taxes because we have oil... That allows us to pay less in taxes and allows the state to make little effort to collect them."



2 The Main Model

To capture some of the key ideas above, we develop a simple stylized model of the economy, the government and the citizenry. The economy produces a single final good with labor (l), capital (k) and a non-excludable public input provided by the government (e.g., infrastructure) G:

$$Y = A(k^{\alpha} l^{1-\alpha}) G^{\beta} \quad \alpha, \beta \in (0, 1) \tag{1}$$

where, A is the usual scale factor that determines the level of technology. Demand for labor and capital are determined by their respective marginal products derived from maximization of profits, $\pi_Y = A(k^{\alpha} l^{1-\alpha})G^{\beta} - wl - rk$, where Y is the numeraire good with price of 1. Labor is fully employed with measure 1, so that labor demand l^* equals its supply of unity: $l^* = 1$. We assume that capital markets are open so that return to capital, r, is determined exogenously at the international capital market rate, , so that $r = \bar{r}$. With this background, following the derivation of the usual profit maximizing conditions yield aggregate output Y and labor demand as follows, given the level of public goods, G, to be determined later.

$$Y = \Omega G^{\frac{\beta}{1-\alpha}} \tag{2}$$

$$Y_l = w^* l = w^* = (1 - \alpha)\Omega G^{\frac{\beta}{1-\alpha}} \tag{3}$$

$$Y_k = \bar{r} k^* = \alpha \Omega G^{\frac{\beta}{1-\alpha}} \tag{4}$$

where $\Omega \equiv A^{\frac{1}{1-\alpha}}(\frac{\alpha}{\bar{r}})^{\frac{\alpha}{1-\alpha}}$ defines some of the constants of the economy.

2.1 Determining Public Goods and Government Budget

Pubic goods G are financed by both natural resource revenue R and income tax revenue TX. Income is taxed at the rate t, but is subject to some citizen non-compliance (the extent of which is to be determined later). Further, for simplicity, both capital income, and labor income are assumed to be taxed at the same rate and to be subject to the same level of non-compliance, represented by a fraction, $1-\mu$, where μ is the fraction of income that *is* reported. Since both types of income are subject to the same rate of non-compliance, total reported income is:

$$Y_r = \mu Y \tag{5}$$

Resource revenue is also expressed as a fraction ρ of national income, Y:

$$R = \rho Y \tag{6}$$

Finally we allow for diversion of some revenue outside of the transparent system. This is represented by some fraction b for total revenue and may represent the degree of extractive (corrupt) behavior by government officials. With this background, government spending on public goods is given by,

$$G = (1-b)(R+TX) = (1-b)(\rho+t\mu)Y = (1-b)(\rho+t\mu)\Omega G^{\frac{\beta}{1-\alpha}} \tag{7}$$

where $TX = t\mu Y$ is aggregate tax revenue, and where we have substituted for national income, Y, from (2). Solving for the level of public goods from 7, we find:

$$G = [(1-b)(\rho+t\mu)\Omega]^{\frac{1-\alpha}{1-\alpha-\beta}} \tag{8}$$

2.2 Tax Evasion and Tax Compliance Technology

Citizens' decisions of how much of their income to underreport are based on the penalty for under-reporting and the probability of being caught and penalized for under-reporting. For example, a study of Argentina (Andres, 2002) finds that citizens' subjective beliefs about being caught was the main driver of their decision to evade taxes. In the extension to this model, we capture other potential mechanisms for citizen compliance. For example citizen compliance may also depend on whether they perceive their taxes as being efficiently translated to public goods and not wasted or diverted.[5]

Let the cost/penalty for under-reporting per unit of income, $1-\mu$, be quadratic in the degree of under-reporting,

$$C_u(1-\mu) = \frac{\gamma}{2}(1-\mu)^2 \tag{9}$$

where γ is some positive constant (see below). The quadratic dependence is needed for interior solution but is also rather plausible in that higher levels of evasion are likely to be caught and also deserving of progressively higher penalty. Let π_b^e denote the expected probability of being caught and penalized for under-reporting. We assume that, if caught, the individual is always penalized. Thus, we ignore the possibility of bribing the functionary to avoid the penalty. While it is easy to incorporate this aspect (for example by considering μ to be net of the bribe rate) our focus in this paper is on sovereign or grand corruption. Then the expected penalty cost for under-reporting per unit of income is:

$$E[C_u(1-\mu)] = \frac{\gamma}{2}\pi_b^e(1-\mu)^2 \tag{10}$$

Note that because the cost function is convex in μ , it follows that, $E[C_u(1-\mu)] = \frac{\gamma}{2}\pi_b^e(1-\mu)^2 > C_u[E(1-\mu)] = \frac{\gamma}{2}[\pi_b^e(1-\mu)]^2$. This means that a risk averse taxpayer facing convex costs considers $E[C_u(1-\mu)]$ in her calculations. While γ is merely a parameter in this section, our extension of the base model (next section) allows it to increase with the efficiency of public spending G, say z, so that to taxpayers the cost of non-compliance is not merely the penalty of being caught but the opportunity cost of higher foregone efficiency of G. For this section, however, γ is assumed a constant parameter.

Given G, citizens choose the level of compliance by balancing the benefits and costs of non-compliance. They do so by maximizing their expected incomes from labor and capital. Assuming same tax evasion behavior from both sources, this is same as maximizing expected aggregate income:

$$\underset{\{\mu\}}{Max}[E(Y)|_{\bar{G}}] = \underset{\{\mu\}}{Max}[(1-\mu t) - E(C_u(1-\mu)].Y|_{\bar{G}} \tag{11}$$

leading to:

[5] Our empirics, however, will show that the latter mechanism is less likely to be at work.

$$\mu^*(t;T) = 1 - \frac{t}{\gamma \pi_b^e} \quad (12)$$

While citizens can estimate π_b^e from experience and casual observation, in the aggregate the probability of being caught depends on government transparency. Although transparency and corruption are not the same, we make the plausible assumption that opacity facilitates corruption. Coupled with the evidence that more corruption is associated with weaker enforcement of the rule of law[6], one would expect that opacity to also imply weaker enforcement of taxes, as it is hard to imagine weaker enforcement of the rule of law but greater enforcement of tax laws. The direct reasoning for such a behavior is that a less transparent government can divert resources for extra-budgetary (private) use (parameter b above) because this action is not visible to the citizens. In that case, enforcement of tax laws will be self-incriminating to some extent which an opaque regime would therefore rather avoid. One could also argue that because enforcement is generally a function of the net benefits and costs of enforcement, even a transparent government may keep enforcement light to reduce the cost of enforcement, or a less transparent and corrupt government may double its enforcement efforts to maximize the revenue it can divert. Although an optimum enforcement level that balances these costs and benefits of enforcement could still exist whether a government is transparent or not, the self-incrimination argument above would suggest that a less transparent government would always choose a lower optimum enforcement level (a downward shift) due to this added cost/risk of enforcement.

Given the above discussion we will assume that a more transparent government is more likely to enforce the rules including tax collection, thereby having a higher probability of penalizing non-compliant tax payers. Greater transparency implies greater accountability[7] and greater accountability require more strict enforcement of tax laws. Thus in the aggregate the probability of being caught is an increasing function of transparency, T:

$$\pi_b = f(T) \text{ with } f^{'} > 0 \; , \; f^{"} < 0 \quad (13)$$

In equilibrium, expectations are realized and $\pi_b^e = \pi_b = f(T)$ so that optimum compliance ratio from equation 12 becomes:

$$\mu^*(t;T) = 1 - \frac{t}{\gamma f(T)} \quad (14)$$

[6] For example, in a sample of 118 counties for 1990-2007 period Mohtadi, Polasky and Roe (2014) have shown a strong association between corruption and rule of law.

[7] An argument in which accountability is enhanced by citizen scrutiny per Devarajan et. al. (2011) is developed section three and empirically tested. The empirics rule out this channel as an important channel.

The concavity of f, i.e., $f" < 0$ is necessary since π_b is a probability measure that rises in T but is bounded by 1. Further, for analytical reasons that will become clear soon, f will have a lower bound, i.e., there is always some chance of being caught for tax evasion even by the most opaque government, i.e.,

$$f(T = 0) = \underline{f} \Longrightarrow f \in [\underline{f}, 1] \tag{15}$$

Here, $f(t = 0) > 0$ by 15 guarantees that μ^* is well defined near the low bound of T. Notice that,

$$\frac{\partial \mu^*}{\partial T} > 0 \ , \ \frac{\partial^2 \mu^*}{\partial T^2} < 0 \ , \ \frac{\partial \mu^*}{\partial t} < 0 \tag{16}$$

The first two results are based on the properties of probability measure π_b that is expressed through function f . This increasing but concave property of compliance plays an important role in our empirical analysis and is supported by that evidence—more on that later.

Proposition 1: Tax compliance improves with increased government transparency at a decreasing rate.

2.3 Government

Government must set the tax rate, t, the level of public goods, G, and importantly the level of transparency, T. From equation 8 we have seen the relation between G and t. This relation arises from the fact that G enters both the production function, Y, and the balanced budget equation, given by the first equality in 7 so that when G is solved for, one obtains 8. For reasons discussed below, we shall assume that G is determined by the political process but drives the tax rate in the economy via 8, to satisfy the balanced budget condition. Thus politics drive G which drives t. This departs from the optimal taxation literature (e.g., Barro, 1990) in which a welfare maximizing government chooses the efficient level of G, and is more in line with the political economy literature in which either the interest groups lobby the government for G (e.g., Mohtadi and Roe, 1998, 2003) or voters choose the types of government associated with different levels of G (e.g., Persson, et al., 2007). As long as the voting or lobbying behavior of citizens and their tax evasion behavior are independent of each other, our approach is valid, so that endogenizing the political process adds an analytical complexity unrelated to the task at hand and can therefore be avoided. Empirically, since we have data on public spending, we can control for G. But we also do examine whether G is endogenous via other mechanisms, for example whether oil revenues drive the size of G. Furthermore, to the extent that democracies and non-democracies may have distinct political economic structures, we control for this fact by including a polity variable from the Polity

IV dataset as well as stratify our sample to both include and exclude the more democratic OECD group.

In setting this tax rate, the government anticipates citizens' response. This means that it acts as a Stackelberg leader so that equation 8 can be re-expressed as:

$$G = (1 - b)[\rho + t\mu^*(t; T)\Omega]^{\frac{1-\alpha}{1-\alpha-\beta}} \tag{17}$$

The tax rate t then is the solution to this simple budget equation.

$$t = h(G|T, b) \tag{18}$$

The critical decision of the government is whether to withhold information or be fully transparent and accountable to the citizens. The trade off comes from the fact that on the one hand extra-budgetary diversions b are easier to hide when there is some degree of opacity. On the other hand, citizens comply more with tax payments under a more transparent system, yielding larger income base from which to extract and divert resources. We capture this trade-off by modeling a government utility that is based on how much is diverted by the government:

$$U_G(T) = \bar{V}_{oG} + b(T)[\rho + t\mu^*(t, T)]Y = \bar{V}_{oG} + \{b(T)\rho + \bar{t}.\mu^*[\bar{t}, T)\}\Omega G^{\frac{\beta}{1-\alpha}} \text{ with } b^{'}(T) < 0 \tag{19}$$

where we have allowed the diversion fraction, b, to decrease in transparency, T as discussed above. Granted, this is a somewhat cynical view of government. But it goes to show that even such a government might still be interested in raising the income base if for no other reason than to set aside a greater amount for itself. We also allow for some base utility of the government, $\bar{V}_{oG}$, that is free from being influenced by corruption and revenue extraction and sensitive to public opinion. In a democratic society one would expect $\bar{V}_{oG}$ to be determined by the median voters. In such a society T is likely to be large and $b(T)$ small, so that much of the weight in $U_G(T)$ comes from $\bar{V}_{oG}$. While a more complex model should allow for $\bar{V}_{oG}$ to be increasing in T, we consider this a second order effect and assume that corruption, especially because it is hidden, can operate somewhat independently of $\bar{V}_{oG}$. Later, by controlling for democracy in our sample we control for variations in $U_G(T)$ coming from $\bar{V}_{oG}$. We also examine this issue by both including and excluding the more democratic OECD group in the empirical section.

The second equality in 19 comes from substituting for Y in terms of public spending, G from 2. But, as stated, G is determined by political economy which then drives the determination of the tax rate, per equation 18. This observation is critical to our being able to empirically estimate compliance: although we have data on personal taxes paid to the government as a share of GDP, i.e., $t\mu$, we do not have data on *tax rate*, t. To isolate compliance which is captured by μ in our model, we therefore need to control for variations in the tax rate across countries and over time. Equations 17 allows us to estimate μ^* by controlling for the variations in G and thus in t, since G and t are the only two variables in 17.

The negative sign of $\partial b/\partial T$ coupled with the positive sign of $\partial \mu^*/\partial T$ express the dilemma of the government in how open or opaque it must be. A rational government would thus opt for an optimum level of transparency, T^* to maximize utility. The idea of optimal transparency is found in both monetary and public policy discussions[8], but its consideration in the context of corruption and tax compliance is new. Optimum T^* can be written as:

$$T^* = \arg\max_{\{T\}} U_G(T)|_G \tag{20}$$

The first order condition from this Max problem is:

$$T^*|_G : b^{'}(T^*)[\rho + t\mu^*(t, T^*)] + b(T^*)t\mu^*_T(t, T^*) = 0 \tag{21}$$

Studying the second order condition for this problem turns out to be important for both the model and the empirical approach we take to examine the model. This condition is:

$$B(\rho, t, T^*)|_G \equiv b^{"}(T^*)[\rho+t\mu^*(t, T^*)]+2b^{'}(T^*)t\mu^*_T(\bar{t}, T^*)+b(T^*)t\mu^*_{TT}(t, T^*) < 0 \tag{22}$$

We know from 16 that $\mu^*_T > 0$ and $\mu^*_{TT}(t, T^*) < 0$, a necessity less imposed by assumption as by the probability measure, π_b as discussed. In the empirical section we are able to verify this condition quite strongly. We also know that $b^{'} < 0$ as opacity facilities extraction to extra-budgetary channels. Thus, if $b^{"} = 0$, that is if the relation between extra-budgetary activity b and transparency T is linear then 22 is satisfied. On the other hand, if b is convex such that $b" > 0$ size of this curvature must have an upper bound given by $-[2b^{'}t\mu^*_T - b(T^*)t\mu^*_{TT}]/[\rho + t\mu^*]$. Regardless, it is clear that a rising but concave function $\mu(T)$ is a necessary condition for 22 to hold.[9] We shall return to 22 again in the next subsection. The condition will also have important implications for our empirical analysis.

2.3.1 Properties of Transparency: The Role Resource Rent

We are interested here in how rents from natural resources impact the level of transparency. We assume that the government is rational and has chosen its desired level of transparency. To see the effect of resource revenues, ρ, on government transparency, implicitly differentiate T^* in 22 with respect to ρ. This yields,

[8]For example the cost of transparency in public policy has been attributed to the fact that "public announcements serve as focal points for higher-order beliefs and affect agents' behaviour more than justified by their informational contents" (Conrad and Heinemann, 2008)

[9]Obviously, if $b" = 0$ this is also a sufficient condition.

$$\frac{dT^*}{d\rho}|_G = -\frac{b^{'}(T^*)}{B(\rho, t, T^*)} < 0 \text{ iff second order condition is satisfied} \quad (23)$$

That is, if an optimum level of transparency does exist, guaranteed by the second order condition, then transparency will be negatively associated with countries' level of natural resource revenues. In turn, a necessary pre-condition for the second order condition to be satisfied is that tax compliance function as a function of transparency $\mu(T)$ be increasing and concave in T.

Proposition 2: An optimal transparency level (a) exists and (b) decreases with more resource revenues in relation to citizen tax compliance behavior. This behavior should exhibit an increasing but concave relation to transparency (proposition 1).

In the empirical section we examine these propositions.

3 Extension: Alternative Mechanism: Public Sector Efficiency and Tax Compliance

Devarajan et al. (2011) have argued that the role of taxation is to induce citizens to scrutinize public expenditures more, thereby increasing the cost effectiveness of public expenditures. The implication of such an argument for our paper is that the greater are resource revenues (and lower are tax revenues), the less citizens are induced to scrutinize public spending. As a result, government spending becomes more wasteful as there is less transparency in how public resources are used. This mechanism could possible apply to a number of low-income, oil rich countries, perhaps those in Africa, where there is a paucity of taxpayers and much of tax revenues derive from indirect taxes[10]. Is it therefore the case that a mechanism that relies on the effect of transparency on tax compliance is less likely to be the salient mechanism as compared to a mechanism that relies on the efficiency of public spending? The answer depends crucially on how such an efficiency is realized. If, as Devarajan et al. (2011) have argued, this is realized via the scrutiny of the taxpayers, this begs the question of how are taxpayers able to better scrutinize the government policies and budget. That ability would surely depend on the flow of information from the government. But that flow is often controlled by the government itself and there is no reason to think that self-interested policy makers would naturally make government more transparent. Thus we come back full circle and recognize the critical role of transparency. In some sense our perspective is more of an explanatory (positive) approach rather than one of a normative (policy) approach as the latter assumes a welfare maximizing government. Citing the Roman poet, Juvenal, the late

[10] We thank a reviewer for suggesting this mechanism.

Nobel laureate Leo Hurwicz, famously asked (2008) “But Who Will Guard the Guardians?” Still we will be able to draw some policy inferences which we will discuss in various subsequent parts of the paper.

We thus combine some variant of the efficiency argument with the argument by Tanzi and Zee (2000) cited in the introduction that "If people begin to feel that what they pay the government is wasted or ends up in somebody’s pocket, then the attitude toward taxes is not very good" (ibid). Given all this, here we allow for the possibility that tax-payers are sensitive to the efficiency of the public sector, but recognize that this depends ultimately on greater transparency. On the other hand, the government sees that the cost of increased efficiency is to reduce its ability to extract resources for extra-budgetary private use but its benefit is to increase the size of G and thus the national income "pie" from which it extracts rents. Thus, transparency will have a new channel entering into the government decision process. As we shall see, our extension will yield different results from our base model. Both models will then be subject to empirics that will allow us to discriminate between them and determine which is better supported by the evidence.

Let $z(T)$ with $z \in (0,1]$ denote the efficiency of the public spending as an increasing function of transparency $z'(T) > 0$ (higher G means tax payers’ are better able to scrutinize G). We also assume that there are diminishing returns to the extent to which transparency can improve public scrutiny and thus the efficiency of G, that is $z^{"}(T) < 0$. The factional nature of z simply means that out of G "dollars" of spending entering into the budget constraint only $z(T)G$ enters into the production function. Thus we have,

$$Y = A(k^{\alpha} l^{1-\alpha})[z(T)G]^{\beta} \quad \alpha, \beta \in (0,1) \tag{1'}$$

with equations (2)-(4) of previous section all modified to,

$$Y = \Omega[z(T)G]^{\frac{\beta}{1-\alpha}} \tag{2'}$$

$$Y_l = w^* l = w^* = (1-\alpha)\Omega[z(T)G]^{\frac{\beta}{1-\alpha}} \tag{3'}$$

$$Y_k = \bar{r}k^* = \alpha[\Omega z(T)]G^{\frac{\beta}{1-\alpha}} \tag{4'}$$

and with Ω as defined before. With equations (5) and (6) remaining the same, the budget constrains now shows the contrast between the actual G spent and the efficiency of that spending zG. This is seen in the modified version of equation 7.

$$G = (1-b)(R+TX) = (1-b)(\rho + t\mu)Y = (1-b)(\rho + t\mu)\Omega[z(T)G]^{\frac{\beta}{1-\alpha}} \tag{7'}$$

yielding,

$$G = [(1-b)(\rho + t\mu)\Omega]^{\frac{1-\alpha}{1-\alpha-\beta}} z(T)^{\frac{\beta}{1-\alpha-\beta}} \tag{8'}$$

Notice that in (8') the source of the positive relation between G and z traces back to the higher national income that is afforded by greater efficiency of public spending. This in turn leads to a higher tax base and thus greater spending level. The maximum occurs when $z = 1$ at which point actual and efficient levels of spending coincide and we are back in the base model

The key innovation is how tax payers think about the government and how this affects their behavior. In the base model tax payers respond to the fear/risk of being caught and otherwise act selfishly. Instead, we would now like to allow them to evade taxes if they think the government is not delivering the public good efficiently. In this case, the cost of non-compliance is the opportunity cost of foregoing the higher efficiency of government spending if they choose to underpay their taxes. We therefore modify equation 10 as follows:

$$E[C_u(1-\mu)] = \frac{\gamma(z)}{2}[\pi_b^e(1-\mu)]^2 \tag{10'}$$

Maximizing expected income of taxpayers in compliance per equation 11 leads to optimum compliance similar to 12 but with a focus on the efficiency coefficient, z:

$$\mu^*(t, z) = 1 - \frac{t}{\pi_b^e \gamma(z)} \tag{12'}$$

Since our goal is to examine the alternative mechanism for tax payer compliance, we can now assume that the probability of being caught, π_b^e is a constant unrelated to transparency. If actual probability of being caught is given by π_b, in equilibrium, $\pi_b^e = \pi_b$. Furthermore, while z is a *given* to the individual agent, in the aggregate efficiency depends positively on the level of transparency. In short, we are trying to examine the impact of an alternative channel by which government transparency affects tax compliance, not through better enforcement of the tax code, but rather, via more efficient spending by the government. Thus, we replace equation 13 $\pi_b = f(T)$ with an analogous equation for z,

$$z = z(T) \text{ (with } z' > 0 \text{ , } z'' < 0) \tag{13'}$$

With these considerations, at equilibrium, optimum compliance of equation 12' becomes:

$$\mu^*(t;T) = \mu^*[(t; z(T)] = 1 - \frac{t}{\pi_b \gamma[z(T)]} \tag{14'}$$

As before, μ^* must be decreasing in the tax rate but increasing and concave in transparency[11]:

$$\frac{\partial \mu^*}{\partial T} > 0 \ , \ \frac{\partial^2 \mu^*}{\partial T^2} < 0 \ , \ \frac{\partial \mu^*}{\partial t} < 0 \tag{16'}$$

Let us now consider how the government behaves in this model. First, similar to the previous section, G is determined by the political process, which then driving the tax rate, t. Equation 8' expressed the government budget constraint with the new $z(T)$ variable. With G given, this gives the tax rate, echoing the previous section, the tax rate is given by,

$$t = h(G|T, b) \tag{18'}$$

The key difference between this and the base model in terms of government behavior is the added benefit of greater efficiency, due to the larger revenue base. To see this, we re-examine the government utility function (equation 20) in light of the role of the new variable $z(T)$.

$$U_G(T) = \bar{V}_{oG} + b(T)\{\rho + t\mu^*[t, z(T)]\}Y = \bar{V}_{oG} + \{b(T)\rho + t.\mu^*[t, z(T)]\}.\Omega.[z(T)G]^{\frac{\beta}{1-\alpha}}$$
$$\text{with } b^{'}(T) < 0 \tag{19'}$$

The added benefit via $z(T)$ further contributes to the offsetting forces against the government pursuit of obfuscation. This is a good thing. The question is what happens to the optimum level of transparency in this case. With $T^* = \arg\max U_G(T)|_G$,the first order condition from this Max problem becomes
:

$$T^*|_G : b^{'}(T^*)[\rho + t\mu^*(t, T^*)] + b(T^*)t\mu^{*'}(t, T^*) + b(\rho + \tau\mu)\frac{\beta}{1-\alpha}.b(T^{*)}[\rho + \tau\mu^{*'}(t, T^*)]\frac{1}{z(T)} = 0 \tag{21'}$$

Notice the added term involving $z(T)$ in equation 22' in comparison to equation 21. To examine the existence of a maximum, the second order condition is considered. This yields,

$$\begin{aligned} Q(\rho, t, T^*)|_G \equiv\ & b^{"}(T^*)[\rho + t\mu^*(t, T^*)] + 2b^{'}(T^*)t\mu^*_T(t, T^*) + b(T^*)t\mu^*_{TT}(t, T^*) \\ & + \frac{\beta}{1-\alpha}b^{'}(T^*)[\rho + t\mu^*(t, T^*)]\frac{1}{z(T)} + \frac{\beta}{1-\alpha}b(T^*)t\mu^*(t, T^*)\frac{1}{z(T)} \\ & - \frac{\beta}{1-\alpha}b(T^*)[\rho + t\mu^*(t, T^*)]\frac{z'(T^*)}{z(T^*)} < 0 \end{aligned} \tag{22'}$$

[11] The concavity result for μ follows, in turn, from the concavity of γ and z: $\frac{\partial^2 \mu^*}{\partial T^2} = \frac{t}{\pi_b}.\frac{(\gamma' z" + \gamma" z')\gamma - 2\gamma'^2 z\gamma'}{\gamma^2} < 0$

Condition 22' is more involved than the analogous condition in the main model 22. But a necessary condition certainly continues to be $\mu_T^*(t, T^*) > 0$ and $\mu_{TT}^*(t, T^*) < 0$ as before[12]. Suppose (22') is in fact satisfied; that is, suppose a maximum T^* does exist and let us examine the comparative statics of the effect of resource revenues, ρ, on optimum transparency in this new environment. To do so, we implicitly differentiate the first order condition. The result is:

$$Q(\rho, t, T^*).\frac{dT^*}{d\rho} = -b' - \frac{1}{z}.\frac{\beta}{1-\alpha}b \tag{23'}$$

Since $Q(\rho, t, T^*) < 0$, it follows that,

$$\frac{dT^*}{d\rho} \lesseqgtr \text{ iff } z(T^*) \lesseqgtr \frac{\beta}{1-\alpha}.\frac{b}{|b'|} \tag{24}$$

Since public sector efficiency z is an increasing function of transparency T, the above relation can be written in terms of the inverse function $z^{-1}(.)$ as follows:

$$\frac{dT^*}{d\rho} \lesseqgtr \text{ iff } T^* \lesseqgtr z^{-1}\left(\frac{\beta}{1-\alpha}.\frac{b}{|b'|}\right) \tag{25}$$

This yields a multiple equilibrium outcome: it suggests that if the state of governance is characterized by limited transparency–i.e., less than some threshold given by the right hand side of 24–then an increase in resource revenue further inhibits transparency. By contrast with a sufficient level of transparency to begin with–i.e., greater than the right hand side of 25–then an increase in resource revenues further improves transparency. The purported mechanism is of course seen from the government's utility function (equation 19'). Here when T is large enough it pays to reduce rent extraction (b) per unit of GDP as resource rents rise, and instead enjoy larger overall rent accrued from a larger tax base. With limited transparency, T, the dominant transmission mechanism from higher oil revenues to government utility comes from b. Thus the government gains from further reduction in transparency. To summarize this finding we can write:

Proposition 3: If tax compliance increases in response to more efficient public spending, instead of greater enforcement of taxes (the base model), a multiple equilibrium will emerge in response to an increase in resource revenues: a government that is less transparent than some threshold level will become less transparent and a government that is more transparent than the threshold level will become more transparent.

[12] Additional conditions for satisfaction of the second order condition are that $b" = 0$ or else that $b"$ is bound from above similar to the previous section (e.g., here, $\frac{b"}{|b'|} < \frac{\beta}{(1-\alpha)z}$). In addition, we must also have, $\frac{\mu_T}{\mu} < \frac{z_T}{z}$.

The multiple equilibrium implication of this model makes our task of empirically distinguishing and evaluating the two models relatively easy. In the following section, we will embark on this task.

4 Empirics: Evidence for the Models

We divide this section into several components. First, we discuss how to design the empirical model to test the deep structure of the theory. Next, we describe the data and the new datasets that we use. Finally, we discuss the results and the econometrics issues in relation to the theory.

4.1 Relation to the Theory

Our goal here is to examine the following hypothesis required by our model:

a) There is an inverse relationship between oil or resource revenues and taxation of income: countries that have more resource revenue rely less on taxation. This can be seen as a fraction of GDP either from equation 7 in the base model or equation 7' in the extension, in which given G/Y, tax revenues $t\mu$ are less, the greater is resource revenue as a share of GDP, ρ.

b1) Base Model: Transparency is inversely affected by resource rents, given G/Y (which pins down the tax rate t via the budget constraint–see part a above). This assumes that tax compliance μ is increasing but concave in transparency (see equation 15, 16 and condition for 22).[13] Mohtadi, Ross and Ruediger (2014) have established this adverse relation between transparency and resource rents. Our re-estimation of that relation in *this* paper is called for, as the relation is tied to the shape of the compliance function, based on the theory. Thus, examining the relation between tax compliance function μ and transparency is our final task.

b2) Alternative Model: Transparency's relation to resource rents depends on whether countries are already transparent or not (given G/Y and thus t). This assumes that tax compliance μ is increasing but concave in transparency (see equation 15', 16' and 22'). Naturally, at the first glance it would seem that the implication of Mohtadi, Ross and Ruediger findings (2014) regarding the adverse effects of resource revenues on transparency call into question the validity of the alternative model. But this issue needs further investigation. For example while Mohtadi, Ross and Ruediger (2014) results could hold in the aggregate, breaking the sample into low transparency and high transparency states could still produce results consistent with the alternative model. We shall therefore re-examine this issue with the new data as well.

[13] We noted earlier that this condition on tax compliance is necessary for the trasnaprency to exhibit negative response to resource revenue. This statement is based on the reasonable assumption that the portion of budget removed for corrupt or other purposes, b, falls with transparecy $b' < 0$ but at non-increasing rate, $b" \geqq 0$. (see 22) We do not have corruption data as a proxy for b at a level deep and extensive enough to be compatible with other variables. However, even in the absence of information about corruption, the concavity of compliance function is still necessary so long as we rule out highly unusual curvatures for b.

4.2 Data

Our ability to examine these deep structures of either model is made possible by three unique datasets. One dataset is the measure of transparency developed and compiled by Williams (2009). This index, called the Release of Information (RI) index, counts the frequency and extent of annual data released by governments and published in World Bank's World Development Indicators (WDI) and the IMF's International Financial Statistics. Its main advantage is its annual availability from 1970 to 2010, covering every country listed in WDI.[14] However, the overlap between this dataset and a second one on taxation and government revenue (see below), forces us to be content only with the 1980-2010 dataset. While simply counting the amount of information is not an accurate measure of the quality of information released by governments, Williams (2011) shows that the RI index is highly correlated with World Bank's Statistical Capacity index and thus also casts light on the quality of information released by governments. This dataset allows us to use panel estimation techniques and hence examine within-country effects over time.

The second dataset is about government taxes and revenues. A key challenge to cross-country research on the role of revenue and taxation has been the weakness of available data. To remedy this problem the International Center for Tax and Development (ICTD) has released a new dataset that significantly improves on existing data in quality, standardization and coverage.[15]

A third dataset is about natural resource and rents. Data on resource rents are available from the World Development Indicators (WDI). But there are several problems associated with using this data. First, while the measure of rents nets out the cost of production of a resource and therefore in theory seems a suitable measure, in practice the measure of the cost is a rough estimate taken at a single point in time and is heavily dependent on accounting assumptions; it is hence both uncertain and does not reflect temporal variations in extraction costs, which can be very large. Second, using the WDI 'rents' measures may also create an endogeneity problem: The measure relies on countries' self-reporting of their resource data to the World Bank and since our measure of transparency is based on the frequency and extent of reporting of data by countries (see next section), any missing observations may be an indication of low transparency rather than randomly distributed. Third, there are many missing observations, which could bias our estimate of oil's impact. Fourth, due to the missing observations the scope of the coverage of WDI's data is somewhat limited, especially when interacted with other variables.

To circumvent all these problems, we will use an alternative natural resource measure, namely "oil and gas value" which is available from Ross (2013). The

[14] Recently Hollyer et. al. (2014) have developed a similar dataset which is instead based on a Bayesian methdology.

[15] Wilson, Cobham and Goodall (2014) describe the new ICTD data as follows: "The dataset meticulously combines data from several major international databases, as well as drawing on data compiled from all available International Monetary Fund (IMF) Article IV reports. It achieves marked improvements in data coverage and accuracy, including a standardized approach to revenue from natural resources."

Ross measure is simply the quantity of oil and gas extracted in a given year multiplied by the per-unit world price; the underlying production data are collected from the World Bank, the US Energy Information Administration, the BP Statistical Review, and the US Geological Survey. Due to its approximate independence from the pure WDI measure, this measure allows us to circumvent, to a large extent, the above endogeneity issue and yet it is highly correlated with the WDI measure. Furthermore, our measure is able to avoid the thorny challenge of estimating extraction costs. Consequently, it is able to cover nearly all countries. Since there is no comparable measure for the value of mineral production we are compelled to use the WDI measure; unlike the WDI measure of fossil fuel production, however, the WDI mineral production measure covers almost all countries and is therefore unlikely to lead to biased estimates due to nonrandom "missingness".

Most of our other variables are from WDI, but the democracy data is from Polity IV. The time coverage from the overlap of various datasets is 1980 to 2010 but the country coverage varies depending on the variables used but ranges from about 115 to 150 for the oil variable. (The country coverage for the resource variable is more limited. But it is the oil variable whose consistency is key to the analysis). In the tables below, the number of observations are indicated below each regression. The Appendix provides several tables including a list of all countries, the list of all variables and data sources, and the descriptive statistics of all the variables.

4.3 Econometric Issues and Results

In carrying out our panel analysis we examined both a panel of 5-year averages and a panel of annual data. There are pros and cons for each approach. For example the transparency response to resource revenue is an institutional process that is slow. On the other hand, tax payers may improve their compliance more rapidly in response to observing improved transparency. Thus one might want to run perhaps 5-year regressions for the first and annual regressions for the second. But this posed an obstacle. To the extent that the response of transparency to resource revenue requires *endogenously* that the compliance function be concave, the two issues are linked and cannot be tested separately with two different time periods. To remedy this problem we opted for the use of annual data with several years of lag for the transparency equation and shorter lags (or even a contemporaneous structure) for the compliance equation. All other technical issues, e.g., error clustering, instrumental variables versus 2SLS, potential endogeneity of other regressors, potential sample bias, etc. are addressed in the course of the empirical presentation.

4.4 Stage a: Resource Revenue and Taxation

First we examine whether states with higher resource revenue experience lower income taxation per theory (hypothesis a in subsection 3.1). For reasons of compatibility of the annual data that are to be used for the other hypotheses, we also use annual data to examine this hypothesis. Results are reported in tables 1 and 1' which differ only in terms of the sample. Table 1 focuses only on non-OECD group of countries while table 1' focuses on all the countries for which data are available.

Table 1:Income Tax Share versus Oil and Resource Share for Non-OECD Countries

Panel A: Taxation versus Oil

Table 1 Panel A							
Oil (OECD excluded)	Dependent Variable: Taxes on Individuals						
log(1+Oil Value per GDP)	-0.6969	1.6450	1.6878	1.6929	1.7102	0.9981	1.4533
	(0.4830)	(1.1180)	(1.0760)	(1.0689)	(1.0391)	(0.7438)	(0.7662)
Lag[log(1+Oil Value per GDP)]	0.0406	-1.5988*	-1.7502**	-1.7472**	-1.7719**	-1.8727**	-2.4563***
	(0.3271)	(0.8905)	(0.7894)	(0.7888)	(0.7485)	(0.7560)	(0.7710)
Gov't Consumption per GDP		0.0833***	0.0823***	0.0818***	0.0798***	0.0822***	0.0814***
		(0.0261)	(0.0256)	(0.0244)	(0.0246)	(0.0241)	(0.0248)
Log(GDP per Capita)			0.3351	0.3923	0.4954	0.5458	0.5729
			(0.4181)	(0.4125)	(0.4233)	(0.4171)	(0.4221)
Polity2				0.0238	0.0208	0.0226	0.0246
				(0.0215)	(0.0222)	(0.0206)	(0.0211)
Taxes intern trade & trans per GDP					0.0653**	0.0748**	0.0188
					(0.0293)	(0.0310)	(0.0331)
Exchage rate(see note 1)						0.0000	0.0000
						(0.0000)	(0.000)
Constant	1.8748***	0.5350	-1.8567	-2.2550	-3.3407	-3.3569	-3.5324
	(0.2775)	(0.5686)	(3.0105)	(2.9954)	(3.0970)	(2.9570)	(2.9426)
MENA group excluded	no	no	no	no	no	no	yes
R2	0.040	0.135	0.147	0.157	0.183	0.187	0.187
# of observations	1999	1945	1907	1826	1732	1620	1470
# of countries	123	123	122	116	112	111	101

using heteroskedasticity robust standard errors, standard errors are adjusted for country clusters

* p<0.10, ** p<0.05, *** p<0.01. All estimates include both country and time fixed effects

Note 1. Exchange rate is allowed to be endogenous per Dutch Disease hypotheis. Thus, the last column reports stage 2 of a 2SLS estimation. For stage 1, Exchage Rate is regressed against 2 and 3 lags of the oil variable, [log(1+Oil Value per GDP)]. The first lag of the oil variable is used for stage 2

Panel B: Taxation versus Natural Resources

Resources (OECD excluded)	Dependent Variable: Taxes on Individuals					
Resource Rev per GDP	-0.0207***	-0.0212***	-0.0212***	-0.0237***	-0.0240***	-0.0179***
	(0.0060)	(0.0062)	(0.0062)	(0.0066)	(0.0071)	(0.0065)
Lag(Resource Rev per GDP)	0.0022	0.0052	0.0045	0.0064	0.0065	0.0050
	(0.0037)	(0.0037)	(0.0038)	(0.0039)	(0.0044)	(0.0053)
Gov't Consumption per GDP		-0.0080	-0.0095	-0.0107	-0.0109	-0.0156
		(0.0056)	(0.0065)	(0.0067)	(0.0070)	(0.0093)
Log(GDP per Capita)			-0.2154	-0.1891	-0.1976	-0.1769
			(0.3160)	(0.3642)	(0.3667)	(0.3927)
Polity2				0.0073	0.0075	0.0069
				(0.0106)	(0.0108)	(0.0132)
Taxes intern trade & trans per GDP					-0.0158	-0.0412
					(0.0559)	(0.0698)
Exchage rate (see note 1)						0.0001
						(0.0003)
Constant	1.9035***	1.9762***	3.4260	3.3610	3.5703	3.9183
	(0.2909)	(0.3493)	(2.3136)	(2.5734)	(2.7710)	(2.9451)
R2	0.219	0.211	0.229	0.242	0.244	0.248
# of observations	399	369	355	340	328	283
# of countries	37	36	34	33	31	31

using heteroskedasticity robust standard errors, standard errors are adjusted for country clusters

* p<0.10, ** p<0.05, *** p<0.01. All estimates include both country and time fixed effects

Note 1. Exchange rate is allowed to be endogenous per Dutch Disease hypotheis. Thus, the last column reports stage 2 of a 2SLS estimation. For stage 1, Exchage Rate is regressed against 2 and 3 lags of the resource variable, Resource rev per GDP. The first lag of resource variable is used for stage 2

Table 1':Income Tax Share versus Oil Share for all Countries

Oil (all countries)	Dependent Variable: Taxes on Individuals					
log(1+Oil Value per GDP)	-0.4767	2.1265*	2.0901*	1.8440*	1.8394*	1.2759
	(0.3801)	(1.1073)	(1.0784)	(0.9656)	(0.9407)	(0.7935)
Lag[log(1+Oil Value per GDP)]	0.0104	-1.8299*	-1.9548**	-1.7621**	-1.7822**	-1.8598**
	(0.3145)	(0.9858)	(0.8742)	(0.7926)	(0.7558)	(0.7613)
Gov't Consumption per GDP		0.0948***	0.0924***	0.0804***	0.0784***	0.0770***
		(0.0268)	(0.0267)	(0.0237)	(0.0240)	(0.0236)
Log(GDP per Capita)			0.3128	0.4220	0.5244	0.7531*
			(0.3881)	(0.3813)	(0.3899)	(0.3820)
Polity2				0.0434*	0.0442*	0.0441*
				(0.0252)	(0.0260)	(0.0243)
Taxes intern trade & trans per GDP					0.0374	0.0491
					(0.0355)	(0.0347)
Exchange Rate (see Note 1)						0.0000
						(0.0000)
Constant	4.1432***	2.5757***	0.1280	-0.5704	-1.4561	-3.2031
	(0.2408)	(0.5743)	(3.0204)	(2.9938)	(3.0803)	(2.9259)
R2	0.010	0.085	0.089	0.096	0.102	0.114
# of observations	2662	2608	2551	2432	2338	2058
# of countries	146	146	145	138	134	132
using heteroskedasticity robust standard errors, standard errors are adjusted for country clusters						
* p<0.10, ** p<0.05, *** p<0.01. All estimates include both country and time fixed effects.						
Note 1. Exchange rate is allowed to be endogenous per Dutch Disease hypotheis. Thus, the last column reports stage 2 of a 2SLS estimation. For stage 1, Exchage Rate is regressed against 2 and 3 lags of the oil variable, [log(1+Oil Value per GDP)]. The first lag of the oil variable is used for stage 2						

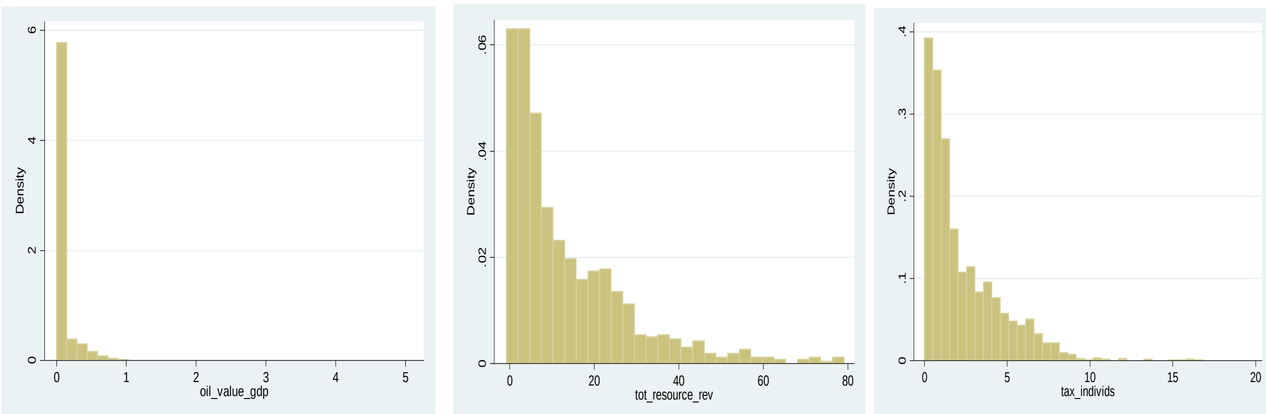
Table 1 consists of two panels; one for oil, and the other for all minerals and resources. Table 1' is only about oil, but not resources. The reason for the absence of a resource panel for table 1' is the lack of data on total resource revenue from ICTD source for the OECD group. As a result the "all country sample" is identical to non-OECD sample for the natural resource variable.

In each case, we begin with current and lagged values of oil or resource revenue per capita and then progressively add additional controls representing respectively, government spending as a share of GDP, per capita income, political openness, trade related taxes (such as import duties) and exchange rate. We shall explain each control. But first we note the negative and significant coefficients of the resource variable in panel B and the lagged oil values in panel A. Moreover the size of the oil effect appears to be much larger than the resource effect. Since the second stage of our grand hypothesis (stage B) on transparency and tax compliance will be based on the oil variable only (for reasons explained later), the fact that the adverse effect of oil on transparency in Panel A shows up with a lag gives us somewhat greater confidence that we are not looking at some form of simultaneity bias and paves the way for stage B regressions on a more solid ground. In general the negative findings are consistent with the theory, i.e., both in terms of equation 7, $G = (1-b)(\rho+t\mu)Y$ (main model) and its counterpart equation 7' (alternative model). In both models, given the ratio of G/Y (represented by "Gov't Consumption/GDP") as a control, personal income tax revenue as a share of GDP, i.e., $t\mu$, is negatively and significantly associated with resource revenue or oil value per GDP (the latter, represented by log(1+Oil Value per GDP). This is ρ in the theory. It is interesting to note that the government spending variable itself is positive and highly significant in the case of the oil regressions, but not in the case of the resource regressions.

Although the negative effect of resource and oil revenues on personal taxation is consistent with the theory, correlation is not causality. For example, we might ask: is it that resource rich countries collect less taxes because they have more resources, or is it that less taxes lead to greater extraction of resources? We try to answer this question in two ways. First we regress our oil variable against contemporaneous and lagged values of our tax variable along with various controls. Results, reported in table A5 in the appendix, show no significant effect of taxation on our oil variable. Second, to further shed light on this point, we include in our regressions other types of taxes to see if their inclusion affects the size of focus coefficient, i.e., that of the oil or resource variable. Certainly, a hypothesis based on the influence of a poor tax environment on increased extraction should imply a change in the size of the oil or resource coefficient when we include the particular tax variable. For this purpose, we picked trade taxes, reported in tables 1 and 1' defined as "taxes from international trade transactions." We chose this form of taxes especially since they bring in tariff revenues that are often easier to collect in countries with weak income tax environment. Comparison of columns 4 and 5 in all three tables shows almost no effect in the size of the coefficient of the oil or resource variable. Thus, a poor tax environment does not seem to drive the decision to extract more oil or resources.

Finally, one might ask what if it is not the *level* of the resource, but an *increase* in its extraction that should be viewed as a policy response to a poor taxation environment? That may or may not be true. But our variable of focus is ρ not $\Delta\rho$. Resource abundance, ρ, is generally random and exogenously distributed among countries (except some regional clustering), whereas taxation is policy induced. Figure 2 shows three histograms for resource revenues, for oil revenues (values), and for individual taxation. There seems to be a large mass near zero especially for oil. But the resource and the taxation variables also show concentration at the low end of the distribution. The fact that if any, the three distributions have similar shapes, seems to suggest poor taxation is *not* the cause of greater resource extraction.

Figure 2. Distribution of resource revenues, Oil, and individual taxation across countries



Among other variables in table 1, the inclusion of per capita GDP as a control is worth noting. This inclusion is aimed at controlling for the possibility that a resource shock (increase in resource revenues per capita) leads to an increase in GDP and hence causes taxes/GDP to fall simply because the GDP in the denominator is increasing (see Alexeev and Conrad 2009 for a similar concern). Moving from column 2 to 3 in both panels of table 1, as well as in 1', we see minor change in the size or significance of the coefficient of the oil variable (table 1 panel A and table 1') but not in the case of the resource variable (table 1 panel B). We also repeated the same inclusion and exclusion of GDP per capita for the "nearly fully" and the fully specified models for oil regressions (e.g., columns 5 and 6 of table 1 panel A). The results (not reported) showed almost no change in the key coefficient of the oil variable.

The variable Polity2 which is a measure of democratic freedoms[16] is insignificant in table 1 but is significant and positive in one model of Table 1' (column 4). Given that the results are not robust, one may refrain from speculation, but the larger variation in institutions in the "all county sample" that includes OECD may be responsible for this effect. Importantly, however, whether this variable is included or excluded, our key coefficient of interest–that of resource revenues–hardly changes (compare columns 3 and 4 in either panel). This is consistent with the earlier discussion (preceding equation 17) regarding G and also the discussion (subsequent to equation 19) regarding the government utility function.

[16] Polity2 is a revised combined polity score. "This variable is a modified version of the POLITY variable added in order to facilitate the use of the POLITY regime measure in time-series analyses. It modifies the combined annual POLITY score by applying a simple treatment, or 'fix,' to convert instances of "standardized authority scores" (i.e., -66, -77, and -88) to conventional polity scores (i.e., within the range, -10 to +10)." (Polity IV Project). Specifically, the value -66 (foreign 'interruption') is treated as 'system missing;' -77 ('interregnum,' or anarchy), is converted to a 'neutral' score of '0;' -88 ('transition') is prorated across the span of the transition" (see Polity IV Project for more details).

The variable "exchange rate" is a measure of exchange rate from the IMF that captures possible influence of exchange rate overvaluation arising in resource rich countries (the Dutch disease) and its impact on the economy and tax payments. To address this potential path through which natural resources may impact taxes, we first regressed exchange rate against lagged and twice lagged values of our resource variable and then used the predicted values of real effective exchange rate in a regression of our taxation variable (stage 2). Results, shown in columns 7 of table 1-panel A, column 6 of table 1-panel B and table 1'), continue to indicate the strength of the direct channel of resource-taxation hypothesis.

Finally, we recognize that oil is generally, even if not exclusively, associated with the MENA region with a geographic concentration and a common history, while the natural resource variable does not have this property due to its broad scope and its varied nature. We therefore ask whether the MENA factor is what drives the results, at least in the case of the oil variable. Since introducing a MENA dummy in panel estimation methods is not possible, we examine the role of MENA indirectly. We do this by removing the MENA group from the sample and examine what this removal does to the key coefficient of interest. The last column of table 1 panel A shows that if any the negative effect of oil on personal income taxation intensifies. Thus, MENA's institutional and historical similarities do *not* seem to drive what appears to be a more universal oil effect. Later, we examine the oil effect within MENA itself and verify that replicates this global effect.

In short, tables 1 and 1' are consistent with the first pillar of our hypotheses; that resource rich countries collect fewer revenues from personal taxes. We will see below that this result is associated with the second pillar, i.e., a reduced need for transparency in these countries and a corresponding reduced tax compliance among the citizens of such countries.

At this point, there is a "branching" of the pathway to test the theory, due to the differences between the main and the alternative model. We begin with the main model.

4.5 Testing the Base Model: Transparency and Tax Compliance

To design the empirics such that they reflect the key structure of the base model, we focus on estimating the transparency and the compliance equations. We note that in equation 21 in which the government optimally chooses the level of transparency, the degree of tax compliance, μ^*, is endogenous and optimally chosen by the citizens. This is seen from equation 21 in which $\mu^* = \mu^*(.,T)$ coming from equation 14. In effect then equation 21 is a reduced form equation which can be estimated with the endogenous structure of compliance as the latter is already incorporated. The only condition for the equation to hold is that tax compliance should have the right curvature as described. To examine this aspect of the theory correctly we note that government as the first mover (Stackelberg leader) optimizes over its level of transparency, T^*, incorporating citizen tax compliance response $\mu(T|t)$. Thus given a tax rate, this compliance response must be consistent with the government move (i.e., it must be subgame perfect). We therefore approach the estimation in the following way.

We use an Instrumental Variables (IV) method to estimate the tax compliance equation $\mu^*(T|t)$ in which the transparency , T^* is an endogenous regressor. We also add a second endogenous regressor, T^{*2}, to test the concavity of the compliance function per requirement of the theory. The choice of instrument is critical. Although the oil (resource) variable ρ is a natural instrument to choose, this variable may also be correlated with tax compliance (in fact table 1 tells us that it is at least correlated with overall tax collections). Thus, while the oil (resource) variable is exogenous, it likely affects both the compliance and the transparency equation and therefore is not an appropriate instrument. In search of a strong instrument we find Polity2 as promising. First, theoretically, democracy and transparency are likely associated. Second, there is no *a priori* reason to expect democracy and tax compliance to be related, other than through the transparency mechanism we have extensively discussed.[17] Third, our IV regressions, reported below, show that in fact Polity2 is highly correlated with transparency. Thus, Polity2 seems to satisfy all the "strong instrument" criteria.

Measuring tax compliance is the next challenge. We note that data on taxes come in the form of *tax revenue*, not tax compliance. In the language of the theory we have data on $t\mu$ but not on μ. Yet our dependent variable in the second equation must be an estimate of tax compliance μ not tax revenue $t\mu$. To address this problem we recognize from the expression after the second equality in equation 7 i.e., $G/Y = [(1-b)(\rho + t\mu^*(t, .)]$, that knowing G/Y and ρ we would know the value of t. It follows that by empirically controlling for the value of G/Y (which is determined by political economy considerations), the variations in t are controlled for, since the resource revenue share per GDP, ρ is given, entering the regressions as exogenous.

Pinning our analysis on the very theory that we would like to confirm runs the risk of being circular. Thus we seek an independent corroboration of our tax compliance measure: Friedman, et. al. (2000) have shown that tax avoidance is associated with a greater share of the unofficial economy. Using their estimate for 1- share of unoffical economy (converting their proxy for tax avoidance to tax compliance) for their 69 countries in 1995 (which is their available data), we then ran the same IV model for their tax compliance variable and for ours, when ours data is tailored to conform to theirs. We then examined the correlation between their *predicted* values of compliance and ours from these IV regressions. We found the correlations ranged anywhere from a low value of 78% to a high value 87% depending on the choice of controls and regressors. Thus, we feel with some confidence that in fact our measure above does capture tax compliance.

[17] To examine this claim we ran a pilot test of regressing tax compliance (using a measure derived from the discussion below) on all other variables *and* Polity2. The latter showed no significance.

Table 2 and 2' present the results, with table 2 focusing on non-OECD group and table 2' on "all" countries. Each table has three models, based on inclusion or exclusion of select controls to examine the robustness of the results, and each model has two columns for stage 1 and stage 2 regressions, associated respectively with the endogenous variable (transparency) regressions, and the main (tax compliance) regressions. Although transparency-squared is our second endogenous variable, regressions for transparency-squared are not shown to save space. Of the three models that are presented, one does *not* control for G/Y, notwithstanding the above discussion about the role of G/Y as a necessary control. The reason for this is discussed later below. Finally, all regressions control for the regional clustering of the error around MENA region, given the resource, geographic and institutional similarities of the countries in that region.

Table 2, stage 1 shows a highly significant and negative effect of the lagged oil variable on transparency. When we do this for the resource variable, the coefficient is *not* significant. So, it is not reported here. It follows that transparency is negatively and significantly associated with oil value per GDP but *not* with resources revenue at large. This result is consistent with, and echoes, the findings in Mohtadi, Ross and Ruediger (2014) where oil, but not mineral resources, showed robust adverse transparency effect. Although our model does not distinguish between oil and other natural resources, it is easier to estimate the effects of oil because of its prevalence: between 90 and 95 percent of the global minerals trade is made of petroleum alone. This prevalence factor, combined with the fact that where oil is the prevailing resource–it constitutes a large part of the economy–are probably responsible for the differences in our findings between oil and other natural resources. For example, of the 20 most resource-dependent countries in the world in 2010, 16 were dependent on oil and gas, while just four were dependent on non-fuel minerals[18].

The reasons for a lack of transparency may entail a range of institutional variables such as level of development, political institutions, colonial history, etc.. But Polity2 most likely captures a significant part of these institutional mechanisms. The fact that the coefficient of Polity2 is quite significant as seen from stage 1 regressions confirms the importance of these mechanisms. This variable (and its square) was shown to be strong instrument for the endogenous regressors, as was explained earlier.

We now focus on the tax compliance results in table 2: from the stage 2 estimates we observe a positive and significant coefficient of the linear term and a negative and significant coefficient of the quadratic term; that is, tax compliance *increases* with increased transparency but at a *decreasing* rate, i.e., tax compliance is *concave* in transparency.

Thus, in terms of the theory table 2 is consistent with the full model; the results on the negative effect of oil on transparency are consistent with equation

[18] Another factor may be state ownership, which is more common in the petroleum sector than in non-fuel minerals. Mahdavi (2015) shows that corruption rates are apparently higher in oil-producing countries in which decision-making authority is vested in state-owned oil companies.

23 and the results on the increasing by concave effect of transparency on tax compliance are consistent with equation 16. (This equation also happens to be the pre-requisite for the satisfaction of equation 23.) Results for table 2' (all country sample) confirm the negative role of oil revenues in transparency but they are less significant and less robust in terms of the concavity of tax compliance, even as the sign of the coefficients still indicate the "right" curvature.

One might ask: is it possible that the observed concavity simply reflects the fact that less transparent governments are more successful in hiding tax revenues and thus under-reporting them? If this is what produces the observed concavity, then we must observe the same under-reporting by governments for other types of taxes. We therefore tried to re-examine the results of table 2 and 2' for several other tax types: import taxes, export taxes, taxes from all international trade transactions, taxes including and excluding social contributions, and taxes on resources. While some (not all) of the alternative tax measures produced a positive linear coefficient when regressed against predicted transparency, *none* produced concavity (i.e, a negative and significant coefficient of the nonlinear term). Thus, we believe, with some confidence, that it is in fact compliance of individual tax payers (per theory) that produces the results observed in tables 2 and 2'.

A final issue is whether government spending might itself depend on oil revenues and whether such a potential link affects our main findings. For example Ross (2012, chapter 2) has argued that governments in oil producing countries may spend relatively more than those in other countries. In our empirical model, this would result in a colinearity between the government consumption variable and the oil variable. To see if such a potential colinearity, even if it exists, would affect our main results, we compare the column-pairs 1 and 2 with the column-pairs 3 and 4. The pairs differ only by the exclusion or the inclusion of the government consumption variable. For table 2 which focuses on the non-OECD group, the result indicate almost *no influence* on our key coefficients, i.e., either the role of oil in transparency or the curvature of the tax compliance variable. But excluding government consumption G/y raises a different problem: We have argued earlier than having G/y as a control is necessary to extract a proxy for tax compliance per GDP (μ in the model) from tax revenue per GDP ($t\mu$ in the model) by indirectly controlling for variations in the tax rate t via controlling for G/y. But the fact that columns 2 and 4 yield the *same* coefficient for transparency (represented by T in the model) means basically that $\partial(t\mu)/\partial T = \partial(\mu)/\partial T$. That is, both tax revenue per GDP and tax compliance per GDP indicate the same behavior with respect to transparency. This is of course possible if the tax rate, t, is *independent* of transparency. This is a reasonable inference but cannot be directly tested due to lack of tax rate data. However, it can be indirectly examined if we infer that the expression after second equality in equation 7 should imply that $t = F(G/y - \rho)$ where $F(.)$ is some increasing function. Constructing a proxy for the tax rate t in this way, that is from $G/y - \rho$, we then examine the correlation between this proxy and transparency T and find that correlation to be -0.021 which is almost zero. Thus our proxy for tax rate is independent of transparency. This finding is consistent with the finding that the marginal impact of transparency on tax compliance in columns 2 and 4 is the same.

For table 2', the coefficients of the transparency variable *are* affected by the presence or absence of G/y when we compare columns 2 and 4, but these coefficients are nearly insignificant. So not much can be said of the marginal impact of government spending on the coefficient size in this case. However, the strong adverse effect of oil on transparency remains (columns 1 and 3).

In sum, the evidence, particularly for the non-OECD countries of the world in our sample, is consistent with our proposed theory in which the governments of oil producing countries are less reliant on income taxes, thus less transparent, in turn adversely affecting the tax-compliance of the citizens.

Table 2: IV Estimates of Oil, Transparency & Tax Compliance in non-OECD Countries

Stages 1 (Transparency) Stage 2 (Tax Compliance)

	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
dependent variable:	Transparency	Taxes on Individual	Transparency	Taxes on Individual	Transparency	Taxes on Individuals
	(1)	(2)	(3)	(4)	(5)	(6)
Transparency		33.7079**		33.2994**		19.8346*
		(0.6161)		(1.1490)		(1.6744)
Transparency squared		-12.8802*		-15.6030**		-6.5286
		(1.4787)		(0.8835)		(1.0578)
Log(GDP per Capita)	0.0863***	-0.9896*	0.0820***	-0.9790***	0.0828***	-0.8651**
	(0.0077)	(0.0795)	(0.0083)	(0.0013)	(0.0082)	(0.0176)
Lag(log(1+Oil Value p	-0.0731***	0.8361*	-0.0682***	0.3742*	-0.0697***	0.2412
	(0.0264)	(0.0864)	(0.0265)	(0.0302)	(0.0253)	(0.0903)
Gov't Consumption			0.0012***	0.0594*	0.0009**	0.0631*
			(0.0004)	(0.0068)	(0.0004)	(0.0060)
Off exchg rate					-0.0000***	-0.0000***
					(0.0000)	(0.0000)
Polity2	0.0013***		0.0012**		0.0017***	
	(0.0004)		(0.0005)		(0.0004)	
Polity2 squared	0.0002***		0.0002***		0.0002*	
	(0.0001)		(0.0001)		(0.0001)	
Constant	-0.2614***	-4.2988*	-0.4545**	-4.8832**	-0.2383***	-1.9020
	(0.0815)	(0.5383)	(0.0643)	(0.3189)	(0.0826)	(0.4648)
R2	0.894	0.685	0.890	0.753	0.900	0.820
# of observations	1843	1843	1801	1801	1781	1781
Standard errors are in parenthesis. All estimates include country and time fixed effects. Standard errors are adjusted for regional country clusters. To save space, the stage 1 regressions of the second endogenous variable, transparency squared, are not presented. They are available for interested readers.						
* p<0.10, ** p<0.05, *** p<0.01						

Table 2': IV Estimates of Oil, Transparency & Tax Compliance - All Countries
Stages 1 (Transparency) Stage 2 (Tax Compliance)

	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
dependent variable:	Transparency	Taxes on Individual	Transparency	Taxes on Individual	Transparency	Taxes on Individuals
	(1)	(2)	(3)	(4)	(5)	(6)
Transparency		13.5883		21.9144*		22.6440**
		(4.9897)		(2.2339)		(1.4544)
Transparency squared		-0.2596		-8.6789		-8.6346*
		(4.3476)		(1.7780)		(1.0925)
Log(GDP per Capita)	0.0927***	-0.4565**	0.0925***	-0.7427**	0.0901***	-0.7838***
	(0.0077)	(0.0346)	(0.0082)	(0.0152)	(0.0080)	(0.0073)
Lag(log(1+Oil Value p	-0.0459*	0.2103**	-0.0416	0.0077	-0.0539**	0.1926*
	(0.0271)	(0.0058)	(0.0272)	(0.0184)	(0.0252)	(0.0264)
Gov't Consumption			0.0003	0.0723**	0.0005	0.0656**
			(0.0004)	(0.0048)	(0.0037)	(0.0051)
Off exchg rate					-0.0000**	-0.0000***
					(0.0000)	(0.0000)
Polity2	0.0035***		0.0035***		0.0032***	
	(0.0004)		(0.0004)		(0.0004)	
Polity2 squared	0.0002***		0.0002**		0.0001*	
	(0.0001)		(0.0001)		(0.0001)	
Constant	-0.3074***	-2.4202	-0.4552***	-3.1766	-0.0989***	-3.3615*
	(0.0854)	(1.2099)	(0.0682)	(0.5605)	(0.0726)	(0.4089)
R2	0.883	0.946	0.878	0.952	0.899	0.954
# of observations	2449	2449	2407	2407	2257	2257

Standard errors are in parenthesis. All estimates include country and time fixed effects. Standard errors are adjusted for regional country clusters. To save space, the stage 1 regressions of the second endogenous variable, transparency squared, are not presented. They are available for interested readers.

* p<0.10, ** p<0.05, *** p<0.01

4.6 The MENA Effect

Many countries in the Middle East and North Africa region share similar institutions and access to a natural resource, notably oil. So, it is natural to ask: how do these results relate to the MENA region? Are they more exaggerated or less so? Does the tax mechanism work the same way for this group as for oil producing countries at large? Unfortunately, the paucity of tax data on the MENA countries for the years of coverage is so great that answering these questions with regressions is not possible. Instead, we opt for a means testing approach to learn what we can from the existing data that is available for the MENA group. Since our interest is to uncover any potential oil-taxation-transparency mechanism, our descriptive approach needs to be able to sort out the large oil MENA producers from those that have little or no oil. Table 3 indicates a list of all MENA countries with their corresponding "oil value per GDP" statistic for every 5-year period from 1980 to 2010.

Table 3: The MENA Oil Divide

Panel A: Low Oil Countries						
Country	1980 to 1984	1985 to 1989	1990 to 1994	1995 to 1999	2000 to 2004	2005 to 2009
Israel	0.0001407	0.000052	2.04E-05	6.02E-06	6.77E-06	0.0000148
Jordan	0	0.0002464	0.000227	0.0000313	0.0000305	0.0000279
Lebanon		0	0	0	0	0
Morocco	0.0002566	0.0001559	5.85E-05	0.0000308	0.0000665	0.0001681
Panel B: High Oil Countries						
Country	1980 to 1984	1985 to 1989	1990 to 1994	1995 to 1999	2000 to 2004	2005 to 2009
Algeria	0.1726284	0.068443	0.0989676	0.1526746	0.2135253	0.2902671
Bahrain	0.1411249	0.0773221	0.0590088	0.0387357	0.0421323	0.0479711
Egypt, Arab Rep.	0.2651309	0.148503	0.1378743	0.0734093	0.081758	0.1071546
Iran, Islamic Rep.	0.1762858	0.107267	0.2692671	0.2054304	0.2717864	0.3055223
Iraq	0.3280041	0.2761623		0.6383151	0.7189637	0.5058031
Kuwait	0.4586923	0.3237851	0.3200332	0.376527	0.4123699	0.4557388
Libya			0.2664281	0.2689943	0.4289362	0.5080547
Oman	0.4349989	0.367584	0.3516629	0.3204047	0.3536384	0.369795
Qatar	0.4593741	0.2992678	0.3243213	0.3027244	0.2932655	0.256834
Saudi Arabia	0.4332452	0.2834259	0.3639723	0.3050029	0.3573604	0.434051
Syrian Arab Republic	0.1308736	0.1266442	0.2452927	0.2368226	0.2089458	0.2113716
Tunisia	0.1422925	0.0719041	0.0469214	0.0253495	0.0310882	0.0521574
United Arab Emirates	0.298184	0.2293215	0.2622716	0.1786732	0.1856722	0.2329787
Yemen, Rep.			0.2385954	0.3171698	0.3360328	0.3129333

It is clear from this table that two groups of countries can be distinguished, countries with very low oil value as a share of GDP are shown in panel A, notably Lebanon, Israel, Jordan[19] and Morocco, and the rest of the MENA countries are shown in panel B. Taking this as our clue, we study the mean

[19]It might be noted that Jordan relies on remittences and aid from oil producing countries. Notheless, the lack of direct ownership of oil resources seems to play some role in putting Jordan among the more transparent MENA states.

value of transparency and individual taxation for each of our two groups. Table 4 presents this result as well as the mean oil value per GDP for each group.

Table 4: Mean Values of Oil, transparency & Income Tax for two groups

	low oil group	high oil group	tstat of the difference of means: high vs low oil
Oil Value per GDP	0.00007 (n=116)	0.30338 (n=403)	-30.75***
Transparency	0.52944(n=124)	0.43547 (n=424)	6.66***
Polity2	-0.20183 (n=109)	-7.05769 (n=416)	9.8***
Taxes on Individuals per GDP	4.20764 (n=58)	0.97085 (n=114)	5.2***
*** p<0.01			

High oil MENA countries experienced less transparency and lower individual income taxation than the low oil group.[20] While these results are unable to examine the deeper structural question regarding tax the compliance mechanism they are entirely consistent with our hypothesis that oil shelters governments from the need to answer to their constituents and as such reduces their incentive for openness and transparency. One policy implication is that a move from low transparency to high transparency would be associated with a rise in the income tax revenue as a share of GDP. This also implies that the 2014-15 collapse in global oil prices could bring about an increase in the level of transparency, political openness and taxation in the MENA region as the model predicts.

[20] This is consistent with the findings from Open Budget Index (2015) (OBI) in which many MENA countries received low scores. A ranking of 100 countries by their budget transparency, the OBI is prepared biannually by the International Budget Partnership, an NGO. The region's highest-ranked country was Jordan, which received 55 out of 100 possible points. The OBI identified 17 countries that publicly disclose little or no budget information; seven are from the MENA region (Algeria, Egypt, Sudan, Qatar, Lebanon, Saudi Arabia, and Iraq). The report notes that many of these states annually prepare essential budget documents but fail to release them to the public; simply disclosing these pre-existing documents could significantly boost their OBI scores.

4.7 Testing the Alternative Model: Public Sector Efficiency and Tax Compliance

Equation 22', 24 and 25 suggest that if tax payer compliance is concave in transparency, then we will have a multiple equilibrium where, if the state of governance is characterized with limited transparency–i.e., less than some threshold given by the right hand side of 25–then an increase in resource revenue further inhibit transparency; by contrast with sufficient level of transparency to begin with (greater than the right hand side of 25) an increase in resource revenues further improves transparency. We test this by dividing the sample into low and high transparency countries relative to the sample mean. We then regress transparency against oil value per capita (or its lags) and various controls in each sub-sample in an empirical specification similar to the stage 1 regressions of table 2. The multiple equilibrium result of the model predicts that "low transparency countries" have a negative coefficient of the oil variable and high transparency countries a positive coefficient. Table 5 reports the results. Contrary to the theory, the coefficients are negative for *both* cases regardless of the model specification. Even if multiple equilibrium were to be possible with two different negative coefficients, the coefficients of the high transparency group must be smaller in absolute value (less negative) than the low transparency group so as to approach equilibrium faster. This does not seem to be the case in table 5. We therefore reject model 2, based on the scrutiny-cum-public goods efficiency hypothesis. It may be argued that the absence of a publics goods efficiency variable (z) could lead to model specification bias. But from theory, z depends on T and that dependence is already incorporated in equation 25. It is of course possible that an alternative formulation that would allow for a different interpretation of the Devarajan et al. (2011)–for example one where citizen scrutiny does *not* depend on government decision of how much information to reveal–could find support by the evidence. But as it stands transparency seems to be the key driving force.

Table 5. Test of Multiple Equilibrium Implications of the Alternative Model

Dependent Variable: Transparency Index								
	Level of Transparency							
	High trans	Low trans	High trans	Low trans	High trans	Low trans	High trans	Low trans
Lag[log(1+Oil Value per GDP)]	-0.1542	-0.0620	-0.1515	-0.0473	-0.1415	-0.1067**	-0.1463*	-0.1254***
	(0.1077)	(0.0545)	(0.1076)	(0.0395)	(0.0862)	(0.0460)	(0.0793)	(0.0464)
2 Lags[log(1+Oil Value per GDP)]					0.0073	0.0094	0.0170	0.0096
					(0.0980)	(0.0301)	(0.1004)	(0.0310)
3 Lags[log(1+Oil Value per GDP)]					-0.0570	-0.0172	-0.0607	-0.0121
					(0.0736)	(0.0274)	(0.0717)	(0.0283)
Log(GDP per Capita)	0.0411	0.0227	0.0411	0.0208	0.0629**	0.0213	0.0608**	0.0267*
	(0.0256)	(0.0171)	(0.0252)	(0.0169)	(0.0281)	(0.0146)	(0.0270)	(0.0147)
Polity2	0.0036***	0.0017*	0.0036***	0.0015*			0.0037***	0.0014
	(0.0012)	(0.0009)	(0.0012)	(0.0009)			(0.0013)	(0.0009)
Exchage rate	0.0000***	-0.0000***	0.0000***	-0.0000***	0.0000*	-0.0000***	0.0000**	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Taxes intern trade & trans per GDP	-0.0053*	0.0031*	-0.0053*	0.0029**	-0.0062**	0.0029*	-0.0054*	0.0024
	(0.0030)	(0.0016)	(0.0030)	(0.0015)	(0.0029)	(0.0015)	(0.0030)	(0.0015)
Gov't Consumption per GDP			-0.0008	0.0008*	-0.0005	0.0009*	-0.0008	0.0009*
			(0.0015)	(0.0004)	(0.0019)	(0.0004)	(0.0016)	(0.0004)
Constant	0.2552	0.2017*	0.2676	0.2046*	0.1066	0.2006**	0.1234	0.1798*
	(0.2116)	(0.1166)	(0.2010)	(0.1140)	(0.2196)	(0.1005)	(0.2117)	(0.1013)
R2	0.394	0.234	0.394	0.252	0.369	0.239	0.389	0.274
# of observations	1810	1161	1807	1085	1809	1115	1726	1020
# of countries	115	91	115	90	124	96	115	88

using heteroskedasticity robust standard errors, standard errors are adjusted for country clusters

* p<0.10, ** p<0.05, *** p<0.01. All estimates include country and time fixed effects.

5 Conclusion

Mohtadi, Ross and Ruediger (2014) showed that more oil is associated with less transparency. In this paper we try to explain why this occurs. Economic historians suggest that the need for public finance in early modern Europe eventually forced governments to become more accountable to their citizens (North 1990, North and Weingast 1989, Hoffman and Norberg 1994). We extend this insight to show how windfall revenues from oil and possibly other natural resources also can diminish any incentive for governments to make their policies and institutions more transparent.

We develop a simple analytic framework in which government, acting as a Stackelberg leader, chooses an optimum level of transparency that maximizes a utility that entails some diversion of resources and thus the need for opacity. Citizens knowing this comply only partly with taxation, since an opaque government is less likely to enforce tax laws rigorously or impartially.

Testing this result with three novel datasets on transparency, oil values, and taxes, we find support quite consistent with the structural and analytical mechanism suggested by the model. Although our analysis of the MENA region is constrained by the scarcity of taxation data, the available data are consistent with the theory: oil-rich MENA states are highly opaque and maintain exceptionally low income taxes, while MENA states without oil look much like the rest of the developing world. The region's most distinctive feature, on the issues we scrutinize, is simply its concentration of oil-dependent states.

We also test an alternative model based on the notion that citizen scrutiny would improve government accountability of public spending. We argue that the ability for citizens to scrutinize the public sector is likely to depend on the flow of information that the government controls. If this is the case, our alternative model leads to a multiple equilibrium outcome for which we do not find support in the evidence.

Yet, in a world where the government does act in the public interest, the policy relevance of our findings is tied to several proposals (Sala-i-Martin and Subramanian 2003, Devarajan et al.2011) in which the transfer of oil revenues directly to the public is a way of avoiding the resource curse. These proposals rely on the principle that households can better spend the money than an oil-rich government with weak accountability and suggest that transferring oil revenues to citizens and then taxing them to finance public goods may improve the quality of public expenditures. This paper provides empirical evidence in support of that proposition, since it shows that higher levels of taxation are associated with higher levels of transparency. In light of the 2014-15 collapse in oil prices, it also raises the possibility that the resulting fall in natural resource revenues will ultimately bring about increases in transparency, political openness and tax collection in the MENA region.

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Appendix

1. List of Countries in the sample

Table A1.. List of All Countries...............Table A2. of which the following are OCED as of 1980 (start of study)

all Countries		
Afghanistan	Gabon	Niger
Albania	Gambia, The	Nigeria
Algeria	Georgia	Norway
Angola	Germany	Oman
Argentina	Ghana	Pakistan
Armenia	Greece	Panama
Australia	Guatemala	Papua New Guinea
Austria	Guinea	Paraguay
Azerbaijan	Guinea-Bissau	Peru
Bahamas, The	Guyana	Philippines
Bahrain	Haiti	Poland
Bangladesh	Honduras	Portugal
Barbados	Hungary	Qatar
Belarus	Iceland	Romania
Belgium	India	Russian Federation
Belize	Indonesia	Rwanda
Benin	Iran, Islamic Rep.	Saudi Arabia
Bhutan	Iraq	Senegal
Bolivia	Ireland	Sierra Leone
Bosnia and Herzegovin	Israel	Singapore
Botswana	Italy	Slovak Republic
Brazil	Jamaica	Slovenia
Brunei Darussalam	Japan	Solomon Islands
Bulgaria	Jordan	Somalia
Burkina Faso	Kazakhstan	South Africa
Burundi	Kenya	Spain
Cambodia	Korea, Rep.	Sri Lanka
Cameroon	Kuwait	Sudan
Canada	Kyrgyz Republic	Suriname
Cape Verde	Lao PDR	Swaziland
Central African Republi	Latvia	Sweden
Chad	Lebanon	Switzerland
Chile	Lesotho	Syrian Arab Republic
China	Liberia	Tajikistan
Colombia	Libya	Tanzania
Comoros	Lithuania	Thailand
Congo, Dem. Rep.	Luxembourg	Timor-Leste
Congo, Rep.	Macedonia, FYR	Togo
Costa Rica	Madagascar	Trinidad and Tobago
Cote d'Ivoire	Malawi	Tunisia
Croatia	Malaysia	Turkey
Cyprus	Maldives	Turkmenistan
Czech Republic	Mali	Uganda
Denmark	Malta	Ukraine
Djibouti	Mauritania	United Arab Emirates
Dominican Republic	Mauritius	United Kingdom
Ecuador	Mexico	United States
Egypt, Arab Rep.	Moldova	Uruguay
El Salvador	Mongolia	Uzbekistan
Equatorial Guinea	Morocco	Venezuela, RB
Eritrea	Mozambique	Vietnam
Estonia	Namibia	Yemen, Rep.
Ethiopia	Nepal	Zambia
Fiji	Netherlands	Zimbabwe
Finland	New Zealand	
France	Nicaragua	

OECD countries		
Australia	Greece	Norway
Austria	Iceland	Portugal
Belgium	Ireland	Spain
Canada	Italy	Sweden
Denmark	Japan	Switzerland
Finland	Luxembourg	United Kingdom
France	Netherlands	United States
Germany	New Zealand	

Table A3. Descriptive Statistics

all Countries	count*	mean	sd	min	max
Transparency	5326	0.481573	0.172255	0.01	0.87
Oil Value per GDP	4743	0.068658	0.204363	0	5.161178
Resource Revenue per GDP	940	13.54209	14.25519	-0.72101	79.11037
GDP per capita (const 2005 US$)	5480	9957.447	16458.2	50.04221	158802.5
Gov't Consumption per GDP	4976	16.65318	8.189839	1.375188	164.6963
Polity2	4669	1.683872	7.238787	-10	10
Taxes on Individuals per GDP	2968	4.206779	4.617985	0	26.25562
Taxes intern trade and trans per GD	3880	3.098318	3.648829	-0.02934	39.17577
Official exchange rate	5437	1236894	9.12E+07	9.33E-12	6.72E+09
non-OECD sample	count*	mean	sd	min	max
Transparency	4169	0.46573	0.159927	0.01	0.87
Oil Value per GDP	3691	0.07327	0.21996	0	5.161178
Resource Revenue per GDP	940	13.54209	14.25519	-0.72101	79.11037
GDP per capita (const 2005 US$)	4069	4333.777	6983.571	101.7755	55526.16
Gov't Consumption per GDP	3826	16.09134	8.497774	2.047121	164.6963
Polity2	3571	0.660319	6.865637	-10	10
Taxes on Individuals per GDP	2283	2.316201	2.265805	0	16.81312
Taxes intern trade and trans per GD	3185	3.694188	3.76E+00	-2.93E-02	3.92E+01
Official exchange rate	4196	1602670	1.04E+08	9.33E-12	6.72E+09
*"Count" is N x T where N is the number of countries for a given variable and T is sample period.					

Table A4. Variable Descriptions

Variable Name	Variable Description	Source
Transparency	Transparency Index	Release of Information Index by Williams (2009 & 2011), World Development Indicators, International Monetary Fund
Oil Value per GDP	quantity of oil and gas extracted in a given year multiplied by the per-unit world price divided by GDP	Ross (2013)
GDP per capita (const 2005 US$)	GDP per capita in constant 2005 US$	WDI
Gov't Consumption	Natural log of convernment consumption per GDP	WDI
Polity2	Revised Combined Polity Score; measuring on a scale from -10 to +10 the polity of a country	"Political Regime Characteristics and Transitions, 1800-2013 Dataset Users' Manual Monty G. Marshall Center for Systemic Peace and Societal-Systems Research Inc Ted Robert Gurr University of Maryland Keith Jaggers Colorado State University
Resource Rev	Resource Revenue per GDP	International Center for Tax and Development; Prichard, Wilson, Alex Cobham, and Andrew Goodall. "The ICTD Government Revenue Dataset." (2014). [ICTD]
Taxes on Individuals	Taxes on Individuals	ICTD
Taxes intern trade and trans	Taxes on international trade and transactions	ICTD
Off exchg rate	Official exchange rate (LCU per US$, period average)	WDI

Table A5. Testing Reverse Causality from Taxation to Oil Extraction

dependent variable: log(1 + oil value per GDP)						
Tax on Individuals	-0.0039	0.0021	0.0022	0.0023	0.0021	-0.0004
	(0.0030)	(0.0030)	(0.0031)	(0.0032)	(0.0037)	(0.0015)
Lag(Tax on Individuals)	0.0025	0.0023	0.0020	0.0022	0.0028	0.0012
	(0.0025)	(0.0025)	(0.0025)	(0.0027)	(0.0030)	(0.0017)
Gov't Consumption		-0.0043	-0.0044	-0.0044	-0.0045	-0.0012**
		(0.0030)	(0.0030)	(0.0030)	(0.0031)	(0.0006)
Log(GDP per Capita)			0.0047	0.0048	0.0066	0.0071
			(0.0111)	(0.0114)	(0.0117)	(0.0106)
Polity2				0.0001	0.0002	-0.0000
				(0.0006)	(0.0006)	(0.0004)
Taxes intern trade and trans					-0.0006	0.0001
					(0.0012)	(0.0006)
fcrf_hat_nonOECD						-0.0000*
						(0.0000)
Constant	0.0572***	0.1181***	0.0843	0.0850	0.0780	0.0121
	(0.0053)	(0.0427)	(0.0956)	(0.1007)	(0.1059)	(0.0718)
R2	0.046	0.120	0.120	0.119	0.123	0.159
# of observations	1882	1834	1799	1723	1639	1533
# of countries	123	123	122	116	112	111
using heteroskedasticity robust standard errors, standard errors are adjusted for country clusters						
* p<0.10, ** p<0.05, *** p<0.01						