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Natural Resource Endowments, Governance, and the Domestic Revenue Effort: Evidence from a Panel of Countries

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Abstract

The recent development literature stresses that countries that receive large revenues from natural resource endowments typically raise less revenue from domestic taxation, and that this creates governance problems because the lower domestic tax effort reduces the incentive for the public scrutiny of government. Our results from a panel of 30 hydrocarbon producing countries indicate that the offset between hydrocarbon revenues and revenues from other domestic sources is about 20 percent but that it is invariant to governance indicators.

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I. Introduction

The recent development literature stresses that countries receiving large revenues from natural resource endowments typically raise less revenue from domestic taxation, and that this creates governance problems because the lower domestic tax effort reduces the incentive for the public scrutiny of government (e.g., Moore, 1998, 2007; Collier and Hoeffler, 2005; and Collier, 2006).[2] A similar and older argument has been made with respect to the impact of foreign aid on the domestic revenue effort (Bauer, 1976). In both cases, relying on revenues from sources other than domestic taxation is seen as reducing incentives to strengthen domestic revenue mobilization. However, while there has been some empirical work on the impact of foreign aid on the domestic revenue effort, the impact of natural resources on the non-resource-related tax base has received scant attention.[3] In this paper, we focus on the relation between natural resource endowments and the domestic (non-resource-related) revenue effort in natural resource-rich countries. Specifically, we examine whether there is evidence of an offset between government revenues from hydrocarbon (oil and gas) related activities and revenues from other domestic sources in a panel of 30 hydrocarbon producing countries. Our results indicate that there is an offset of about 20 percent, which is robust to the inclusion of control variables and alternate estimation methodologies.

II. Data and Methodology

Governments of countries with hydrocarbon endowments typically receive revenues from taxing the extraction companies, from the royalties these companies pay, and from production sharing arrangements. Table 1 provides summary data for these revenue streams in 30 countries for the period 1992-2005. It shows hydrocarbon revenue in relation to total government revenue (net of foreign grants) and to GDP. On both measures, revenue has increased substantially over the period (from 48.8 percent to 60.1 percent of total government revenue, and from 14.7 percent to 24.0 percent of GDP), reflecting increases in hydrocarbon production and world prices, and in the tax and royalty rates applied to the hydrocarbon sector. Figure 1 plots for the same countries hydrocarbon revenues against non-hydrocarbon domestic revenues (both in percent of GDP).[4]

We model non-hydrocarbon domestic revenue, R^{NH}, as a function of revenue from hydrocarbon products, R^{H}, normalized by GDP, Y, and a series of control variables. The basic equation that we estimate is:

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[2] This contrasts sharply with the early development literature which viewed a sizeable endowment of natural resources as helping countries to grow (e.g., Lewis 1955; Viner, 1952).

[3] See Gupta et al (2004) for a survey of the debate on the relation between foreign aid and the domestic revenue effort and a contribution to the empirical evidence.

[4] The total government revenues (i.e., hydrocarbon plus other domestic tax and non-tax revenues) of hydrocarbon and non-hydrocarbon producing countries are broadly similar. For example, the average total government revenue-to-GDP ratio in our sample of hydrocarbon producers is 29.6 percent, which compares to an average ratio of about 28 percent in a sample of 60 non-hydrocarbon producing countries.

Table 1. Government Revenue from Hydrocarbons, 1992–2005

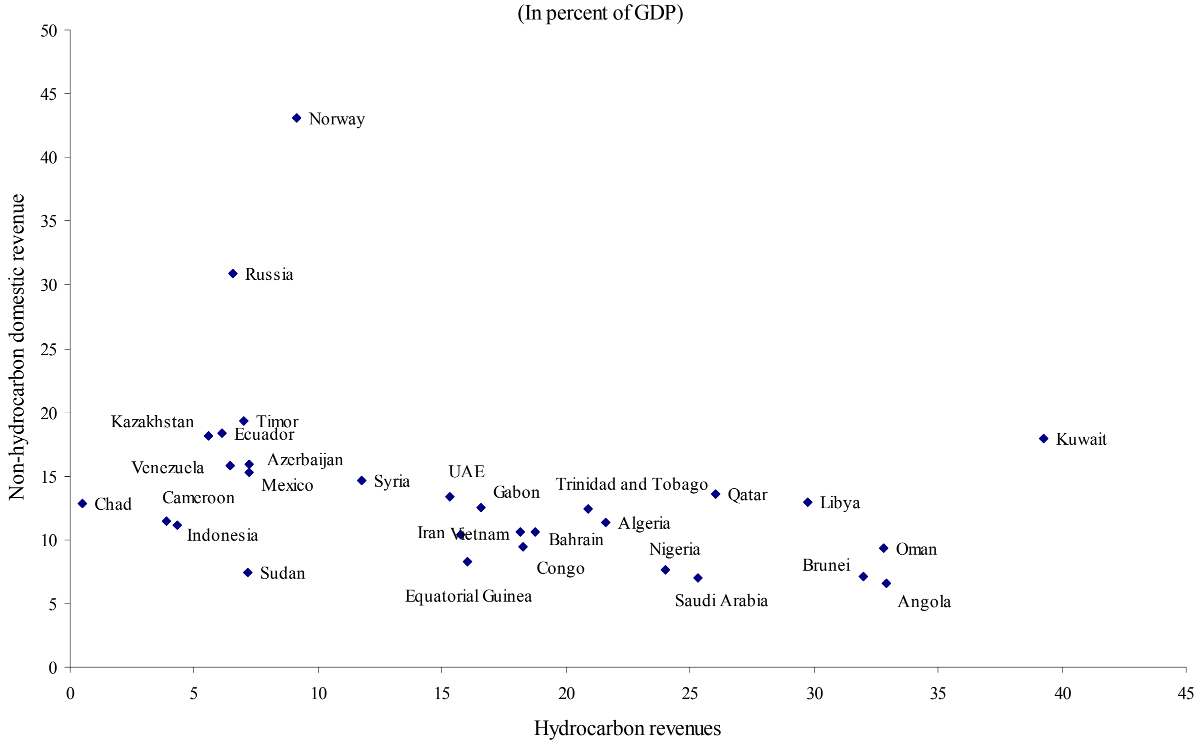
	In percent of: GDP	Total Revenue
Africa	16.0	52.4
Angola	32.9	83.6
Cameroon	3.9	25.2
Chad	0.5	4.0
Congo	18.3	64.7
Equatorial Guinea	16.0	59.0
Gabon	16.6	56.3
Nigeria	24.0	73.8
Asia-Pacific	14.3	45.8
Brunei	32.0	81.2
Indonesia	4.3	27.9
Vietnam	6.5	28.3
Europe	7.9	17.1
Russia	6.6	17.0
Norway	9.2	17.2
Middle East	20.0	57.2
Algeria	21.6	64.8
Azerbaijan	7.2	29.2
Bahrain	18.7	63.0
Iran	15.7	58.8
Kazakhstan	5.6	22.2
Kuwait	39.3	68.3
Libya	29.7	65.3
Oman	32.8	77.1
Qatar	26.0	65.7
Saudi Arabia	25.3	77.0
Sudan	7.2	43.8
Syria	11.7	44.3
UAE	20.9	62.6
Yemen	18.1	58.2
Western Hemisphere	8.9	33.7
Ecuador	6.1	24.5
Mexico	7.2	31.8
Trinidad and Tobago	7.0	26.1
Venezuela	15.3	52.5
Average	16.2	49.1

Source: International Monetary Fund.

$$\left(\frac{R^{NH}}{Y}\right)_{it} = \alpha_i + \beta_1\left(\frac{R^{H}}{Y}\right)_{it} + controls + u_{it} \qquad (1)$$

for $i = 1, \ldots, 30$ and $t = 1992, \ldots 2005$. We allow for a country specific fixed effect α_i and include the error term u_{it}, the assumptions on which are relaxed according to the estimation technique. The coefficient on β_1 indicates the marginal effect of an additional percentage point of government revenue from hydrocarbons on the non-hydrocarbon domestic revenue effort. For any estimate of β_1 less than zero, an increase in hydrocarbon revenue is associated with lower non-hydrocarbon revenue.

Figure 1. Government Revenue from Hydrocarbon and Domestic Taxes
(In percent of GDP)



For the control variables, we draw on the empirical literature on the basic determinants of cross-country variations in tax revenue-to-GDP ratios (e.g., Tanzi, 1992; Gupta 2007). Thus, our variables are: income, measured as the log of per capita GDP; openness to international trade, measured as the sum of non-hydrocarbon exports plus imports in relation to GDP; the composition of output between agriculture and non-agricultural activities; and perceptions of levels of corruption. In addition, we include dummy variables to control for common time effects that may have an impact on hydrocarbon revenues, such as the effect of the oil price.

We test three particular variations of the basic equation. First, we differentiate countries according to the relative importance of hydrocarbon revenue to GDP, where our expectation is that a larger share of revenues from hydrocarbons would have a correspondingly greater adverse impact on other domestic revenues. To this end, we interact R^H/Y with three 0,1 dummy variables that enter as 1 for countries where the share of hydrocarbon revenues in total revenue is between zero and 15 percent, greater than 15 percent but less than 25 percent, and greater than 25 percent, respectively. Second, we take explicit account of the interaction between hydrocarbon revenues and corruption by interacting R^H/Y with two corruption indices, one indicating perceptions of low corruption and the other indicating perceptions of high corruption. Finally, we interact R^H/Y with an indicator variable for periods of rising and of falling hydrocarbon revenue to determine whether any offset is symmetrical.[5]

A potential difficulty with equation (1) is that since the hydrocarbon sector often represents a significant and volatile part of GDP, the normalization of revenues by total GDP could affect the size and significance of the estimated coefficients for β_1. Specifically, if hydrocarbon production increases sharply, and hydrocarbon revenues grow relative to GDP, the non-hydrocarbon revenues may appear depressed as a fraction of GDP simply because of the increased income and the estimates for β_1 may be biased downwards. Accordingly, we decompose GDP into it hydrocarbon and non-hydrocarbon components (i.e., $Y = Y^H + Y^{NH}$) and reformulate equation (1) to estimate:

$$\left(\frac{R^{NH}}{Y^{NH}}\right)_{it} = \alpha_i + \beta_1\left(\frac{R^H}{Y^H}\right)_{it} + controls + u_{it} \qquad (2)$$

where Y^{NH} and Y^H represent the non-hydrocarbon and hydrocarbon components of GDP respectively, and the other variables are as defined previously.[6]

The data for hydrocarbon and non-hydrocarbon fiscal revenues, and for hydrocarbon and non-hydrocarbon GDP are from the International Monetary Fund;[7] and data on the control variables is taken from the World Bank's World Development Indicators database, and the data for foreign grants (to compute the domestic non-hydrocarbon revenue) is from the OECD's database on official development assistance. The corruption series is the perception-based index from the International Country Risk Guide (ICRG) dataset, which assigns risks points on a scale of 1 to 6 and is described by Keefer and Knack (1997). For the interaction with R^H/Y, 'high' corruption countries are those with risk points from 1 to 3 and 'low' corruption those with risk points from 4 to 6. Summary statistics for the key variables are reported in Table 2. The estimation method is panel OLS with fixed effects to account for time invariant, country specific effects.

[5] A period of rising (falling) hydrocarbon revenue is defined as a period in which R^H/Y is higher (lower) than in the preceding period.

[6] Non-hydrocarbon GDP excludes value added from the hydrocarbon sectors.

[7] The data are unpublished but are available from the authors on request.

Table 2. Summary Statistics for Selected Variables

Variable	Mean	Standard Deviation
R^H/Y	16.0	11.1
R^{NH}/Y	13.5	8.6
R^H/Y^H	67.0	40.7
R^{NH}/Y^{NH}	18.4	11.0
Y^H/Y	71.7	19.0
Log(GDP per capita)	7.8	1.3
Log (GDP)	3.2	1.5
Openness	81.0	32.9
Agriculture	11.3	9.7

Sample for specification (3) in Table 3. R^H and R^{NH} refer to government revenues from hydrocarbon and non-hydrocarbon domestic sources, respectively; Y, YH and YNH are nominal GDP, and its hydrocarbon and non-hydrocarbon components, respectively; openness is non-hydrocarbon exports plus imports in relation to GDP; and agriculture referes to its share in GDP.

III. Empirical Results

The empirical results are reported in Table 3. The effect of hydrocarbon revenue on the domestic revenue effort is statistically significant and negative in all specifications. The first column of the table reports results excluding the control variables. The coefficient on R^H/Y indicates that an additional percentage point of revenue from hydrocarbons reduces revenues from other domestic sources by 0.19 percentage points of GDP. The results with all control variables included are reported in column 2. The coefficient on R^H/Y is largely unchanged and the composition of GDP is the only statistically significant control variable, with non-hydrocarbon revenue ratios tending to be lower where agriculture is a large share of value added.[8]

We carried out a number of robustness checks. First, we dropped the main outlier countries (Norway, Russia and Kuwait) from the sample; these estimates are reported in column 3 and are little different from the full sample estimates. Second, as revenue ratios tend to be persistent over time, and as shocks may last for more than one period, we estimate a dynamic specification and a specification allowing for first-order autocorrelation in the residuals, the results from which are reported in columns 4 and 5, respectively. The results reported in column 4 are from using the Arellano-Bond (1991) estimator, which allows the specification of a common lagged

[8] Interestingly, the size of the offset coefficient is in line with that reported by Gupta et al. (2004) in their study of the impact of foreign aid on the domestic revenue effort.

Table 3. Panel OLS Results with Fixed Effects

Dependant variables:	R^{NH}/Y								R^{NH}/Y^{NH}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
R^H/Y	-0.1852***	-0.1850***	-0.1727***	-0.2305***	-0.2581***				
	(0.0365)	(0.0523)	(0.0353)	(0.0466)	(0.0345)				
$0 < R^H/Y < 0.15$						-0.3127***			
						(0.0655)			
$0.25 < R^H/Y < 1$						-0.2601***			
						(0.0471)			
$0.15 < R^H/Y < 0.25$						-0.2113***			
						(0.0365)			
High corruption							-0.1790***		
							(0.0357)		
Low corruption							-0.2179***		
							(0.0546)		
Periods of falling production								-0.1855***	
								(0.0428)	
Periods of increasing production								-0.1886***	
								(0.0380)	
R^H/Y^H									-0.0955***
									(0.0277)
$(R^H/Y^H)^{\wedge 2}$									0.0395***
									(0.0114)
R^{NH}/Y (t-1)				0.2428***					
				(0.0670)					
Log (GDP per capita)		-0.0005	0.0038	-0.0027	0.0244***	-0.0031	-0.0005	-0.0020	0.0369***
		(0.0089)	(0.0072)	(0.0101)	(0.0055)	(0.0074)	(0.0073)	(0.0079)	(0.0072)
Non hydrocarbon openness		-0.0218	-0.0242*	-0.0006	0.0000	-0.0195	-0.0221	-0.0159	0.0016
		(0.0205)	(0.0143)	(0.0194)	(0.0149)	(0.0151)	(0.0152)	(0.0165)	(0.0172)
Corruption		-0.0033	-0.0027	-0.0013	0.0139***	-0.0032	-0.0014	-0.0040	0.0109**
		(0.0041)	(0.0032)	(0.0037)	(0.0036)	(0.0032)	(0.0039)	(0.0035)	(0.0048)
Agriculture		-0.0017*	-0.0013*	-0.0013	-0.0006	-0.0016**	-0.0017**	-0.0017**	0.0004
		(0.0009)	(0.0007)	(0.0009)	(0.0005)	(0.0007)	(0.0007)	(0.0007)	(0.0006)
Constant	0.1575***	0.2117**	0.1507**	0.1792**	0.0000	0.2438***	0.2069***	0.2233***	0.0000
	(0.0055)	(0.0797)	(0.0611)	(0.0863)	(0.0000)	(0.0650)	(0.0640)	(0.0686)	(0.0000)
Time effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.20	0.20	0.20	0.74	0.72	0.22	0.20	0.21	0.66
F-test on equality of the coefficients						0.05	0.43	0.86	
Observations	389	290	253	244	286	290	290	268	277
Number of countries	30	25	22	25	24	25	25	25	24

Column (4) report results using the Arellano Bond estimator, where corruption is instrumented with lagged values.
The results in column (5) and (9) correct for member specific first order serial correlation in the residuals, and corrected standard errors.
Standard errors are in parenthesis below the estimated coefficients. ***, ** and * indicate statistical significance at the 1 percent, 5 percent , and 10 percent levels, respectively.

effect and allows us to instrument corruption with lagged variables to address potential endogeneity. The estimated dynamic effect is significant but modest in size (0.24). In column 5, we report results from an estimation that allows member specific autocorrelation and presents corrected standard errors.[9] The coefficient on R^H/Y in columns 4 and 5 is somewhat larger, indicating a decline in non-oil and gas revenues of 0.25 percentage points of GDP. The control variables are not statistically significant in specification 4, but in specification 5 non-

[9] The procedure assumes that disturbances are heteroskedastic and serially correlated, with member specific autocorrelation coefficients. The average estimated AR(1) coefficient is 0.66.

hydrocarbon revenues would appear to increase as GDP per capita increases and as the level of corruption decreases.

Columns 6 to 8 of Table 3 report results from the interaction of R^H/Y with the dummy variables for the relative importance of hydrocarbon revenues, low and high levels of corruption, and periods of increasing and falling hydrocarbon revenue, respectively. The results in column 6 are somewhat counter-intuitive with the coefficients on the three interaction variables for the relative importance of hydrocarbon revenues indicating that the adverse effect of hydrocarbon revenues on the domestic revenue effort decreases as the share of hydrocarbon revenues in total revenues increases; moreover, the result of an F-test on the equality of the interacted coefficients rejects the hypothesis that the coefficients are equal (p value=0.05). The results reported in column 7 indicate that the negative response of the domestic revenue effort to hydrocarbon revenues is broadly the same in countries with low or high corruption; and in this case, an F-test on the equality of the interacted coefficients does not allow us to reject the hypothesis that the coefficients are equal (p value=0.45). In column 8, the coefficient on the interaction of R^H/Y with the indicator variable for periods of rising and of falling hydrocarbon revenue suggests no difference in the size of the offset during these periods: the coefficients are virtually identical and an F-test does not allow rejection of the hypothesis that they are equal.

Finally, column 9 presents the results for the specifications where R^H and R^{NH} are normalized by Y^H and Y^{NH}, respectively. The estimated coefficients on R^H/Y^H is -0.1, which is smaller than in any of the previous estimates of R^H/Y , and the signs on the coefficients of the control variables are broadly in line with the previous estimates. However, the coefficient from this estimate has a somewhat different interpretation as the narrower tax bases (Y^{NH} and Y^H) increase the value of the ratios on both sides of the equation (see the summary statistics in Table 2). Evaluating the estimated coefficient for R^H/Y^H at the sample means indicates an offset of about 33 percent between hydrocarbon and non-hydrocarbon revenues. In this case, an interesting non-linearity emerges, suggesting that the offset decreases as hydrocarbon revenues increase.[10]

IV. CONCLUSIONS

The recent development literature suggests that countries receiving large revenues from natural resource endowments are likely to raise less revenue from domestic taxation, and that this creates governance problems because of the reduced incentive for the public scrutiny of government. This argument implies that there is a negative relation between government revenues from natural resources and revenues from other domestic sources, and causality running from a (reduced) domestic revenue effort to (increased) corruption. Our results from a panel of 30 hydrocarbon producing countries support the first part of this hypothesis. Thus, we find a statistically significant negative relation, with a typical result being that a 1 percentage point increase in hydrocarbon revenue (in relation to GDP) lowers non-hydrocarbon revenues by about 0.2 percent after controlling for other factors that might be expected to impact on domestic revenues. However, our finding that the negative response of the domestic revenue effort to hydrocarbon revenues is broadly the same in countries with low and high corruption levels, which suggests that factors other than the domestic revenue effort are the more important determinants of governance problems.

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[10] In columns 1–8 such nonlinearities are not significant.

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