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Does the political resource curse affect public finance?

The vulnerability of tax revenue in resource-rich countries

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Abstract: This paper explores the extent to which government revenue is affected by external shocks, and whether these effects are different for resource-rich as compared with non-resource-rich countries. We are particularly interested in the fate of poorer countries, as we assume they will find it more difficult to implement the policies needed to offset the effect of shocks. Based on data from the International Centre for Taxation and Development Government Revenue Dataset for 1980–2010, we measure the elasticity of tax revenue with respect to terms-of-trade shocks. We find that revenue in resource-rich countries is more vulnerable to such shocks. Interestingly, it is above all the richer countries that appear to be adversely affected. Also, resource-rich countries became less vulnerable in the 2000s as compared with previous decades. When we look at the poorer resource-rich countries, we find that a country's general institutional characteristics may not always reflect the quality of its management of natural resources.

Keywords: taxes, natural resources, terms-of-trade shocks, developing countries, government revenue, volatility

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1 Introduction

Conventional wisdom has it that countries with a high dependence on natural resource exports are particularly vulnerable to exogenous shocks. Their economies usually depend on a small range of export products, the prices of which oscillate on world markets, making public revenue from these sources highly volatile. In addition, an abundance of natural resources often crowds out investment in other sectors (the infamous 'Dutch disease'), resulting in smaller tax bases.

But is this conventional wisdom corroborated by empirical findings? To be sure, a broad body of literature links an abundance of natural resources with growth and revenue volatility (Crivelli and Gupta 2014; IMF 2013). However, volatility does not equal vulnerability. In the context of the issues discussed in this paper, 'volatility' is defined as a measure of revenue instability, based on deviations from an observed trend. 'Vulnerability' refers to the elasticity of tax revenue with respect to different kinds of exogenous shocks (Briguglio et al. 2008).

Both concepts are obviously interconnected, but they are not equivalent. Resource-rich (RR) countries that are able to deal with external shocks by means of sound macroeconomic and fiscal management might well be less affected by these shocks than other countries. At the same time, the high revenue volatility of RR countries might depend not only on exogenous factors, but also on domestic ones, such as widespread rent-seeking, corruption, limited state capacity (Thies 2010), and economic mismanagement (Raddatz 2007). To give an example, revenue from mining in Zambia oscillated between 5 and 18 per cent of aggregate government revenue between 2002 and 2011. At the same time, the average government revenue take compared with the contribution of mining to gross domestic product (GDP) was less than one-fifth of the ratio applying in international benchmark countries such as Chile and Botswana. Zambia's poor performance has been linked to political instability and a critical lack of state capacity in the management of the mining sector (Lundstøl et al. 2013).

This paper explores the extent to which natural resource dependence is associated with a greater vulnerability of tax revenue to external shocks, in particular terms-of-trade (ToT) shocks. We are interested above all in the fate of poorer countries, as we assume they will find it more difficult to implement sound macroeconomic and fiscal policies. The paper also examines whether low-income and lower middle-income countries behave differently according to political regime type and bureaucratic quality. In accordance with the literature on the resource curse, we would expect political regime type and state capacity to have an impact on how governments deal with resource wealth (Andersen and Ross 2014; Collier and Hoeffler 2009; Davis 2013; Ehrhart and Guerineau 2013; Haber and Menaldo 2011; Liou and Musgrave 2012; McGuirk 2013; Prichard et al. 2014; Ross 2012a; Schaffer and Ziyadov 2012; Wright et al. 2014).

We rely on two different approaches to operationalize the concept of resource richness. First, we use the categorization employed by the International Monetary Fund (IMF 2012) to obtain a list of RR countries (see Appendix A1). Second, we treat exports of minerals and fuels as a continuous variable.[1]

[1] An alternative option would have been to use the 'non-tax revenue' category in the International Centre for Taxation and Development (ICTD) dataset. According to Prichard et al. (2014), this category comprises all revenue from non-renewable resources, regardless of its formal classification in national government finance statistics. It should be kept in mind, however, that 'non-tax revenue' also includes revenue from other sources. Also, non-tax revenue is obviously closely linked to our dependent variable, i.e. total government revenue. We did use this category as a robustness check for our findings, as reported below.

Based on information obtained from the International Centre for Taxation and Development (ICTD) Government Revenue Dataset (Prichard et al. 2014), we find evidence that the revenues of RR countries are indeed more *volatile* than those of non-resource-rich (non-RR) countries. One reason is that they are required to deal with more volatile ToT shocks. We also find that resource richness is associated with increased vulnerability to ToT shocks, i.e. higher elasticity of government revenue with respect to the shocks. High-income and upper middle-income RR countries appear to be more affected by this kind of shock. The findings further indicate that the revenue of poorer RR countries was less vulnerable to ToT shocks in the 2000s, compared with the previous two decades. This could be the result of a general improvement in resource management.

Finally, the use of governance-related indicators produces mixed results. Focusing again on the poorer countries, democracies were found to be less affected by ToT shocks in general, but the interaction of the shock with resource richness does not produce any significant effects for democracies. In contrast, high bureaucratic quality is associated with significant adverse effects on revenue. The results suggest that a high quality of governance in general does not necessarily translate into good governance of the resource sector, which is a major source of public revenue in RR countries.

The paper is structured as follows. The next section develops the argument based on a discussion of the literature on shocks, revenue volatility, and natural resources. Section 3 introduces the method and data used. Section 4 presents the findings of the econometric analysis. Section 5 concludes.

2 Literature review

The impact of natural resources on the *volatility* of economic growth is a well-established fact (for instance, see Arezki et al. 2012; Papyrakis 2016; van der Ploeg and Poelhekke 2016). Many observations point to a strong relationship between volatility and vulnerability to shocks (Collier and Venables 2008; Ehrhart and Guerineau 2013; Frankel 2010; Humphreys et al. 2007; Ross 2012b; van der Ploeg and Poelhekke 2008; van der Ploeg and Venables 2012). As the IMF observes: 'research suggests that external shocks contribute to large output losses and protracted growth slowdowns in LICs […] A number of LICs face fragilities defined by their weak institutions, ongoing or recent conflict, and high poverty levels, which put them in a weak position to cope with the effects of shocks and to mediate their social impact' (IMF 2013: 7–8).

Price fluctuations in world markets make it more difficult to plan major investment projects and medium-term government budgets, as dependence on a few export products raises the vulnerability of public revenue systems to changes in the ToT (Araki and Claus 2014; Loayza and Raddatz 2007). Furthermore, in the absence of competition, the state's acquisition of resource rent often leads to inefficiencies, which have an adverse effect on the development of the resource sector itself.

As a result, these countries tend to have a small tax base, and public revenues depend on sources that are more volatile than others. States may escape the volatility–vulnerability nexus mainly by saving part of the resource rent for countercyclical spending and by investing in the diversification of the economy (Gelb and Grasmann 2010). In an analysis of 44 countries, including 14 oil exporters, Buetzer et al. (2012) show that oil price shocks do not necessarily lead to exchange rate appreciation, as oil exporters tend to counter currency appreciation pressure by accumulating foreign exchange reserves.

Some papers point to changes over time in this relationship. Ebeke and Ehrhart (2011) show that, while tax revenue instability (measured as the standard deviation of the log difference) remained high in sub-Saharan African countries, it declined from a peak in the late 1980s as the composition of the tax base changed. Taxes on corporate income and trade tend to be the most unstable, so the gradual decline in overall tax instability is attributed to higher shares of relatively stable indirect taxes. Tax instability tends to increase with the instability of GDP, less consistently with dependence on natural resource rents, and in some specifications is lower in countries with a higher trade openness (i.e. the measure of trade volume) and per capita GDP (Ebeke and Ehrhart 2011: table 5). In a similar vein, Adler and Tovar (2012) observe lower levels of vulnerability to global financial shocks in Latin America and Asia over the past 15 years. Though limited, this is further evidence that instability is associated with exposure to exogenous shocks and related to the composition of revenue (see also Kaminsky 2010).

The relationship becomes more complicated, however, once governance factors are taken into consideration. It is here that the political dimension of the resource curse kicks in. Two factors account for this. First, a society derives revenue from the resource sector in the form of rents and so (to some extent) independently of its own efforts. This paralyses individual initiative, creates disincentives for domestic revenue mobilization, and weakens the monitoring of authorities (Hendrix and Noland 2014). At the same time, rents from natural resources can also be spent on improving state capacity—for instance, by building up a strong military and police apparatus. Second, a large chunk of the proceeds from extractive industries goes to the state, which then distributes the bounty. Control of the state becomes an 'all-or-nothing' game if very few profitable activities are possible outside the public sector.

As a result, RR countries often have inefficient or 'unbalanced' administrative structures. They are frequently plagued by distributive, resource-related conflicts (Helwege 2015), and are also, on average, less democratic than resource-poor countries with comparable per capita incomes (IMF 2015). Hence, the political resource curse impacts on (1) political regime type, (2) state capacity, and (3) the incidence of violent conflict (Barma et al. 2012).

A number of empirical studies have explored the relationship between natural resource wealth and these dimensions. Some test the argument that rents from natural resources—in particular, from oil—affect the quality of political regimes or the chances of democratization. Important contributions to this debate have been made by Ross (2001, 2012a, 2014), who finds robust evidence of the stabilizing effect of resource wealth on autocratic rule. This is in line with the theoretical arguments and empirical findings presented by other authors (Collier and Hoeffler 2005; Hendrix and Noland 2014; Tsui 2011; Wright et al. 2014), and it has recently been corroborated by Prichard et al. (2014), who use the ICTD Government Revenue Dataset to obtain more detailed information on natural-resource-based versus non-resource-based revenue.[2]

[2] The micro-theoretical mechanisms underlying this relationship are complex and difficult to measure, however. Introducing additional variables, various authors find that the adverse effect of resource-based revenue on democracy or democratization weakens or disappears completely. For instance, Herb (2005) observes that other factors (such as region, the Muslim share of the population, and income levels) have stronger effects on political regime type than the resource rent. Morrison (2009) and Liou and Musgrave (2012) conclude that resource rents stabilize political regimes of any kind. In a study of 15 sub-Saharan countries, McGuirk (2013) shows that rents from natural resources lead to lower levels of tax enforcement, thus reducing the demand for democratic accountability. Haber and Menaldo (2011) even report the opposite effect of resource rents, but critics of their approach claim that it has conceptual and methodological flaws (see Andersen and Ross 2011). Finally, Brooks and Kurtz (2016) argue that both democracy and oil revenue are endogenous to earlier industrialization processes and that the political regimes of neighbouring countries have a significant effect on the extent of democracy in RR countries.

Nonetheless, it remains unclear how this dimension of the resource curse affects the vulnerability of revenue to external shocks. There are no compelling theoretical arguments supporting the assumption that resource-dependent autocracies are somehow more exposed to external shocks than are resource-dependent democracies, or vice versa. Thus, we would not expect regime type to have a big impact on the vulnerability of revenue in RR countries.

Another line of research aims at testing the hypothesis that natural resource abundance has an adverse effect on state capacity, mainly in terms of weak institutional checks and balances and high levels of corruption. For instance, Collier and Hoeffler (2009) provide evidence of an erosion of institutional checks and balances over time due to resource rents. Sala-i-Martin and Subramanian (2003) show that natural resource wealth has an adverse effect on institutional quality in Nigeria. Besley and Persson (2010) and Knack (2008) argue that rents from natural resources and other sources create disincentives for leaders to invest in tax collection. Hendrix and Noland (2014) provide initial evidence of a negative association between resource rents and government effectiveness and corruption.

By contrast, Thies (2010) finds that resource abundance has a generally positive impact on state capacity when the latter is measured in fiscal terms. Morrison (2009) shows that non-tax revenue increases social spending in autocracies. Among the influencing factors discussed in the literature are the short-term impact of windfalls (resource *abundance*) versus the long-term effects of natural resource *dependence*, as well as the differentiated effects of point-source natural resources versus diffuse resources (Ross 2014; van der Ploeg 2007; Werger 2009). All in all, natural resource wealth would not seem to have a clear effect on state capacity in general.

A third dimension involves the impact of natural resources on civil war and violent conflict. Smith (2004) discusses the contrasting claims that natural resource wealth may either lead to higher levels of (distributional) conflicts in a society, or endow political leaders with additional resources to appease conflicts. He finds that resource (oil) wealth was associated with lower levels of civil war and anti-state protests, but that protest levels were pro-cyclically related to revenue from oil. To a certain extent, these results are echoed by Thies (2010), who does not find any robust evidence of resource wealth having a direct effect on the onset of civil war. By contrast, Ross (2014) concludes that oil wealth helps to trigger violent conflict in low-income and lower middle-income countries.

To sum up, most of the available literature contains evidence of a concurrence of revenue volatility and vulnerability with external shocks in RR countries. However, once governance factors are introduced into the equation, an analytical puzzle arises. While low state capacity and higher levels of conflict are theoretically associated with greater revenue vulnerability, it is by no means clear that natural resource abundance produces these effects. By contrast, while the literature contains robust evidence that natural resources affect political regime type and democratization, this relationship does not seem to be conceptually linked with revenue vulnerability. Unfortunately, the evidence is strong where the theory is weak, and weak where the theory is strong.

3 Methodological approach

We measure the volatility and vulnerability of tax revenue in 178 countries between 1980 and 2010. 'Volatility' is a measure of revenue instability, based on its deviations around a time trend. The methodology used to measure volatility is described in Appendix A2. 'Vulnerability' is a measure of the elasticity of tax revenue with respect to ToT shocks. In order to identify the sign and magnitude of the elasticity, i.e. the effect of a shock on tax revenue, we use a fixed-effects panel estimation:

$$r\ddot{e}v_{\{i,t\}} = \alpha + \beta\, \ddot{w}_{\{i,t\}} + \Gamma\, \ddot{X}_{\{i,t\}} + \ddot{\varepsilon}_{\{i,t\}} \quad (1)$$

where *i* is the country index and *t* is the year index; *rev* is total government revenue without grants (as a percentage of GDP); *w* is the ToT shock; X is the vector of the controls; and ε is a random error. Our interest lies in β. $\ddot{a}$ denotes the time-demeaned value of any variable *a*:

$$\ddot{a}_{\{i,t\}} = a_{\{i,t\}} - \sum_t a_{\{i,t\}} = a_{\{i,t\}} - \bar{a} \quad (2)$$

In identifying the control variables X for our regression analysis, we follow the literature on tax effort (see Bird 1976; Fenochietto and Pessino 2013; Gupta 2007; Tanzi 1992; Teera and Hudson 2004; von Haldenwang and Ivanyna 2012). We use the import:GDP ratio (*imports*) as an indicator of the tax base for tariffs, along with the export:GDP ratio as an indicator of the performance of major sectors in the economy. The latter consist of agriculture, minerals, fuels, and manufactured exports (*agri_exp*, *min_exp*, *fuel_exp*, *manuf_exp*). Treating each type of export separately allows us to measure the differential performance of separate parts of the economy, which may be related to external shocks and the tax structure. Logged GDP per capita (*ln_GDP*) and agricultural value added as a share of GDP (*agri_va*) are included as proxies for the level of development that is expected to reflect improvements in administrative capacity and tax collection efficiency.

Our dependent variable is total government revenue excluding grants as a ratio of GDP. This is the most appropriate measure for analysing RR countries, as revenue from extractive activities is treated differently across countries, depending on the institutional arrangements.

To identify the effects of shocks on government revenue, we analyse changes in the ToT index as a continuous variable.[3] The ToT index (*ToT*) is scaled as the unit price of imports divided by the unit price of exports.[4] The factor that probably raises the vulnerability of government revenue to this shock is the reliance of the tax system on trade taxes. Economies that are not sufficiently diversified and are unable to quickly reorient exports in accordance with price changes are also likely to be more vulnerable. Some countries can reduce their vulnerability to ToT shocks by establishing insurance mechanisms against them. For instance, certain RR countries have adopted a fiscal rule by which they save extra revenue in a stabilization fund when times are good, and then use revenue from the fund when times are bad (IMF 2015). Countries with access to (and who enjoy the trust of) international capital markets can protect themselves against ToT shocks by adjusting their borrowing needs.

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[3] We also check for possible non-linear effects when the magnitude of shocks is particularly large. For each shock X, we define a dummy variable 'X, large', which is equal to 1 if a shock is greater than the 90th percentile of the respective income group distribution. See IMF (2013) for a similar approach. However, we find no evidence of shocks having non-linear effects on revenue. See von Haldenwang et al. (2013) for more details.

[4] In addition to ToT shocks, we check for three other types of shock. (1) Exchange rate pressure has been widely used in the literature on international finance (see Aizenman and Hutchison 2012; Berg and Patillo 1999; Buetzer et al. 2012; Candelon et al. 2010) to assess the impact of foreign capital flow shocks and export demand shocks. This is generally defined as the weighted average of percentage changes in policy variables in response to current account or financial account shocks. We find no evidence indicating that RR countries are more vulnerable to exchange rate pressure. (2) GDP decline is a proxy for a general output shock. We find that all coefficients are statistically insignificant and very close to zero. These results indicate that, *on average*, tax systems are neutral, i.e. the elasticity of revenue with respect to output is close to 1. (3) The intensity of natural disasters is a measure based on the number of people killed and affected by natural disasters in every year *t* and every country *j* (Fomby et al. 2009). We find that RR countries face less severe natural disaster shocks than non-RR countries, and that their revenues are not significantly affected by them. The reason could be that extractive industries—the main sources of revenue in RR countries—are usually less affected by natural catastrophes than other types of economic activity, such as agriculture. For a more in-depth analysis of these relationships, see von Haldenwang et al. (2013).

The interpretation of β is as follows. If it is 0, the revenue:GDP ratio does not depend on ToT shocks. This means that, on average, ToT shocks change revenue and GDP by the same percentage, i.e. the elasticity of revenue with respect to GDP equals 1. If β is negative, revenue is more sensitive to ToT shocks than GDP, and vice versa if β is positive.

We consider negative β to be an adverse outcome, i.e. vulnerability. At first glance this may seem inconsistent with the idea that government revenue should act as an automatic stabilizer in the short run—it should automatically increase in good times (i.e. favourable ToT shocks) and decrease in bad times (i.e. adverse ToT shocks), thus steering the economy closer to the potential. However, when $\beta = 0$ (or assumes small negative values) in our model, revenue still acts as an automatic stabilizer, because our dependent variable is the revenue:GDP ratio. $\beta = 0$ means that the elasticity of revenue with respect to output is equal to 1. Large negative β means that the revenue is too elastic, which can generate instability.[5] More importantly, fiscal policy in many low-income and middle-income countries is in fact procyclical due to both internal factors (such as political pressure) and external factors (such as the pro-cyclicality of capital flows) (see Frankel et al. 2013). In such a setting, instability of revenue translates into instability of expenditure, thus adding to macroeconomic instability.

To capture the extent to which the effect of ToT shocks on revenue differs in RR as opposed to non-RR countries, we introduce an interaction term with the respective resource identifier in Equation (1). We use two different measures of resource richness:

1 a dummy variable based on the IMF (2012) list of RR countries (see Appendix A1);
2 a continuous measure: exports of minerals and fuels as a share of GDP.

We then divide our sample of countries into various categories to explore the potential heterogeneity in β. We begin by dividing the sample into high-income and upper middle-income countries (i.e. 'richer' or 'higher-income' countries) on the one hand, and lower middle-income and low-income countries (i.e. 'poorer' or 'lower-income' countries) on the other hand.

We also explore the behaviour of RR vs non-RR countries during different periods—in particular before and after the year 2000. This division is based on the knowledge that many RR countries were able to improve their management of the extractive sector during 2000–10, partly due to the long commodity supercycle and to the lessons learned from previous decades.

We then divide the sample according to governance characteristics, in order to tease out the possible effects of the 'political resource curse'. First, we divide countries according to their political regime characteristics, based on their Polity IV score. On a scale ranging from −10 to +10, a country is considered to be a democracy if its Polity IV score is higher than 5, and a non-democracy if this is not the case (see Marshall et al. 2010). As a second measure, we use the bureaucratic quality index from the International Country Risk Guide (ICRG) dataset. This ranks countries from 0 (lowest quality) to 4 (highest quality). Scores above 2 are rated as 'high bureaucratic quality', while scores equal to or lower than 2 are rated as 'low bureaucratic quality'.

[5] In fact, our results demonstrate that β is, on average, close to 0 in advanced economies, whose fiscal policies are usually considered to be more consistent with the objective of macroeconomic stability than the policies of poorer countries.

4 Findings

4.1 Government revenue volatility and shocks

Table 1 summarizes government revenue volatility and the size of shocks in RR and non-RR countries. A number of conclusions may be drawn from the figures.

Table 1: Revenue volatility and size of shocks in RR and non-RR countries (IMF list), by decade

	Total government revenue volatility		Terms of trade	
	Non-RR	RR	Non-RR	RR
1980–2010				
Mean	7.84	15.94	−0.02	−0.13
Standard deviation	5.67	9.85	0.23	0.38
10th percentile	2.27	6.95	−0.25	−0.63
90th percentile	14.26	26.73	0.20	0.23
Observations	115	57	2,298	1,190
1981–90				
Mean	6.43	11.62	−0.08	−0.25
Standard deviation	5.34	7.01	0.36	0.42
10th percentile	1.71	4.91	−0.54	−0.81
90th percentile	11.3	20.44	0.29	0.26
Observations	71	41	508	290
1991–2000				
Mean	5.1	11.07	−0.04	0.05
Standard deviation	4.94	6.03	0.15	0.31
10th percentile	1.09	4.19	−0.2	−0.23
90th percentile	11.5	19.55	0.12	0.45
Observations	106	52	572	325
2001–10				
Mean	4.65	10.43	0.02	−0.17
Standard deviation	3.27	9.06	0.16	0.34
10th percentile	1.6	3.19	−0.13	−0.59
90th percentile	8.52	17.42	0.2	0.1
Observations	113	54	1,170	550

Source: authors' calculations based on the ICTD Government Revenue Dataset, the World Development Indicators (WDI), and IMF (2012).

First, as indicated by the higher mean values, government revenue is on average more volatile in RR countries. This is true both for the whole sample from 1980 to 2010 and for the 1980s, 1990s, and 2000s separately. Over the three decades, the difference in average volatility between RR and non-RR countries is fairly stable, at between 5.2 and 6.0 index points.

Second, RR countries seem to be more heterogeneous, as is indicated by the higher standard deviation of the volatility index, and the spread between the 10th and 90th percentiles of the index distribution. Again, the heterogeneity within both groups of countries—measured as the spread between the 10th and 90th percentiles—is relatively stable during the observation period. It hovers around 15 index points for RR countries and between seven and ten points for non-RR countries. Yet, of the 44 RR countries for which government revenue data are available for both the 1990s and the 2000s, 28 countries (60 per cent) managed to reduce their volatility in the 2000s, whereas

there was a dramatic deterioration in the situation in other countries—Chad, Bolivia, and Sao Tomé and Principe in particular.[6]

The difference in average government revenue volatility between RR and non-RR countries could be the result of two factors. First, RR countries may be exposed to more volatile external conditions. Second, government revenue in RR countries may be more sensitive to external shocks for other reasons, including reasons of a domestic nature. These two factors may commingle and work in the same direction, or they may offset each other.

As Table 1 shows, RR countries face more volatile external shocks with regard to ToT. The standard deviation of ToT shocks to RR countries is 0.38 for 1980–2010, whereas it is considerably lower, i.e. 0.23, for non-RR countries. To illustrate, one standard deviation ToT shock in a non-RR country means a 26 per cent change in the import–export unit price, whereas the change is 46 per cent in an RR country.[7]

Compared with the previous decades, the difference in volatility of ToT shocks between RR and non-RR countries is higher in the 1980s and the 2000s, and somewhat lower in the 1990s. At the same time, two-thirds of RR countries improved the stability of their government revenue in the 2000s, despite a greater volatility of shocks.

4.2 Revenue vulnerability: complete sample

Table 2 reports our estimation results for revenue vulnerability with regard to ToT shocks. As we have already mentioned, we use two alternative variables to operationalize resource richness:

1 a dummy variable based on the IMF (2012) list of RR countries (columns 1–3);
2 mineral and fuel exports as a percentage of GDP (columns 4–6).

For each measure, we report both the aggregate results for all countries and the separate results for higher-income and lower-income countries. All regressions contain country fixed-effects, specifications as in (1). All standard errors are clustered by country.

[6] This may be due to these countries' greater dependency on natural resources in the 2000s.

[7] Note that the ToT shocks are expressed in logarithms.

Table 2: Effect of ToT shocks on government revenue: low- and lower middle-income vs high- and upper middle-income countries

	(1)	(2)	(3)	(4)	(5)	(6)
	All	LIC/LMIC	HIC/UMIC	All	LIC/LMIC	HIC/UMIC
RR operationalized as	RR dummy (IMF list)			Fuel and mining exports		
Dep. variable	Total government revenue excl. grants			Total government revenue excl. grants		
ToT shock	−0.641	−1.827	3.653	−1.530	−2.015*	2.419
	(1.551)	(1.516)	(2.824)	(1.152)	(1.173)	(2.736)
resvar_X_shock	−3.870**	−1.880	−10.17***	−0.113**	−0.100*	−0.239**
	(1.714)	(1.684)	(3.048)	(0.0450)	(0.0537)	(0.0958)
agr_exp_togdp	−0.0222	0.00631	−0.00787	−0.0201	0.00771	−0.0223
	(0.0444)	(0.0571)	(0.0482)	(0.0454)	(0.0584)	(0.0448)
min_exp_togdp	−0.0422	−0.104	0.180	−0.0395	−0.115	0.189
	(0.0828)	(0.0907)	(0.185)	(0.0867)	(0.0932)	(0.149)
manuf_exp_togdp	−0.0687**	−0.0753**	−0.0612	−0.0716**	−0.0930***	−0.0477
	(0.0282)	(0.0317)	(0.0378)	(0.0290)	(0.0312)	(0.0370)
imports_togdp	0.0305	0.0777**	0.00716	0.0299	0.0844**	0.00457
	(0.0253)	(0.0308)	(0.0367)	(0.0260)	(0.0322)	(0.0352)
fuel_exp_togdp	0.185*	0.349***	0.0380	0.155	0.319***	−0.0142
	(0.0989)	(0.103)	(0.0798)	(0.0977)	(0.0893)	(0.0787)
agri_va_gdp	−0.0536	−0.0310	−0.603***	−0.0595	−0.0341	−0.540***
	(0.0441)	(0.0335)	(0.201)	(0.0452)	(0.0353)	(0.183)
ln_gdp	1.347	2.350	−2.008	1.610	2.626	−1.306
	(1.523)	(2.438)	(1.722)	(1.644)	(2.554)	(1.652)
Constant	14.55	2.323	52.88***	12.74	0.398	46.62***
	(12.45)	(17.00)	(16.61)	(13.41)	(17.98)	(15.70)
R squared	0.236	0.306	0.262	0.236	0.309	0.265
Observations	2,026	1,163	863	2,026	1,163	863
Number of id	150	93	82	150	93	82

Note: robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; ToT = terms of trade; LIC = low-income countries; LMIC = lower middle-income countries; UMIC = upper middle-income countries; HIC = high-income countries.

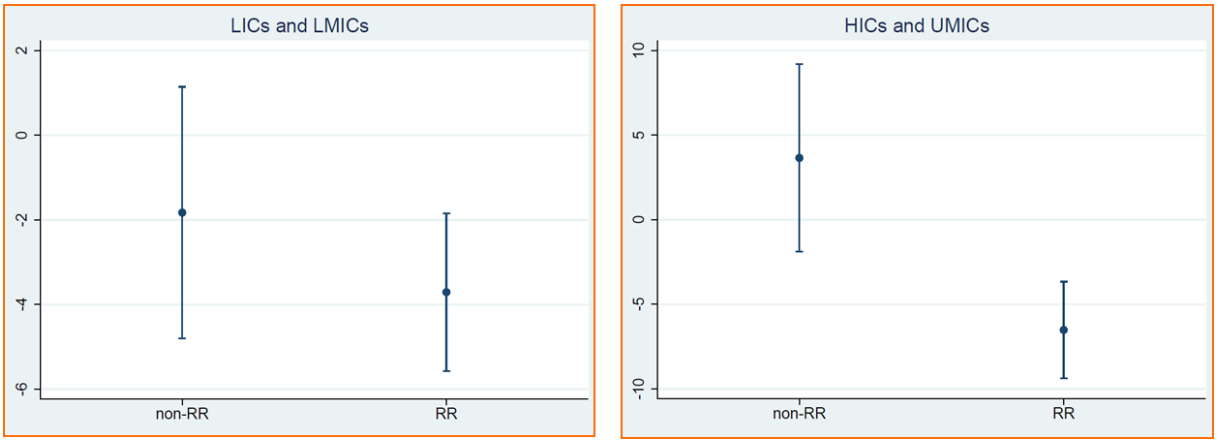
Source: authors' calculations based on the ICTD Government Revenue Dataset, WDI, and IMF (2012).

For non-RR countries (the first line in Table 2), we find that the sign of the effect of ToT shocks is positive, but statistically insignificant in higher-income countries. By contrast, the sign of the effect is negative in poorer countries, regardless of the variable used. However, the results are insignificant when using the IMF dummy and only weakly significant when using fuel and mining exports as a variable for operationalizing resource richness.[8]

Interacting shocks with resource richness, we find that RR countries are more sensitive to ToT shocks than non-RR countries (the second line in Table 2). The effect is more pronounced for higher-income RR countries, whereas for lower-income RR countries the sensitivity is lower and the result is significant, albeit weakly, in only one specification (see Figure 1).

[8] Note that, in interaction models, the reported effect of one component, i.e. the ToT shock in our case, corresponds with the specific case when the second component of the interaction equals zero. See Brambor et al. (2006).

Figure 1: Sensitivity to ToT shocks, RR vs non-RR countries



Note: dependent variable is change in government revenue as a result of one unit change in the shock variable (*log_tot_wdi_impexp*).

Source: authors' calculations based on the ICTD Government Revenue Dataset, WDI, and IMF (2012).

The higher sensitivity of richer RR countries is due to the fact that, on average, they rely on more elastic sources of revenue, such as profits from state-owned enterprises and resource rent taxes. The results also suggest that these countries do not fully offset the volatility of their resource tax revenue with less elastic sources of income, such as transfers from (and to) sovereign wealth funds. By contrast, poorer countries rely to a larger extent on trade taxes, which are often specific rather than *ad valorem*, regardless of whether they are rich in natural resources (e.g. export duties on hydrocarbons) or not. Moreover, poorer RR countries obtain relatively more revenue from royalties, which are less elastic than income or resource rent taxes. In this sense, the difference between RR and non-RR countries is more pronounced in the higher-income group than in the lower-income group.

4.3 Disaggregating the dependent variable: tax vs non-tax revenue

To check for different patterns of association, we disaggregate the dependent variable by looking separately at different revenue categories given by the ICTD Government Revenue Dataset. In particular, we explore differentiated patterns of effects regarding tax revenue vs non-tax revenue. In addition, we check for direct and indirect taxes as well as resource and non-resource taxes. However, the results either are insignificant or mirror the results obtained by analysing tax and non-tax revenue. They are reported in Table 3.

Table 3: Effect of ToT shocks on government revenue—tax vs non-tax revenue

	(1)	(2)	(3)	(4)	(5)	(6)
	All	LIC/LMIC	HIC/UMIC	All	LIC/LMIC	HIC/UMIC
RR operationalized as	Fuel and mining exports			Fuel and mining exports		
Dep. variable	Tax revenue			Non-tax revenue		
ToT shock	−1.847*	−2.176**	0.109	0.0611	−0.109	2.631
	(1.010)	(1.039)	(2.030)	(0.744)	(0.648)	(1.644)
resvar_X_shock	0.0803*	0.115**	−0.0950	−0.112	−0.183***	−0.240**
	(0.0430)	(0.0457)	(0.0722)	(0.0930)	(0.0664)	(0.0988)
agr_exp_togdp	−0.0850*	−0.0528	−0.0892	0.0333	0.0448	0.0135
	(0.0446)	(0.0475)	(0.0633)	(0.0227)	(0.0282)	(0.0458)
min_exp_togdp	−0.0135	−0.0137	0.0209	0.0231	−0.0783	0.183*
	(0.0680)	(0.0626)	(0.159)	(0.0472)	(0.0507)	(0.0969)
manuf_exp_togdp	−0.0861***	−0.0794***	−0.0554	0.0134	0.00329	0.000249
	(0.0278)	(0.0282)	(0.0364)	(0.0132)	(0.0115)	(0.0199)
imports_togdp	0.0607***	0.0863***	0.0490*	−0.0359**	−0.0140	−0.0408
	(0.0193)	(0.0297)	(0.0254)	(0.0142)	(0.0116)	(0.0292)
fuel_exp_togdp	0.0231	0.0790	−0.00657	0.145	0.263***	0.00864
	(0.0898)	(0.122)	(0.0701)	(0.0914)	(0.0855)	(0.138)
agri_va_gdp	−0.0377	−0.0257	−0.125	−0.0152	−0.00427	−0.142
	(0.0378)	(0.0286)	(0.202)	(0.0130)	(0.0105)	(0.149)
ln_gdp	0.987	0.370	2.930	0.580	1.536	−1.979
	(1.446)	(1.920)	(3.031)	(0.740)	(1.117)	(2.135)
Constant	12.91	13.47	−1.604	0.569	−7.512	26.46
	(11.68)	(13.28)	(28.51)	(6.076)	(7.659)	(20.23)
R squared	0.148	0.201	0.150	0.141	0.403	0.127
Observations	2,026	1,164	862	2,023	1,168	855
Number of id	150	95	82	153	96	83

Note: robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; ToT = terms of trade; LIC = low-income countries; LMIC = lower middle-income countries; UMIC = upper middle-income countries; HIC = high-income countries.

Source: authors' calculations based on the ICTD Government Revenue Dataset, WDI, and IMF (2012).

Within the group of poorer countries, RR and non-RR countries seem to rely on different patterns to stabilize their revenue. Tax revenue is more stable in RR countries, while non-tax revenue is more stable in non-RR countries. The findings are less clear for the richer countries: the interaction of non-tax revenue with resource richness (using fuel and mineral exports as an identifying variable) is negative and significant, but no effect can be observed for tax revenue.

4.4 Results for sub-samples of countries

In the next exercise, we explore the effects of both shocks in different subgroups of RR and non-RR countries, focusing on the poorer countries. First, we divide the sample into two categories

according to political regime: democracies and non-democracies. This is because several studies suggest that the revenue systems of democratic regimes are more resilient to external shocks (Arezki et al. 2011; Bhattacharyya and Collier 2011; Ehrhart and Guerineau 2013; Morrissey et al. 2016).

Table 4: Effect of ToT shocks on government revenue in low- and lower middle-income countries—democracies vs non-democracies

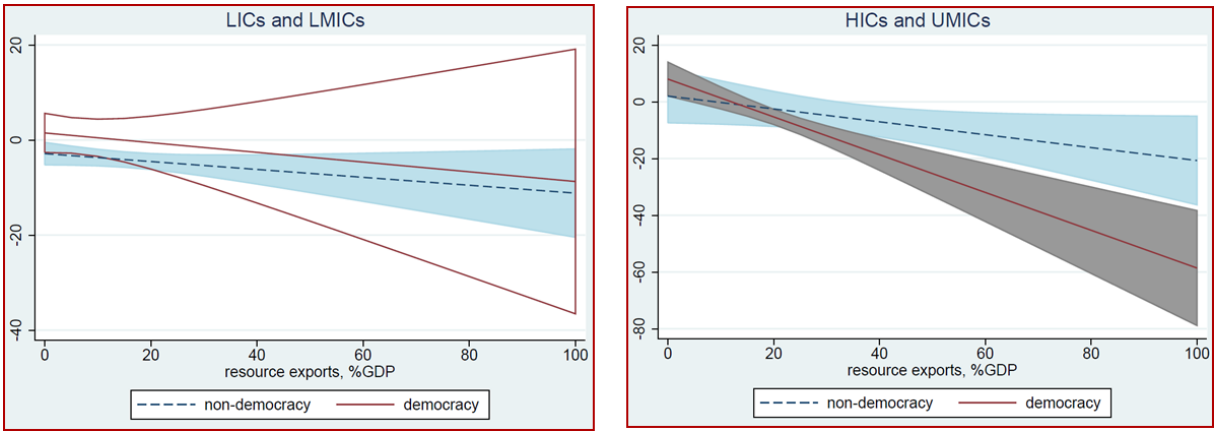
	(1)	(2)	(3)	(4)
	Non-democracy	Democracy	Non-democracy	Democracy
RR operationalized as	RR dummy (IMF list)		Fuel and mining exports	
Dep. variable	Total government revenue excl. grants		Total government revenue excl. grants	
ToT shock	−3.353	1.031	−2.127	1.517
	(2.202)	(1.890)	(1.573)	(1.794)
resvar_X_shock	−0.154	1.150	−0.120*	−0.0471
	(2.370)	(2.174)	(0.0692)	(0.147)
agr_exp_togdp	−0.0287	−0.0181	−0.0317	−0.0166
	(0.124)	(0.0565)	(0.125)	(0.0579)
min_exp_togdp	−0.105	0.111	−0.117	0.0653
	(0.109)	(0.154)	(0.111)	(0.202)
manuf_exp_togdp	−0.0677	−0.122***	−0.106*	−0.121***
	(0.0543)	(0.0376)	(0.0539)	(0.0378)
imports_togdp	0.0723*	0.0333	0.0903**	0.0362
	(0.0371)	(0.0518)	(0.0405)	(0.0516)
fuel_exp_togdp	0.363***	0.428***	0.315***	0.406***
	(0.114)	(0.0927)	(0.0979)	(0.0906)
agri_va_gdp	0.00586	−0.0322	0.0239	−0.0312
	(0.0866)	(0.0303)	(0.0839)	(0.0300)
ln_gdp	3.025	−1.505	3.603	−1.545
	(3.320)	(2.696)	(3.517)	(2.652)
Constant	−3.180	31.94	−7.584	32.10
	(22.66)	(19.67)	(24.49)	(19.39)
R squared	0.335	0.397	0.346	0.397
Observations	644	481	644	481
Number of id	63	47	63	47

Note: robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; ToT = terms of trade.

Source: authors' calculations based on the ICTD Government Revenue Dataset, WDI, IMF (2012), and Marshall et al. (2010).

Our findings for non-RR countries appear to corroborate previous research. Even though most results fail to achieve statistical significance, shocks appear to be associated with less revenue in non-democratic countries. Accounting for natural resource endowments, however, the results fail to provide evidence that democracies perform better. In one specification (using fuel and mining exports), the interaction term is weakly significant and negative for non-democracies. However, the results are far from significant for the democratic group and the interaction terms reported in the Appendix (Table A4) show that the regime type does not seem to matter much in relation to the poorer countries in our sample (see Figure 2).

Figure 2: Sensitivity to ToT shocks—democracies vs non-democracies



Note: dependent variable is change in government revenue as a result of one unit change in the shock variable (*log_tot_wdi_impexp*).

Source: authors' calculations based on the ICTD Government Revenue Dataset, WDI, IMF (2012), and Marshall et al. (2010)..

In the light of the literature on the resource curse discussed in Section 2, this finding—or rather, the lack of clear results—is somewhat surprising. This may be due in part to the fact that RR countries are less democratic on average, meaning that the democratic sub-sample is smaller, in terms of both countries and observations. Furthermore, in non-RR countries, the tax effort and trust in government are likely to matter more for revenue collection and the fight against tax evasion, which means that the political regime is a more relevant indicator for fiscal performance and resilience to shocks in these countries.

The second categorization into subgroups is by time period: 1980–2000 and 2001–10. The results are presented in Table 5. Although most of the results fail to achieve statistical significance, the picture that emerges is that RR countries managed their revenue better in the 2000s than in the earlier period. The coefficients on the interaction terms are negative (and statistically significant) in the earlier period, regardless of the operationalization used. After 2000, the observed effects are smaller and statistically not different from zero.

Table 5: Effect of ToT shocks on government revenue in low- and lower middle-income countries, 1980–2000 vs 2001–10

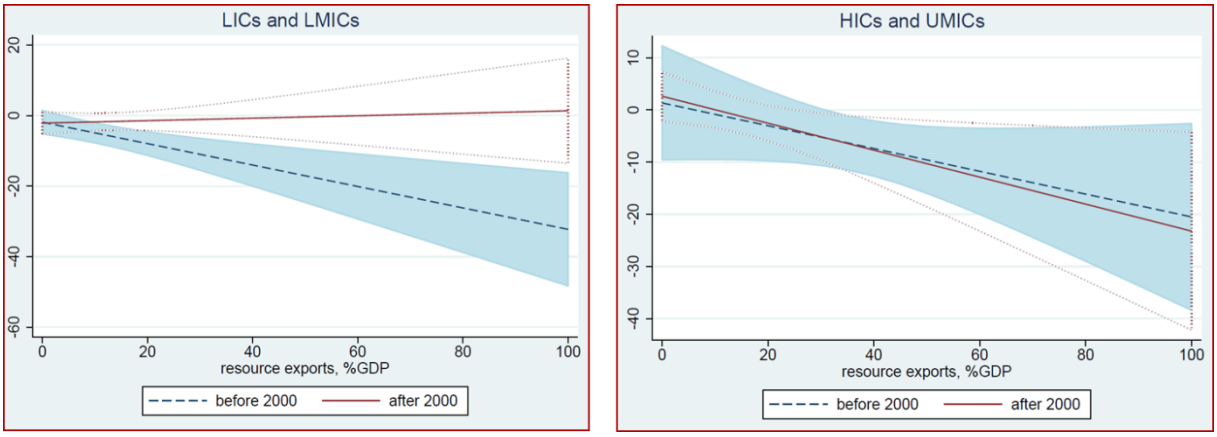
	(1)	(2)	(3)	(4)
	1980–2000	2001–10	1980–2000	2001–10
RR operationalized as	RR dummy (IMF list)		Fuel and mining exports	
Dep. variable	Total government revenue excl. grants		Total government revenue excl. grants	
ToT shock	−1.845	0.198	−1.606	1.696
	(1.685)	(2.095)	(1.770)	(1.980)
resvar_X_shock	−4.375*	1.906	−0.308***	−0.0678
	(2.522)	(3.444)	(0.116)	(0.122)
agr_exp_togdp	0.00977	0.0692	0.00610	0.0545
	(0.0922)	(0.0776)	(0.0951)	(0.0776)
min_exp_togdp	−0.00462	0.0941	−0.0440	0.0409
	(0.151)	(0.135)	(0.170)	(0.134)
manuf_exp_togdp	−0.0308	−0.175***	−0.0652*	−0.177***
	(0.0381)	(0.0547)	(0.0374)	(0.0563)
imports_togdp	0.0501	0.0541	0.0549	0.0645
	(0.0425)	(0.0560)	(0.0408)	(0.0552)
fuel_exp_togdp	0.386***	0.305**	0.272***	0.266**
	(0.100)	(0.121)	(0.0727)	(0.128)
agri_va_gdp	−0.0904	−0.0466*	−0.0875	−0.0439*
	(0.0951)	(0.0273)	(0.0981)	(0.0258)
ln_gdp	0.671	2.754	0.325	2.990
	(3.543)	(2.840)	(3.492)	(2.810)
Constant	12.43	2.059	15.07	0.302
	(22.43)	(19.90)	(22.20)	(19.67)
R squared	0.343	0.278	0.373	0.279
Observations	677	486	677	486
Number of id	82	81	82	81

Note: robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; ToT = terms of trade.

Source: authors' calculations based on the ICTD Government Revenue Dataset, WDI, and IMF (2012).

However, when we look at poorer and richer countries separately (not shown in the table), we see that poorer countries were able to reduce their vulnerability considerably after 2000, whereas no major change occurred among richer countries (see Figure 3). We interpret this finding as the outcome of a general improvement of resource management in the poorer RR countries. The transparency of fiscal regimes improved in some countries (Kazakhstan and Azerbaijan, for example, switched from classified discretionary contracts for each new oil well to an open legislature). Several countries, including Nigeria and Mongolia, adopted fiscal rules for dealing with the volatility of commodity prices. Among the richer countries, the benefits of learning and institutional reform may have been too small to show up in the results.

Figure 3: Sensitivity to ToT shocks, 1980–2000 vs 2001–10



Note: dependent variable is change in government revenue as a result of one unit change in the shock variable (*log_tot_wdi_impexp*).

Source: authors' calculations based on the ICTD Government Revenue Dataset, the World Development Indicators (WDI) and IMF (2012).

We also categorized countries according to the quality of their public sector (based on the ICRG's bureaucratic quality index). The results, presented in Table 6, show that in one of our specifications (i.e. the IMF dummy variable), ToT shocks affect tax revenue in countries with a high bureaucratic quality. The results in relation to countries with a low bureaucratic quality are inconclusive. However, this finding may be driven by outliers, as there are only 10 RR countries with a high bureaucratic quality in our sample. In fact, using fuel and mining exports as an identifying variable yields no conclusive results at all, which suggests that non-linear effects could play a role in explaining the above result. All in all, the results appear to reflect the ambiguous nature of empirical findings for the effect of natural resource wealth on administrative capacity, as reported in Section 2.

Table 6: Effect of ToT shocks on government revenue in low- and lower middle-income countries—low bureaucratic quality vs high bureaucratic quality countries

	(1)	(2)	(3)	(4)
	Low bureaucratic quality	High bureaucratic quality	Low bureaucratic quality	High bureaucratic quality
RR operationalized as	RR dummy (IMF list)		Fuel and mining exports	
Dep. variable	Total government revenue excl. grants		Total government revenue excl. grants	
ToT shock	−2.541	−1.949	−1.212	−5.135
	(1.575)	(3.595)	(1.184)	(4.884)
resvar_X_shock	0.393	−13.23***	−0.0881	−0.313
	(1.756)	(4.250)	(0.0587)	(0.654)
agr_exp_togdp	−0.0399	0.197	−0.0335	0.514*
	(0.0528)	(0.206)	(0.0547)	(0.267)
min_exp_togdp	−0.0179	0.525	−0.0372	0.366
	(0.0825)	(0.648)	(0.0854)	(0.621)
manuf_exp_togdp	−0.0799	0.0128	−0.0994**	−0.0572
	(0.0562)	(0.0587)	(0.0486)	(0.0687)
imports_togdp	0.0929***	−0.0508	0.106***	−0.0955
	(0.0281)	(0.0797)	(0.0300)	(0.0864)
fuel_exp_togdp	0.370***	−0.189	0.339***	−0.127
	(0.108)	(0.165)	(0.0983)	(0.171)
agri_va_gdp	−0.0134	−0.207	−0.00594	−0.576***
	(0.0239)	(0.202)	(0.0243)	(0.191)
ln_gdp	−1.013	4.722	−0.539	6.352*
	(2.146)	(2.975)	(2.334)	(3.670)
Constant	24.77	−15.10	20.95	−22.32
	(14.94)	(20.91)	(16.58)	(26.16)
R squared	0.362	0.636	0.368	0.558
observations	780	124	780	124
Number of id	65	21	65	21

Note: robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; ToT = terms of trade.

Source: authors' calculations based on the ICTD Government Revenue Dataset, WDI, IMF (2012), and the bureaucratic quality index from the International Country Risk Guide (ICRG) Dataset.

Finally, as a robustness check, we use non-tax revenue from the ICTD Government Revenue Dataset to operationalize resource richness (see Prichard et al. 2014). The findings for the whole sample are in line with the results reported above, and show a significant negative effect of the interaction term. Splitting the sample into income groups, however, produces slightly different results. The point estimates for both sub-samples are fairly similar to each other, but the findings are not significant for the richer countries. Hence, using non-tax revenue to identify resource richness tends to blur the distinction between income groups observed above. It might be the case that non-tax revenue in richer countries is less clearly associated with resource richness than in poorer countries. Regarding political regime type, bureaucratic quality and time period, the results are again in line with the findings from our two main specifications.

5 Concluding remarks

Countries rich in natural resources tend to suffer from higher degrees of revenue volatility. This could be a consequence of their exposure to more volatile exogenous shocks. Indeed, the standard deviation of ToT shocks was higher for RR countries in 1980–2010. However, this is only one side of the coin. The other side is that government revenue in RR countries is also more vulnerable, i.e. revenue is more elastic with respect to ToT shocks than in non-RR countries. It is mainly the richer countries that seem to be adversely affected by resource richness. This result is robust to the choice of resource variable, i.e. the 2012 IMF list of RR countries, or mining and fuel exports. In lower-income countries, the difference is less pronounced and not robust to the choice of resource variable.

In addition, government revenue in RR countries was less vulnerable to shocks in the 2000s, indicating higher levels of resource management performance. However, this result is driven principally by the lower-income countries, whereas the richer countries do not seem to benefit from this tendency.

Is the nature of the political regime in poorer RR countries associated with the vulnerability of government revenue? Our findings show that non-democratic regimes in general are indeed more vulnerable to ToT shocks, but that this applies especially to richer countries. However, there is no evidence that, in the lower-income group, resource richness matters more in democratic than in non-democratic settings. As a criterion, bureaucratic quality does not produce conclusive results.

Overall, the somewhat counter-intuitive picture of the effect of governance factors in poorer RR countries could perhaps be explained by the fact that revenue from natural resources is often easier to collect and control than revenue from other sources. This is especially true of drilling for oil and gas, and less so of mining. Autocratic and corrupt governments could even have some additional levers for extracting revenue from resource industries in bad times, for instance by squeezing profits from state-owned enterprises.

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Appendices

A1 List of countries coded as RR

Countries are coded as RR if they 'have either natural resource revenue or exports at least 20% of total fiscal revenue and exports, respectively, over 2006–10 (average)' (IMF 2012: 48).

Afghanistan, Albania, Algeria, Angola, Azerbaijan, Bahrain, Bolivia, Botswana, Brunei Darussalam, Cameroon, Central African Republic, Chad, Chile, Congo (Rep.), Cote d'Ivoire, Ecuador, Equatorial Guinea, Gabon, Ghana, Guatemala, Guinea, Guyana, Indonesia, Iran, Iraq, Kazakhstan, Kuwait, Kyrgyz Republic, Lao PDR, Libya, Madagascar, Mali, Mauritania, Mexico, Mongolia, Mozambique, Niger, Nigeria, Norway, Oman, Papua New Guinea, Peru, Russian Federation, Qatar, Sao Tomé and Principe, Saudi Arabia, Sierra Leone, Syrian Arab Republic, Tanzania, Timor-Leste, Togo, Trinidad and Tobago, Turkmenistan, United Arab Emirates, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia.

A2 Measuring volatility

Volatility of tax revenue is measured by specifying the trend equation:

$$\ln y_t = \alpha + \beta_1 t + \beta_2 t^2 + e_t \qquad \text{(I)}$$

where y is the variable whose level of instability we want to find, t is time, and e_t is the residual at time t. To obtain the index we use the formula:

$$\frac{100}{\bar{y}} \sqrt{\frac{\sum_{t=1}^{n} (y_t - \hat{y}_t)^2}{n-3}} \qquad \text{(II)}$$

where $\bar{y}$ is the arithmetic mean of y, y_t is the observed value of y in year t and $\hat{y}_t$ is the estimated value of y in year t. The square root term in Equation (II) yields the standard deviation of residuals from a quadratic time trend, as the mean of the residuals is necessarily zero. This is divided by the arithmetic mean of y to normalize the index, enabling cross-country comparisons to be made. The variable t^2 is included in the time trend to pick up possible non-linearities. The index is to be interpreted as the typical deviation of the variable from a quadratic time trend over the period. As such, it records average volatility over this period.

Table A1: Summary statistics

	Data source	Count	Mean	SD	p10	p90
Revenue excl. grants (incl. social cont.)	ICTD Government Revenue Dataset	4,912	25.95	12.88	10.87	44.15
log_tot_wdi_impexp	World Development Indicators	3,488	−0.06	0.29	−0.44	0.21
Dummy based on IMF 2012	IMF 2012	5,578	0.34	0.47	0.00	1.00
res_exports	WDI	3,435	7.49	12.81	0.09	22.93
Food + raw ag. exports, percentage of GDP	WDI	3,435	6.30	6.59	0.96	14.82
Ores and metals exports, percentage of GDP	WDI	3,435	2.06	5.10	0.03	4.58
Manufacturing exports, percentage of GDP	WDI	3,435	13.61	18.25	0.97	31.63
Merchandise imports (percentage of GDP)	WDI	4,852	37.14	25.58	15.32	63.66
Fuel exports, percentage of GDP	WDI	3,435	5.43	11.93	0.00	18.27
Agri_va_gdp	WDI	4,546	17.31	15.01	2.28	38.87
ln_gdp	WDI	4,937	7.62	1.57	5.55	9.92
dincome2	WDI	6,249	0.52	0.50	0.00	1.00
dpolity	Polity IV	4,449	0.42	0.49	0.00	1.00
dbur_qual	ICRG	3,330	0.40	0.49	0.00	1.00
dcorruption	Worldwide Governance Indicators	2,092	0.38	0.49	0.00	1.00
dyears		5,456	0.29	0.45	0.00	1.00

Table A2: Effect of ToT shocks on government revenue—interactions with group dummy variables

	−1	−2	−3	−4	−5	−6	−7	−8	−9	−10	−11	−12
	RR dummy (IMF list)								Fuel and mining exports			
	LIC LMIC *d_democr*	HIC UMIC *d_democr*	LIC LMIC *d_bq*	HIC UMIC *d_bq*	LIC LMIC *dyears*	HIC UMIC *dyears*	LIC LMIC *d_democr*	HIC UMIC *d_democr*	LIC LMIC *d_bq*	HIC UMIC *d_bq*	LIC LMIC *dyears*	HIC UMIC *dyears*
Dep. variable	Total government revenue excl. grants								Total government revenue excl. grants			
shock	−3.094*	−9.986	−2.440	2.499	−1.928	15.75***	−2.836**	2.082	−0.835	−2.990	−1.886	1.347
	(1.729)	(7.246)	(1.651)	(3.829)	(1.742)	(4.232)	(1.210)	(4.824)	(1.225)	(2.872)	(1.709)	(5.585)
resvar_ X_shock	−0.771	3.768	0.171	−8.118*	−4.448*	−24.86***	−0.0831	−0.227*	−0.110*	−0.0304	−0.304***	−0.218
	(1.937)	(7.328)	(1.756)	(4.534)	(2.592)	(4.558)	(0.0555)	(0.116)	(0.0551)	(0.119)	(0.0895)	(0.137)
groupvar	0.359	3.982**	−2.024**	−0.391	2.655	−0.994	0.00413	1.526	−1.378	0.704	2.741*	0.270
	(0.669)	(1.502)	(0.905)	(1.392)	(1.607)	(1.086)	(0.706)	(1.197)	(0.869)	(0.891)	(1.555)	(1.187)
group_ X_shock	3.632	17.02**	−1.026	1.583	−0.880	−14.63***	4.356**	5.980	−6.407*	9.654**	−0.282	1.284
	(2.402)	(7.330)	(3.029)	(4.907)	(3.060)	(3.970)	(2.188)	(5.877)	(3.819)	(3.879)	(2.563)	(5.633)
group_ X_rrvar	−0.708	−4.549**	4.298***	−3.114	−0.925	−0.250	0.0366	−0.104	0.180*	−0.234***	−0.0505	−0.0334
	(1.052)	(2.054)	(1.397)	(1.968)	(0.682)	(1.196)	(0.0924)	(0.102)	(0.0989)	(0.0586)	(0.0328)	(0.0560)
group_X_rrvar _X_shock	0.139	−17.58**	−6.230	−4.297	6.379	18.24***	−0.0191	−0.439***	−0.159	−0.454**	0.339***	−0.0400
	(2.869)	(7.609)	(4.724)	(6.507)	(4.059)	(4.771)	(0.154)	(0.157)	(0.336)	(0.196)	(0.106)	(0.144)
agr_exp_togdp	0.00968	0.0255	−0.0300	0.0440	0.0252	0.00305	0.0139	0.0408	−0.00436	0.0279	0.0109	−0.0291
	(0.0615)	(0.0365)	(0.0525)	(0.0691)	(0.0602)	(0.0437)	(0.0614)	(0.0445)	(0.0573)	(0.0664)	(0.0576)	(0.0419)
min_exp_togd p	−0.0712	0.0656	−0.0251	−0.000724	−0.0125	0.163	−0.110	0.0902	−0.0468	0.244**	−0.00620	0.217
	(0.0911)	(0.153)	(0.0841)	(0.158)	(0.0850)	(0.143)	(0.0925)	(0.184)	(0.0888)	(0.114)	(0.0793)	(0.151)
manuf_exp_to gdp	−0.0748**	−0.0261	−0.0801**	−0.0820**	−0.0808***	−0.0816**	−0.0894***	−0.0561*	−0.0716**	−0.0820**	−0.0993***	−0.0412
	(0.0314)	(0.0294)	(0.0396)	(0.0316)	(0.0287)	(0.0370)	(0.0324)	(0.0316)	(0.0297)	(0.0315)	(0.0328)	(0.0363)
imports_togdp	0.0733**	−0.00972	0.0969***	0.0459	0.0649**	0.0193	0.0819**	0.00107	0.0955***	0.0577*	0.0722**	0.00380
	(0.0322)	(0.0349)	(0.0255)	(0.0403)	(0.0303)	(0.0354)	(0.0330)	(0.0340)	(0.0260)	(0.0334)	(0.0311)	(0.0361)
fuel_exp_togd p	0.356***	0.0203	0.360***	0.0389	0.341***	0.0552	0.323***	−0.0395	0.309***	0.154**	0.288***	0.00709
	(0.104)	(0.0740)	(0.106)	(0.0890)	(0.0946)	(0.0746)	(0.0920)	(0.101)	(0.103)	(0.0757)	(0.0662)	(0.0819)

agri_va_gdp	−0.0327	−0.541***	−0.00519	−0.701***	−0.0279	−0.615***	−0.0335	−0.567***	−0.00228	−0.450**	−0.0238	−0.525***
	(0.0343)	(0.161)	(0.0235)	(0.234)	(0.0339)	(0.188)	(0.0342)	(0.189)	(0.0257)	(0.193)	(0.0331)	(0.177)
ln_gdp	2.621	−1.516	−0.297	−1.334	2.137	−3.535**	2.830	−2.261	0.490	1.169	1.910	−1.468
	(2.515)	(1.433)	(2.068)	(2.187)	(2.387)	(1.617)	(2.593)	(1.401)	(2.377)	(1.898)	(2.419)	(1.725)
Constant	0.549	46.03***	19.61	47.24**	1.762	68.04***	−1.053	55.41***	13.87	21.69	3.435	47.76***
	(17.40)	(13.27)	(14.34)	(21.22)	(15.63)	(15.79)	(18.16)	(13.23)	(16.86)	(18.01)	(15.87)	(16.39)
R squared	0.316	0.376	0.362	0.302	0.329	0.292	0.320	0.366	0.346	0.352	0.350	0.269
Observations	1,125	737	904	746	1,163	863	1,125	737	904	746	1,163	863
Number of id	86	67	68	70	93	82	86	67	68	70	93	82