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Commodity Dependence and Fiscal Capacity*

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Abstract

This paper shows that higher commodity dependence reduces the government's incentive to invest in fiscal capacity. After developing a model that makes this prediction, evidence is provided supporting the view that countries more dependent on commodities (whose rents can be easily appropriated by the government, such as oil) have weaker fiscal capacity. Also, fiscal capacity is found to improve less over time in commodity dependent countries relative to countries where commodity exports play a less relevant role. These empirical results are obtained in a panel dataset with estimators that address endogeneity issues.

JEL Classification: H40, O10, O13, P48, Q32, Q34

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1 Introduction

Existing research has shown that the natural resource wealth of a country can be a curse or a blessing for the country's economic development. A number of studies in the growth literature, most notably Sachs and Warner (1995ab, 1997, 1999, 2001), argue that natural resource abundance has a negative impact on economic growth. In contrast, others point out that resource booms during the 19th century led to higher economic progress in Latin America, while natural resource wealth in Great Britain and Germany made the Industrial Revolution possible (Papyrakis and Gerlach, 2003). A more recent success example is Norway, where natural resource wealth has contributed to higher economic growth.

These apparently contradictory results suggest that it may not be natural resource wealth or abundance alone that drives the development process. What seems to actually matter is how this resource wealth is utilized. Lane and Tornell (1996, 1999), Baland and Francois (2000), Torvik (2002), Mehlum et al. (2006), and more recently Bhattacharyya and Hodler (2010), show that the impact of natural resource wealth depends mainly on the quality of institutions. The main message of this growing body of literature is that the so-called "resource curse hypothesis" tends to be valid in countries with "grabber-friendly" institutions. The higher the "appropriability" of natural resources by specific groups in the society, the higher the likelihood that they lead to rent-seeking activities and conflicts (Boschini et al., 2007). Robinson et al. (2006) find that countries with strong institutions, which promote accountability, political stability and efficient redistribution, are likely to benefit from natural resources, rather than suffer from a resource curse.

While the effect of institutions on the impact of natural resource wealth or abundance is well-established, the impact of natural resources on institutional development has been less explored. Filling this gap is the main goal of this paper.

Acknowledging the endogenous nature of the relationship between resource dependence and institutional change, this paper uses a panel data approach that exploits the variability within countries. Flow variables, such as commodity export shares, capture the relative size and variability of resource rents across and within countries that can potentially affect institutional quality. That is, large and volatile resource rents from exports can create "rentier" effects: patronage and rent-seeking behavior by the government officials and groups in power (Sinnot et al., 2010). Although resource abundance (a stock variable) can also have an impact on institutions, this study considers resource dependence, which, as will be discussed below, is a choice variable affected by political incentives, making it more relevant for the analysis of the political economy of natural resources in a panel of countries.

The concept of institutions is very broad. For the purposes of the current study, it is appropriate to narrow institutional development to a specific and tractable dimension, which is "state capacity." Furthermore, the focus here is on "fiscal capacity," which refers to the state's ability to raise tax revenue. Although fiscal capacity is related to fiscal institutions - such as the Internal Revenue Service in the United States - which manage and monitor taxation, the concept captures the broader question of enforceability of taxation. A government may establish a high tax rate, but agents may not comply. Fiscal capacity measures the ability of the state to effectively raise tax revenues. In addition to fiscal capacity, legal state capacity, which refers to the state's ability to protect property rights and support a market economy through "contracting institutions," is also considered.

In defining and studying fiscal and legal capacity, this paper builds on the recent work by Besley and Persson (2009), who develop a framework where the policy choices in market regulation and taxation are constrained by state capacity, as well as the economic institutions inherited from the past. The aim of their study is to analyze the determinants of a government's choice to invest in legal and fiscal capacity. They find that fighting external wars, political stability, and inclusive political institutions are important elements for stronger state capacity. Additionally, they show that legal and fiscal capacity are complements. Besley and Persson (2010a,b) introduce natural resources in this framework and predict that higher share of natural resource rents in total income leads to weaker state capacity. The current paper complements these earlier efforts to understand the effects of natural resources on investment in state capacity, by developing a detailed theoretical framework and conducting an extensive empirical analysis on the relationship between natural resource dependence and fiscal capacity.

The structure of the paper is as follows. In Section 2, a two-period, two-group political economy model is developed. Natural resources generate rents that are received by the government, which in turn decides how to use them. While the rents can be used to pay for investment in fiscal capacity and provision of public goods, they can also be appropriated for private consumption. Investment in fiscal capacity in period 1 determines the maximum enforceable tax rate in period 2. The main finding is that higher natural resource rents decrease the incentive of the government to invest in fiscal capacity. Also, it is shown that higher income inequality amplifies this negative effect of natural resource rents on fiscal capacity investment.

Section 3 presents the empirical evidence and answers three questions. First, is the level of fiscal capacity lower in more commodity dependent countries? Second, do more commodity dependent countries invest less in fiscal capacity? Third, does the relationship between fiscal capacity and commodity dependence hold within countries in the short run?

Although there is empirical work on the negative correlation between resource dependence and institutional indicators at the cross-country level (Leite and Weidmann, 1999; Isham et al., 2005), the literature is mainly focused on legal institutions (or legal state capacity), leaving the fiscal dimension unaddressed. Also, with very few exceptions, the existing literature relies solely on cross-country regressions, either by pooling all observations or by estimating panel regressions with random effects. Thus, the results are vulnerable to reverse causality bias. This source of bias arises because measures of resource dependence, such as trade in commodities, production of minerals, or the size of the workforce employed in resource extraction, are also choice variables endogenous to economic, political, and institutional factors (Norman, 2009). Therefore, initial institutional conditions likely play an important role in determining the contemporaneous measures of resource dependence. With regards to simultaneity, previous empirical work shows strong evidence that institutional measures, such as state capacity, are persistent over time (Cárdenas et al., 2011), making it necessary to model the dynamic relationship in a panel data framework. Finally, omitted time variant and invariant country characteristics are not taken into account in cross-sectional regressions. A good example of the omitted variables is resource stocks by country (as pointed out by Norman, 2009), which also determine resource dependence measures. Haber and Menaldo (2009) is the only work to analyze the resource curse hypothesis based on a dynamic time-series analysis. Contrary to this paper, their main focus is on the relationship between commodity dependence and the political regime.[1]

In Section 3, a new panel dataset is used to test whether country-years with higher commodity dependence also have lower fiscal capacity levels. To address the aforementioned endogeneity problems associated with OLS regressions, the Arellano and Bover (1995)/Blundell and Bond (1998) System GMM estimator is used. The aim is to expunge from the coefficients the fixed and dynamic effects associated with the flow measures of resource dependence. Also, this methodology allows for the estimation of short-run effects of resource dependence on fiscal capacity, which is a novelty.

To assess whether commodity dependent countries invest less in fiscal capacity, the annual panel dataset is collapsed to construct five-year averages of an investment-in-fiscal-capacity measure, defined as the change in the level of fiscal capacity over a five year period as variations in the measures of fiscal capacity are expected to take place over longer periods of time, such as quinquenniums. The percentage of commodity exports in total exports is used as a measure of commodity dependence.

The results indicate that on average, throughout the period 1984-2004, country-years with a higher per-

[1] Another panel data analysis of the resource curse is done by Ross (2001), who studies a global panel of countries from 1972 to 1997. However, the author does not account for the full dynamic nature of the resource curse hypothesis, which is addressed in the present work.

centage of commodity exports are associated with weaker fiscal capacity. Also, legal and fiscal capacity are complements across country-years. In the short run, a strong negative relationship is observed only between oil exports and fiscal capacity, suggesting that oil revenues crowd out the need to raise taxes in a way that is distinct from other commodities. Given the complementarity between fiscal and legal capacity, it follows that low taxation makes it less advantageous for the government to invest in legal capacity, and vice versa. Lastly, the evidence indicates that higher commodity dependence results in lower changes in fiscal capacity during the following five-year period.

2 Theoretical Model

2.1 The Environment

The model presented here is similar to the framework developed in Besley and Persson (2009, 2010a). Time is discrete and consists of two periods, $s = 1, 2$. There are two groups, A (in power) and B (opposition), with population shares β^A and β^B. Total population is normalized to unity. Each member of group A has income level of Y^A, while income level is Y^B for each member of group B. In each period, the group holding power (government) makes the taxation and spending decisions. All agents derive utility from consuming private goods (purchased with after-tax income) and public goods (provided by the government).

Tax rates in both periods are group-specific and denoted with t_s^A and t_s^B. The stock of fiscal capacity determines the maximum tax rate that can be enforced in each period. The capacity to tax depends on previous investments in building an administration (like the Internal Revenue Service in the United States) which manages and monitors taxation. Specifically, the government needs to make a non-negative investment in the first period in order to have a higher level of fiscal capacity in the second period. The stock of fiscal capacity does not depreciate. Taking the stock of the first period fiscal capacity τ_1 as given, the government decides the level of investment $\triangle\tau = \tau_2 - \tau_1$, which determines the level of fiscal capacity in the second period τ_2. In turn, τ_2 gives the maximum tax rate that can be enforced by the government in period 2. It is assumed that investment in fiscal capacity $\triangle\tau$ is costly. The cost of investment takes a functional form $F(\triangle\tau)$, which is increasing and strictly convex, that is $F_{\tau_2}(.) > 0$ and $F_{\tau_2\tau_2}(.) > 0$. It also has the properties $F(0) = F'(0) = 0$. Convexity, which is crucial for the model's results, can be justified on the grounds that tax evasion and informality are present even in very wealthy societies, suggesting that the costs of eliminating these practices are too high.

Each period, there are natural resources that generate rents to the government, denoted with R. The government can use these rents to invest in fiscal capacity and to provide public goods G_s, or to redistribute to either group for private consumption.

The preferences are linear in private consumption and quasi-linear in public goods. Therefore, the indirect utility for each individual in each group can be written as:

$$v_s^A\left(t_s^A, G_s\right) = \alpha_s V(G_s) + (1 - t_s^A)Y^A \tag{1}$$

$$v_s^B\left(t_s^B, G_s\right) = \alpha_s V(G_s) + (1 - t_s^B)Y^B \tag{2}$$

where $V(.)$ is a strictly concave function of G_s with $V(0) = 0$. α_s stands for the time-variant and stochastic valuation of public goods which can be different from the valuation of private goods.

In each period, the government chooses the group specific tax rates, the level of public goods provision and the level of investment in fiscal capacity that maximize the weighted sum of the utilities of the two groups. When the weights are equal to the population shares of the two groups (a utilitarian government) the political system is considered to be democratic. Yet, many countries have political systems where governments deviate from this benchmark. In the presence of political inequality, the weights in the welfare function are equal to the population shares multiplied by two new parameters $\overline{\rho}$ and $\underline{\rho}$, which represent the political preferences of the government. The total weight the group in power attaches to its own group becomes $\overline{\rho}\beta^A$, while that for the opponent group becomes $\underline{\rho}\beta^B$. For example, the group in power can favor its own group members, which corresponds to $\overline{\rho} > 1$ and $\underline{\rho} < 1$. From now on, assume that $\overline{\rho} \geq 1$ and $\underline{\rho} \leq 1$. The measure of <u>political inequality</u> is defined as $\psi = \overline{\rho} - \underline{\rho}$. By assumption, the sum of the weights attached to the groups' utilities should satisfy $\overline{\rho}\beta^A + \underline{\rho}\beta^B = 1$.

Before setting up the period 1 optimization problem of the ruling group, or the government, it is necessary to determine the timing of events. First, nature determines the stochastic value attached to public goods α_1 in period 1, the level of natural resource rents R, and which group (A) holds political control. Second, the government picks its policy vector of taxes t_1^J, spending in public goods G_1 and the level of investment in state capacity $\triangle\tau$. Lastly, agents consume.

More specifically, the first period problem of the government can be expressed as:

$$max_{\{G_1, t_1^A, t_1^B, \triangle\tau\}} \quad \overline{\rho}\beta^A v_1^A\left(t_1^A, G_1\right) + \underline{\rho}\beta^B v_1^B\left(t_1^B, G_1\right) + ENP \tag{3}$$

$$= \quad max \quad (\overline{\rho}\beta^A + \underline{\rho}\beta^B)\alpha_1 V(G_1) + \overline{\rho}\beta^A(1 - t_1^A)Y^A + \underline{\rho}\beta^B(1 - t_1^B)Y^B + ENP \tag{4}$$

$$s.t. \quad \beta^A t_1^A Y^A + \beta^B t_1^B Y^B + R = G_1 + F(\triangle\tau) \tag{5}$$

$$G_1 \geq 0 \tag{6}$$

$$\tau_1 \geq t_1^A \quad and \quad \tau_1 \geq t_1^B \tag{7}$$

Equations (3) and (4) provide the welfare objective, while Equation (5) is the government's budget constraint. Equation (6) simply states that public goods provision is non-negative. The constraints in Equation (7) imply that the maximum tax rates are bounded by the state's fiscal capacity. Finally, in Equations (3) and (4) ENP stands for the second period Expected Net Payoff for the group ruling in the first period. This is an expected payoff, because the outcome depends on which group holds power in period 2.

Similarly, the second period maximization problem of the government is:

$$max_{\{G_2, t_2^A, t_2^B\}} \quad \overline{\rho}\beta^A v_2^A\left(t_2^A, G_2\right) + \underline{\rho}\beta^B v_2^B\left(t_2^B, G_2\right) \tag{8}$$

$$= \quad max \quad (\overline{\rho}\beta^A + \underline{\rho}\beta^B)\alpha_2 V(G_2) + \overline{\rho}\beta^A(1 - t_2^A)Y^A + \underline{\rho}\beta^B(1 - t_2^B)Y^B \tag{9}$$

$$s.t. \quad \beta^A t_2^A Y^A + \beta^B t_2^B Y^B + R = G_2 \tag{10}$$

$$G_2 \geq 0 \tag{11}$$

$$\tau_2 \geq t_2^A \quad and \quad \tau_2 \geq t_2^B \tag{12}$$

As in the first period maximization problem, the government takes the value of public goods α_2, natural resource rents R and the stock of fiscal capacity τ_2 as given, and chooses the optimal levels of tax rates and public goods provision. There is no investment in fiscal capacity in period 2.

2.2 Optimal Taxation and Public Goods Provision

The maximization problem of the government is linear in the policy variables. Taking advantage of this linearity, the optimal taxation and public goods provision decisions are analyzed separately from the optimal fiscal capacity investment decision.

As mentioned above, nature determines the stochastic value of public goods α_s in each period. Since preferences are quasi-linear in public goods, the total value attached to public goods provision can be expressed as $\alpha_s V_G(G_s)$. If this value is greater than the government's valuation of private consumption $\overline{\rho}$, the government chooses to maximize the level of public goods provision. In order to illustrate this, take defense as an example of a public good. If a country engages in an external war, defense becomes very valuable, and it becomes beneficial for the government to maximize military spending. If private consumption is valued higher than public goods consumption, then the government chooses not to spend any resources on the provision of public goods. Finally, if they are valued equally, then the government chooses to provide public goods, but the level of public goods provision is not maximized.

To summarize, there are three possible states of the world. In the first one, public goods are valued more than private goods, that is $\alpha_s V_G(G_s) > \overline{\rho}$. This state occurs with an exogenous probability equal to ϕ_1, and the optimal policy is:

$$G_1 = \tau_1(\beta^A Y^A + \beta^B Y^B) + R - F(\triangle\tau) \tag{13}$$

$$t_1^A = t_1^B = \tau_1 \tag{14}$$

$$G_2 = \tau_2(\beta^A Y^A + \beta^B Y^B) + R \tag{15}$$

$$t_2^A = t_2^B = \tau_2 \tag{16}$$

Intuitively, since public goods consumption is valued more than private goods consumption, the government taxes both groups at the maximum possible rate and uses the collected tax revenue, in addition to the natural resource rents, for the provision of public goods in both periods and investment in fiscal capacity in the first period. In other words, providing public goods is in the interest of both groups; therefore, this state is called the "Common Interest State."

In the second case, the group in power values public goods consumption less than private goods consumption, that is $\alpha_s V_G(G_s) < \overline{\rho}$. This happens with an exogenous probability equal to ϕ_2, and the optimal policy becomes:

$$G_1 = 0 \tag{17}$$

$$t_1^B = \tau_1 \tag{18}$$

$$-\beta^A t_1^A Y^A = \beta^B \tau_1 Y^B + R - F(\triangle\tau) \tag{19}$$

$$G_2 = 0 \tag{20}$$

$$t_2^B = \tau_2 \tag{21}$$

$$-\beta^A t_2^A Y^A = \beta^B \tau_2 Y^B + R \tag{22}$$

In this case, the value attached to public goods is lower than the value attached to private goods; therefore, no public goods are provided. The group in power is only interested in the redistribution of all possible resources in order to increase its own private consumption. Hence, this state of affairs is called the "Redistribution State." The group in power taxes the opponent group at the maximum possible rate and redistributes the tax revenue amongst its own members by setting a negative tax rate. Additionally, it transfers the natural resource rents to its group members, so that these rents become part of the group's private consumption. There can be investment in fiscal capacity if the group in power in period 1 wants to increase the amount of redistribution in period 2.

In the third case, the ruling group values the consumption of both types of goods equally, which corresponds to $\alpha_s V_G(G_2) = \overline{\rho}$. The world is in this state with an exogenous probability equal to $(1 - \phi_1 - \phi_2)$ and the optimal policy changes to:

$$G_1 = G_1^* \tag{23}$$

$$t_1^B = \tau_1 \tag{24}$$

$$-\beta^A t_1^A Y^A = \beta^B \tau_1 Y^B + R - G_1^* - F(\triangle\tau) \tag{25}$$

$$G_2 = G_2^* \tag{26}$$

$$t_2^B = \tau_2 \tag{27}$$

$$-\beta^A t_2^A Y^A = \beta^B \tau_2 Y^B + R - G_2^* \tag{28}$$

where $G_s = G_s^*$ is solved from $\alpha_s V_G(G_s^*) = \overline{\rho}$. In this state of the world, the government uses its resources for the provision of public goods, but it can also transfer part of resources to its own members by choosing $t_s^A < 0$. While the optimal policies in the common interest and the redistribution states correspond to two opposite corner solutions, the solution is an interior one in this state of the world. Therefore, this state is named as the "Middle State."

2.3 Optimal Investment in Fiscal Capacity

The second period Expected Net Payoff (ENP) has to be written in detail in order to solve for the optimal level of investment in fiscal capacity. This subsection uses the optimal taxation and public goods provision results presented previously to calculate the second period expected payoff for the first period's ruling group. When this group continues to rule in the second period, the total utility is:

$$U_2^1 = \begin{cases} A = \alpha_2 V(\tau_2(\beta^A Y^A + \beta^B Y^B) + R) + \overline{\rho}\beta^A(1-\tau_2)Y^A + \underline{\rho}\beta^B(1-\tau_2)Y^B & \text{if } \alpha_2 V_G(G_2) > \overline{\rho}; \\ B = \overline{\rho}\beta^A Y^A + \underline{\rho}\beta^B Y^B + (\overline{\rho} - \underline{\rho})\beta^B \tau_2 Y^B + \overline{\rho}R & \text{if } \alpha_2 V_G(0) < \overline{\rho}; \\ C = \alpha_2 V(G_2^*) + \overline{\rho}\beta^A Y^A + \underline{\rho}\beta^B Y^B + (\overline{\rho} - \underline{\rho})\beta^B \tau_2 Y^B + \overline{\rho}R - \overline{\rho}G_s^* & \text{if } \alpha_2 V_G(G_2^*) = \overline{\rho}. \end{cases}$$

and the second period expected payoff can be written as:

$$V_2^1 = \phi_1 A + \phi_2 B + (1 - \phi_1 - \phi_2)C \tag{29}$$

where ϕ_1, ϕ_2 and $(1 - \phi_1 - \phi_2)$ are the probabilities of being in the common interest, the redistribution and the middle states, respectively. Term A stands for the sum of the weighted utilities of the two groups in the common interest state, where both groups are taxed at the maximum amount. The first part presents the total utility derived by the two groups from the provision of public goods. The second and third parts are the sum of the after-tax income of the two groups. Term B stands for the total utility in the redistribution state, which is derived by inserting Equations (20)-(22) into Equation (9). In this state the group in power taxes the opponent group at the maximum rate in order to redistribute resources to its own members. No public goods are provided. The opponent group loses a share of its income due to taxation, whereas the group in power receives the collected taxes and the natural resource rents, and consumes more than its period income. Lastly, term C stands for the total utility in the middle state and it is derived by inserting Equations (26)-(28) into Equation (9). Again, the opponent group is taxed at the maximum rate, while the tax rate for the ruling group is lower than the maximum tax rate and can also be negative. The group in power uses the collected taxes and the natural resource rents for the provision of public goods, and also redistribution, if it chooses a negative level of tax rate for its own members.

The expected payoff when the opponent group rules in the second period can be derived similarly. The total utility in this case is equal to:

$$U_2^2 = \begin{cases} A = \alpha_2 V(\tau_2(\beta^A Y^A + \beta^B Y^B) + R) + \overline{\rho}\beta^A(1-\tau_2)Y^A + \underline{\rho}\beta^B(1-\tau_2)Y^B & \text{if } \alpha_2 V_G(G_2) \geq \overline{\rho}; \\ D = \overline{\rho}\beta^A Y^A + \underline{\rho}\beta^B Y^B - (\overline{\rho}-\underline{\rho})\beta^A \tau_2 Y^A + \underline{\rho}R & \text{if } \alpha_2 V_G(0) < \overline{\rho}; \\ E = \alpha_2 V(G_2^*) + \overline{\rho}\beta^A Y^A + \underline{\rho}\beta^B Y^B - (\overline{\rho}-\underline{\rho})\beta^A \tau_2 Y^A + \underline{\rho}R - \underline{\rho}G_s^* & \text{if } \alpha_2 V_G(G_2^*) = \overline{\rho}. \end{cases}$$

and the second period expected payoff when the opponent rules in the second period becomes:

$$V_2^2 \quad = \quad \phi_1 A + \phi_2 D + (1-\phi_1-\phi_2)E \tag{30}$$

Again ϕ_1, ϕ_2 and $(1-\phi_1-\phi_2)$ are the probabilities of being in the common interest, the redistribution and the middle states, respectively. Note that the total utility in the common interest state, or term A, is the same regardless of which group holds the power. However, the total utility in the redistribution state changes depending on which group holds the power, thus term B in Equation (29) becomes term D in Equation (30). Term D shows that when the ruling group loses power to the opponent group, its members get taxed at the maximum rate, and the new ruling group collects the tax revenue and the natural resource rents. Similarly, term C in Equation (29) is now term E in Equation (30). The opponent group gains power and taxes the ruling group of period 1 at the maximum tax rate. Taxes and the natural resource rents are then used for the provision of public goods, and also redistribution, if the new ruling group chooses a negative tax rate for its own members.

Now, the second period Expected Net Payoff (ENP) can be defined as:

$$ENP = \gamma V_2^1 + (1-\gamma)V_2^2 - \lambda_* F(\triangle\tau) \tag{31}$$

The sum of the first two terms in Equation (31) corresponds to the weighted total utility derived from investing in fiscal capacity, where the weights are equal to the probabilities of the two possible cases. In the first case the ruling group of period 1 keeps power in period 2 with an exogenous probability γ, and in the second case it loses it to the opponent group with probability $(1-\gamma)$. The last term is the cost of investment in terms of the value of public funds, where $\lambda_* = max\{\alpha_1 V_G(G_1), \overline{\rho}\}$ is the value of public funds used to finance fiscal capacity investment in the first period.

When the payoff values are substituted in and simplified, the ENP becomes:

$$\begin{aligned} ENP &= \phi_1\left\{\alpha_2 V(\tau_2(\beta^A Y^A + \beta^B Y^B) + R) + \overline{\rho}\beta^A(1-\tau_2)Y^A + \underline{\rho}\beta^B(1-\tau_2)Y^B\right\} \\ &+\phi_2\left\{\overline{\rho}\beta^A Y^A + \underline{\rho}\beta^B Y^B + (\overline{\rho}-\underline{\rho})\tau_2[\gamma\beta^B Y^B - (1-\gamma)\beta^A Y^A] + [\gamma\overline{\rho} + (1-\gamma)\underline{\rho}]R\right\} \\ &+(1-\phi_1-\phi_2)\left\{\alpha_2 V(G_2^*) + \overline{\rho}\beta^A Y^A + (\overline{\rho}-\underline{\rho})\tau_2[\gamma\beta^B Y^B - (1-\gamma)\beta^A Y^A] + \right\} \\ &+(1-\phi_1-\phi_2)\left\{[\gamma\overline{\rho} + (1-\gamma)\underline{\rho}](R - G_2^*)\right\} - \lambda_* F(\triangle\tau) \end{aligned} \quad (32)$$

To determine the optimal investment level in fiscal capacity, one needs to use the first period maximization problem and write down the first order condition with respect to τ_2 (which corresponds to the derivative of the ENP with respect to τ_2):

$$\begin{aligned} \lambda_* F_{\tau_2}(\triangle\tau) &= \phi_1\alpha_2 V_{G_2}(\tau_2(\beta^A Y^A + \beta^B Y^B) + R)(\beta^A Y^A + \beta^B Y^B) \\ &-\phi_1\{\overline{\rho}\beta^A Y^A + \underline{\rho}\beta^B Y^B\} \\ &+(1-\phi_1)(\overline{\rho}-\underline{\rho})\{\gamma\beta^B Y^B - (1-\gamma)\beta^A Y^A\} \end{aligned} \quad (33)$$

Equation (33) shows that the optimal level of investment in fiscal capacity $\triangle\tau$ depends on the main parameters of the model, namely, future valuation of public goods α_2, political inequality $(\overline{\rho}-\underline{\rho})$, political stability γ, and the level of natural resource rents R.

This framework implies that higher valuation of public goods in the future leads to greater investment in fiscal capacity. When the government expects that public goods will be more valuable in the future, it is optimal to increase the stock of fiscal capacity, so that higher tax revenue can be raised and more public goods can be provided in the second period. An example of this case would be an increased expectation of an external conflict in the second period. In this case the government would like to increase spending in defense, which requires building up higher fiscal capacity in the first period, in order to be able to collect more tax revenue from all groups in the second period. Another interesting result is that if the political system is stable the government is likely to be in power in the second period, which leads to a higher incentive to expand fiscal capacity in the first period. In that case, it is in the government's best interest to invest in fiscal capacity to be able to raise more tax revenue in the second period, which will lead to higher public goods provision or redistribution (as there is no discounting). Conversely, in the presence of political instability, more specifically when $\gamma < \beta^A$, higher political inequality leads to lower investment in fiscal capacity. Intuitively, because the government thinks that it will lose power in the second period, it does not want to build fiscal capacity in period 1 that can be used to tax its own members for the benefit of the other group in period 2.

While these results are very important, the main focus of this paper is to understand the effect of the natural resource rents R on the fiscal capacity investment decision. To derive the sign and the magnitude of these effects, the optimality condition in Equation (33) can be utilized. Using the Implicit Function Theorem, one gets:

$$\frac{\partial \tau_2}{\partial R} = -\frac{\partial H/\partial R_2}{\partial H/\partial \tau_2} \tag{34}$$

where:

$$\begin{aligned} H &= \phi_1 \alpha_2 V_{G_2}(\tau_2(\beta^A Y^A + \beta^B Y^B) + R)(\beta^A Y^A + \beta^B Y^B) - \phi_1\{\overline{\rho}\beta^A Y^A + \underline{\rho}\beta^B Y^B\} \\ &\quad + (1-\phi_1)(\overline{\rho} - \underline{\rho})\{\gamma\beta^B Y^B - (1-\gamma)\beta^A Y^A\} - \lambda_* F_{\tau_2}(\triangle\tau) \end{aligned} \tag{35}$$

$$\frac{\partial H}{\partial R} = \phi_1 \alpha_2 V_{G_2G_2}(\tau_2(\beta^A Y^A + \beta^B Y^B) + R)(\beta^A Y^A + \beta^B Y^B) \tag{36}$$

$$\frac{\partial H}{\partial \tau_2} = \phi_1 \alpha_2 V_{G_2G_2}(\tau_2(\beta^A Y^A + \beta^B Y^B) + R)(\beta^A Y^A + \beta^B Y^B)^2 - \lambda_* F_{\tau_2\tau_2}(\triangle\tau) \tag{37}$$

Next, plugging Equations (36) and (37) into Equation (34) gives the desired result:

$$\frac{\partial \tau_2}{\partial R} = \frac{\phi_1 \alpha_2 V_{G_2G_2}(G_2)(\beta^A Y^A + \beta^B Y^B)}{\lambda_* F_{\tau_2\tau_2}(\triangle\tau) - \phi_1 \alpha_2 V_{G_2G_2}(G_2)(\beta^A Y^A + \beta^B Y^B)^2} < 0 \tag{38}$$

where the sign of this derivative is determined by assuming $V_{G_2}(.) > 0$, $V_{G_2G_2}(.) < 0$, $F_{\tau_2}(.) > 0$ and $F_{\tau_2\tau_2}(.) > 0$. In words, the utility function associated with the consumption of public goods is strictly concave, while the cost function associated with investment in fiscal capacity is strictly convex.

Equation (38) shows that higher natural resource rents lead to lower investment in fiscal capacity. Note that the government can only tax the groups' incomes, which do not vary over time. Investment in fiscal capacity is costly and the return from this investment is relatively low when R is high, since in this case G_2 is high and $V_{G_2G_2}(.) < 0$. Defining higher commodity dependence as having higher share of natural resource rents in the total income, it follows that higher commodity dependence leads to lower investment in fiscal capacity.

In order to better understand the negative effect of R on the fiscal capacity investment decision, it is necessary to determine the government's investment incentives in the different states of the world. If the world is expected to be in the common interest state in the second period, the main objective of the government becomes increasing the level of public goods provision. In order to achieve this goal, the government would like to increase fiscal capacity in the first period to be able to collect more tax revenue in the second period. The natural resource rents are also used for the provision of public goods in the second period. By assumption, while the marginal gain from higher public goods provision increases at a decreasing rate, the cost associated with higher investment in fiscal capacity increases at an increasing rate. Therefore, it is in the government's best interest to avoid highly costly investments, since the returns from these investments increase at a decreasing rate. When the natural resource rents are high, the government can achieve its goal by allocating these rents for the public goods provision directly. As a matter of fact, when R is high the government can actually provide more public goods in the second period without increasing fiscal capacity significantly. Therefore, if R is high the incentive of the government to invest in fiscal capacity decreases, given the convexity of the investment cost.

The story is different if the world is likely to be in the redistribution state in the second period. In this state it is in the government's best interest to redistribute the available resources to its own group members in order to increase the group's private consumption level. Given the possibility of losing power to the opponent group in the second period, the government fears of being taxed at a higher rate; therefore, it has a disincentive to invest in fiscal capacity. Moreover, when the level of natural resource rents are high, private consumption of the ruling group can be increased by redistributing these rents directly, instead of collecting taxes and investing in fiscal capacity (which becomes beneficial for the group in the next period only if it stays in power).

Lastly, when the world is in the middle state in the second period, a higher level of natural resource rents R decreases the incentive of the government to invest in fiscal capacity for two reasons. First, as in the common interest state, the government provides public goods, and given the convexity of the investment cost, the government can actually provide more public goods in the second period by using R directly, instead of increasing fiscal capacity. Second, in this state the ruling group may choose to redistribute resources from the opponent group to its own members; therefore, as in the redistribution state, the government fears of being taxed at a higher rate in the second period if they lose power to the opponent. A higher level of R means that the private consumption of the ruling group can be increased by redistributing these rents directly, instead of investing in fiscal capacity. For both of these reasons, a higher level of R leads to lower investment in fiscal capacity in the middle state.

2.4 The Effect of Income Inequality

As a final theoretical exercise, this subsection investigates the role of income inequality on the negative effect of the natural resource rents on fiscal capacity investment. The level of income inequality is denoted with ϵ, so that each group's income level can be expressed as $Y^A = \overline{Y} + \epsilon$ and $Y^B = \overline{Y} - \epsilon$, where $\overline{Y}$ is the average income level.

How does income inequality affect the negative impact of R on fiscal capacity investment? To answer this question, the derivative of $\frac{\partial \tau_2}{\partial R}$ with respect to ϵ is used. (See the Appendix for the details of this derivation.) The result indicates that income inequality amplifies the negative effect of the natural resource rents on investment in fiscal capacity. Intuitively, when the wealthier group is in power, the expected gain from higher tax rates is low, given that the other group has a lower level of income. Conversely, in the case where the lower income group rules redistribution in the first period (rather than investing in fiscal capacity) is the preferred option, given that the opponent has a higher income.

3 Empirical Analysis

The baseline empirical model to answer whether fiscal capacity is lower in more commodity dependent country-years is given by:

$$FC_{it} = \beta_0 + \beta_1 CD_{it} + \gamma' X_{it} + \delta' D_t + u_{it} \tag{39}$$

where FC_{it} represents fiscal capacity in country i in year t; CD_{it} denotes commodity dependence; X_{it} is a vector of controls that includes the indicator of the quality of government, a measure of democracy, log of real GDP per capita and incidence of internal and external wars; D_t is a vector of year dummies; and u_{it} is the error term.

3.1 Data

Fiscal capacity is measured with total tax revenue and income tax revenue, both as a percentage of GDP, following Besley and Persson (2009) and Cárdenas et al. (2011). The data is available annually for the period 1975-2006 and comes from Baunsgaard and Keen (2010).[2]

The key explanatory variable is the percentage of commodity exports in total exports, which is used as a measure of natural resource dependence. Not all commodity exports are equal in terms of patronage and rent-seeking behavior, and their impacts depend on the organization of production and, thus, on who

[2] Data for income taxes is only available until 2000.

controls and benefits from them (Sinnot et al., 2010). The data comes from the World Bank and includes both the percentage of commodity exports as a whole and commodity exports disaggregated by commodity type: petroleum and its derivatives; raw materials (crude fertilizers, metalliferous ores, coal, gas, electrical current and nonferrous metal); forest products (lumber, wood, cork, pulp, wood manufactures and paper); tropical products (vegetables, sugar, coffee, beverages and crude rubber); animal products (live animals, meat, dairy products, processed animal and vegetable oils); and cereals products (cereals, feeds, tobacco, oil seeds and textile fibers).[3] Table 1 presents the full list of commodities included.

The control variables are real GDP per capita from the World Development Indicators 2009, an index of democracy, as well as measures of the presence of internal and external wars. The measure of democracy is the polity2 variable (Marshall et al., 2009). The original variable is scaled in the range -10 (complete autocracy) to 10 (full democracy). A slight transformation is used and a country is defined as democratic when the polity2 score, averaged over the five preceding years, is above 3.[4] Additionally, the control variables include internal and external conflict events that serve as proxies for political instability and a higher demand for public goods, respectively. Recent empirical evidence shows that these two variables are strong determinants of state capacity (see Besley and Persson, 2008, 2009 and Cárdenas et al., 2011). The data on wars comes from the UCDP/PRIO Armed Conflict Dataset (version 3-2005) that contains information on armed conflicts during the period 1946-2004. The highest intensity conflict events, which are those with more than 1,000 battle related deaths per year of conflict, are used.[5] With this information, two dummy variables are constructed that capture the occurrence of internal and external wars, respectively; as country-year events.

Legal capacity is added as an additional control to capture the idea that fiscal and legal capacity are complements, or as Besley and Persson (2010b:16) put it, "investments in one aspect of the state reinforce the motives to invest in the other." In particular, a higher level of legal capacity enhances private sector productivity due to higher quality market-supporting regulations, including the ability to protect property rights and enforce contracts. This, in turn, translates into higher market income and higher fiscal capacity, which acts as an incentive to invest further in fiscal capacity. Legal capacity is measured with a summary indicator of the quality of government reported by the Quality of Government Institute (QOG) and based

[3]This classification follows Leamer (1984) and Song (1993).

[4]The polity2 score is computed by subtracting the autocracy score from the democracy score. The Democracy score uses a 0-10 scale and combines measures of competitiveness of executive recruitment, openness of executive recruitment, constraints on the executive and competitiveness of political participation. The Autocracy score also uses a 0-10 scale to measure the degree of restriction or suppression of competitive political participation. Its components are competitiveness of executive recruitment, openness of the executive recruitment, constraints on the executive, regulation of participation and competitiveness of political participation. For more details see Marshall et al. (2009).

[5]Less intense definitions of conflict have no statistically significant effect on the measure of investment in state capacity when used as additional controls.

on the International Country Risk Guide (ICRG).[6] This measure averages the individual scores for three dimensions: law and order, corruption and quality of bureaucracy. It takes values between 0 and 100, and increases with the assessed quality of government.[7] There is information available yearly for the period 1984-2008.

3.2 State Capacity and Commodity Dependence

Table 2 shows the descriptive statistics for the annual panel. All three of the state capacity measures seem to exhibit sufficient variation across countries and years. On average, tax revenues are equal to 21 percent of GDP with a standard deviation of 11 percentage points; income taxes represent around 8 percent of GDP on average, but can be as low as 0 percent or as high as 40 percent. Commodity exports as a whole are on average 56 percent of total exports with a standard deviation of 31 percentage points. Internal wars and external wars have been rare events across countries since 1975; only 5 percent and 2 percent of the country-year observations correspond to these types of episodes, respectively. However, it is important to note that the low occurrence of internal wars has to do more with the definition of conflict considered, which requires as much as 1,000 battle deaths per year in order to be classified as such.[8]

Table 3 shows the OLS results of estimating Equation (39). In general, it is clear from the results in Table 3 that, on average, throughout the period 1984-2004, commodity export dependence has a negative correlation with fiscal capacity.[9] There is also evidence that legal and fiscal capacity are complements across country-years, even after controlling for other determinants of fiscal capacity.

Figure 1 illustrates the above conclusion. The part of fiscal capacity not explained by the control variables is correlated with commodity dependence measures. An exception is forest exports as a percentage of total exports, which are positively correlated with the residuals of fiscal capacity. This issue is revisited below.

[6] The Quality of Government Dataset (QOG) from the QOG Institute at the University of Gothenburg compiles both a cross-sectional dataset with global coverage pertaining to the year 2002 (or the closest year available) and a cross-sectional time-series dataset with global coverage spanning the time period 1946-2008. The datasets can be freely downloaded at http://www.qog.pol.gu.se/. For additional details see Teorrell et al. (2009).

[7] The QOG measure is similar to the one constructed by Knack and Keefer (1995) and later used by Hall and Jones (1999). Knack and Keefer (1995) average 5 of the original 24 categories created by the ICRG to rank countries. These 5 categories are "law and order," "bureaucracy quality," "corruption," "risk of expropriation" and "government repudiation of contracts." QOG only uses the first three in its indicator of the quality of government because, unfortunately, the latter two were discontinued since 1997 and thus could not be used to construct time series beyond this year. The scores of the indicator of the quality of government originally take values from 0 to 1, but are rescaled to take values from 0 to 100 in order to facilitate the interpretation of coefficients in the regression analysis.

[8] Cárdenas et al. (2011) show that, when a less demanding definition of internal conflict is used, the average time of conflict since 1975 rises to 11 percent. The average presence of external conflict (2 percent) is unchanged regardless of the definition used.

[9] Forest exports are an interesting exception.

3.3 Initial Conditions and Short-Run Effects

Problems of endogeneity, namely simultaneity and omitted variables, are pervasive in the previous estimates. Past levels of fiscal capacity and resource abundance likely determine current levels of the commodity dependence variables. As mentioned above, dependence is a choice variable affected by policy decisions, since the capacity of the state affects the ability to develop other sectors of the economy and to diversify the export base. In the case of omitted variables, past levels of fiscal capacity likely influence its present levels due to its persistence over time. The same applies to country-specific characteristics that do not vary over time.

All in all, state capacity is shown to be persistent over time (Cárdenas et al., 2011), and thus it is plausible that higher commodity dependence today is the result of weaker state capacity in the previous years. To deal with this possibility, a within-country strategy is considered to account for the effects of initial conditions and problems of endogeneity. This new approach allows controlling for exogenous political, institutional and economic factors that likely influence the flow measures of commodity dependence and current fiscal capacity. Now, the baseline model is of the following form:

$$FC_{it} = \beta_0 + \alpha FC_{it-1} + \beta_1 CD_{it} + \gamma' X_{it} + \delta' D_t + \epsilon_{it} \tag{40}$$

$$\epsilon_{it} = \mu_i + \nu_{it} \tag{41}$$

$$E[\mu_i] = E[v_{it}] = E[\mu_i v_{it}] = 0 \tag{42}$$

In Equation (40) FC_{it-1} captures fiscal capacity in country i and year $t-1$. In subsequent robustness exercises the term αFC_{it-1} in Equation (40) is replaced with $\Sigma_{k=1}^{3} \alpha_k FC_{it-k}$, which includes three lags of the dependent variable as regressors, instead of just one.[10] Equation (41) shows that the country fixed effects μ_i are controlled for, and Equation (42) reflects the assumption that these fixed effects are orthogonal to the idiosyncratic shocks ν_{it}.

The analysis presented here utilizes the Arellano and Bover (1995), and Bond and Blundell (1998) system GMM estimator, which runs Equation (40) in first differences and in levels, permitting the use of a higher number of lagged instruments for the predetermined (fiscal capacity) and endogenous (commodity dependence) variables.[11] The lagged values of fiscal capacity FC_{it-1} are always instrumented with their own second and earlier lags in the differenced equation and with the first lags of their first differences in the levels equation, and the instrument matrix is collapsed to avoid instrument proliferation. The commodity

[10] These robustness exercises confirm that the initial results hold when both autocorrelation and exogeneity tests pass in all specifications.

[11] This increases the efficiency of the estimators compared to the more common Arellano and Bond (1991) "Difference" GMM methodology, which only estimates the transformed differenced equation.

dependence variables, in turn, are always instrumented with their own third lags in the differenced equation and with the second lags of their first differences in the levels equation. The democracy index and log of GDP per capita are always considered exogenous.[12]

Table 4 shows the results of estimating Equation (40). It is evident that most of the cross-country-year correlations found in Table 3 disappear. Once controlling for initial fiscal capacity, country fixed effects, the dynamic panel bias associated with the fiscal capacity lagged regressors, democracy and real income per capita, only oil exports retain the negative and statistically significant effect on fiscal capacity.[13] It is important to emphasize that the magnitude of the coefficient associated with oil exports is considerably reduced, suggesting that the initial conditions and fixed effects have been successfully expunged from it. Moreover, this result supports a causal interpretation from commodity dependence to fiscal capacity, which is harder to confirm in cross-country regressions. Oil exports as a percentage of total exports have, on average, a highly significant negative effect on fiscal capacity over the short run. The positive effect of forest exports on fiscal capacity remains statistically significant at the 10 percent confidence level. The general lesson is that cross-country differences may be evident, but within-country relationships seem to be weak, with the exception of oil and forest exports (that incidentally have opposite sign effects). In addition, there is a surprising result: raw materials exports as a percentage of total exports now have a positive and significant effect on total taxes as a percentage of GDP at the 5 percent level, whereas in Table 3 this effect was negative and statistically significant.[14]

In Table 5, additional lags of the fiscal capacity variables are introduced to guarantee that the null hypothesis of no autocorrelation cannot be rejected.[15] Results show that, after the inclusion of such additional lags, again, only oil exports as a percentage of total exports have a statistically significant negative effect on fiscal capacity (at the 10 percent level) once controlling for initial conditions, fixed effects, the dynamic panel bias associated with the lagged state capacity regressors and two additional controls. The positive effect of forest exports is no longer present at a statistically significant level, indicating that the positive but weak effect found earlier is not robust to alternate GMM specifications.

Overall, in the short-run there is a statistically significant negative relationship between oil exports as

[12] In the robustness exercises the lag structure of the instruments for both the predetermined and endogenous variables in the differenced and levels equations is unchanged relative to the baseline estimations.

[13] The war dummies are not included as additional controls in any of the regressions of Table 4, because autocorrelation and exogeneity tests do not pass in their presence. Despite this, when wars are included the negative and statistically significant effect of oil exports on fiscal capacity holds. These results are available upon request. For a detailed dynamic analysis of the relationship between state capacity and conflict in a sample of countries see Cárdenas et al. (2011).

[14] It is suspicious, however, that raw materials exports have no positive effect on income taxes as a percentage of GDP, as exporting firms could also be taxed through income.

[15] As explained earlier, this translates into eliminating the term αFC_{it-1} from Equation (40) and replacing it with $\Sigma_{k=1}^{3}\alpha_k FC_{it-k}$.

a percentage of total exports and fiscal capacity. All other negative correlations found in the previous cross-country-year regressions disappear, which strongly suggests that they were capturing the effect of initial fiscal capacity conditions and other unobserved factors that were not accounted for. The same is true for the positive effect of forest exports as a percentage of total exports on fiscal capacity. The dynamic within-country analysis suggests that the ability to collect taxes is not undermined by resource dependence, with the crucial exception of oil.

So what makes oil different? It is probable that the answer lies in a hypothesis initially proposed by Mahdavy (1970), and later generalized by Luciani (1987) and Huntington (1991), according to which oil revenue becomes an external source of financing for the government, because it is directly captured by it, crowding out the need to raise tax revenue and be accountable to citizens. In the context of the present paper, the claim in Luciani (1987) that there is "no representation without taxation," ultimately means that oil revenue directly captured by the government eliminates incentives to raise tax revenue, and thus the power of the citizenry to make the government accountable, which in turn reduces the need for the latter to improve bureaucratic quality, reduce corruption or uphold the rule of law (legal capacity). Recalling the complementarity of fiscal and legal capacity argument proposed by Besley and Persson (2010a,b), low fiscal capacity reduces the government's incentive to invest in legal capacity in order to expand the market income and the associated fiscal capacity.

3.4 Investment in State Capacity

Finally, this subsection presents the cross-country-quinquennium and within-country estimates on investment in fiscal capacity and commodity dependence. As mentioned earlier, for this analysis the annual panel is collapsed to five-year periods, and investment in fiscal capacity is proxied with the change in fiscal capacity over a span of five years. The baseline model in this section is the following:

$$\Delta FC_{iT} = \beta_0 + \beta_1 CD_{iT-1} + \gamma' X_{iT-1} + \delta' D_T + \epsilon_{iT} \tag{43}$$

where $\Delta FC_{iT} = FC_{iT} - FC_{iT-1}$ and T represents a period of five years. The vector X_{iT-1} includes the measure of democracy, incidences of internal and external wars, and log of GDP per capita. In Equation (43) all variables except for those of commodity dependence and log of GDP per capita are averaged over each five-year period; the exceptions take the values in the first year of those periods. That given, all variables at the right hand side of Equation (43) are first lags, except for the democracy variable, which, by construction, already takes into account the polity2 scores over a five-year span. Table A1 in the Appendix shows the descriptive statistics for the panel of quinquenniums. The numbers are very similar to the ones in the annual panel presented in Table 2.

Table 6 shows the cross-country OLS estimations of Equation (43). Commodity exports and oil exports as percentages of total exports have a negative correlation with investment in fiscal capacity. However, forest exports no longer have a positive and significant coefficient associated with investment in fiscal capacity.

The effects are statistically significant when the dependent variable is income revenue as a percentage of GDP. In the case of commodity exports, investment in fiscal capacity is reduced by 0.25 percentage points for every additional standard deviation in commodity exports as a percentage of total exports (31 percentage points) across country-quinquenniums. The correlation associated with oil is somewhat larger: investment in fiscal capacity falls by 0.38 percentage points for every additional standard deviation in oil exports as a percentage of total exports (27 percentage points) across country-quinquenniums.

Table 7 shows the GMM estimates, which control for initial fiscal capacity and endogeneity problems.[16] The results show that oil is the only commodity to reduce investment in fiscal capacity within the average country. Moreover, contrary to the previous OLS estimates, now both measures of investment in fiscal capacity are significantly affected by oil exports as a percentage of total exports. However, in the case of income tax revenue the result must be interpreted with caution, since the null hypothesis of no autocorrelation is rejected by the AR(2) test, rendering some of the instruments invalid.[17] Nonetheless, these results support the notion that only those export revenues that are easily captured by the government, such as oil, reduce investment in fiscal capacity. A very plausible reason of why such revenues are easy to capture is that the oil industry is largely owned by few companies, many of which are state-owned. This is a fact according to the Financial Times, which in 2007 stated that the so called "New Seven Sisters" (most of which are state-owned) in the oil industry hold the major share of the world reserves.[18] No other commodity industry seems to be so much concentrated in state hands as is the oil industry. Thus, oil creates an environment where the incentives for the government to invest in fiscal capacity are severely undermined.

[16]The lag structure of the instruments used for the endogenous and predetermined variables is exactly the same as in the GMM estimates of section 3.3. Internal and external wars are instrumented in the same way as the commodity dependence variables. The former two are included, because, as opposed to the GMM estimations of section 3.3, in this case the autocorrelation and exogeneity tests generally hold under their presence. If wars are excluded from the regressions, the coefficients on initial conditions lose their statistical significance, but the results on commodity dependence still hold.

[17]In this section robustness exercises that include more than one lag of the dependent variable as regressors are not reported. This is because there are not enough countries in the sample with observations for at least 4 five-year periods, implying that AR(2) tests are not defined. The average number of five-year periods per country in the sample ranges between 3.09 and 3.19 across columns in Table 7.

[18]On March 11th, 2007, the Financial Times named the "New Seven Sisters:" Saudi Aramco, Gazprom, China National Petroleum Company, National Iranian Oil Company, Petroleos de Venezuela S.A., Petrobras and Petronas.

4 Conclusion

This paper investigates the relationship between commodity dependence and fiscal capacity. A detailed theoretical model is offered, which predicts that higher natural resource rents lead to lower investment in fiscal capacity. The empirical results are consistent with this theory. While at the cross-country-year level most commodity types show a negative and significant correlation with fiscal capacity, only oil retains its negative effect once initial conditions and endogeneity problems are properly tackled. The within-country analysis suggests that not all natural resources undermine institutional development, just those whose rents can be easily appropriated by the government, as is the case of oil. These results hold in the five-year panel, where the effect of commodity dependence on an investment-in-fiscal-capacity measure is explored. Lastly, evidence shows that legal and fiscal capacity of the state are complements across country-years.

The main lesson is that the natural resource curse is not a law that applies to all commodities, but most likely to those that have an industry concentrated in few state-controlled hands, of which oil is a typical example. The cross-country-year and within-country results show that some commodities may in fact have positive effects on fiscal capacity, as is the case of forest exports. What causes this difference? In most countries the forest sector is quite small, fragmented and competitive, especially in comparison to other natural resources (FAO, 2011). These characteristics are likely to make rents from forests hard to capture by governments. Therefore, it follows that commodity industries have to be large enough to create sufficient rents and also have to be mostly controlled by the state, in order to create an incentive against investment in fiscal capacity. Global forest exports as a percentage of total exports are, on average, the smallest among the seven commodity types, while petroleum exports are the second largest, after tropical exports. The difference between the latter two is that petroleum is largely state-owned.

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Figure 1. Residuals from Fiscal Capacity on "A" and Commodity Dependence ("A": Democracy Index, Year Dummies)

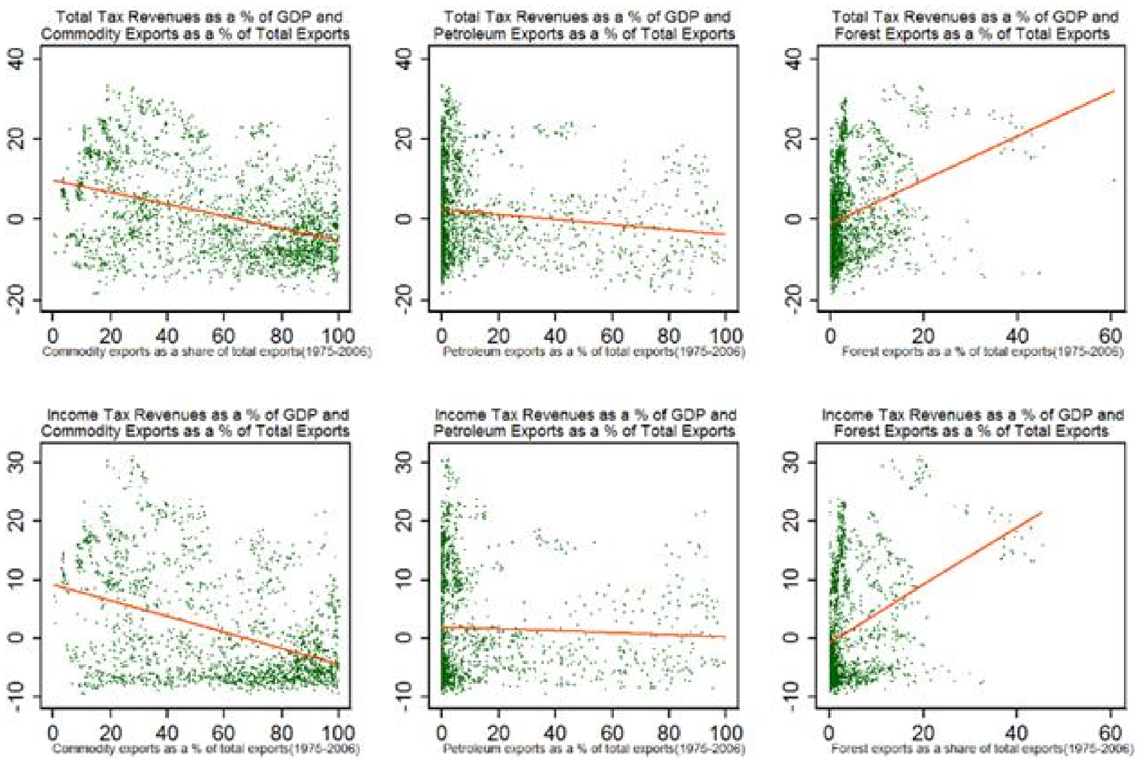

Table 1. Components of Six Commodity Aggregates

Petroleum	**Tropical Products**
Petroleum and Derivatives	Vegetables
	Sugar
	Coffee
	Beverages
	Crude Rubber
Raw Materials	**Animal Products**
Crude Fertilizers and Minerals	Live Animals
Metalliferous Ores	Meat
Coal, Coke	Dairy Products
Gas, Natural and Manufactured	Fish
Electrical Current	Hides, Skins
Nonferrous Metal	Crude Animals and Vegetables
	Processed Animal and Vegetable Oils
	Animal Products n.e.s.
Forest Products	**Cereals Products**
Lumber, Wood and Cork	Cereals
Pulp and Waste Paper	Feeds
Cork and Wood Manufactures	Miscellaneous
Paper	Tobacco
	Oil Seeds
	Textile Fibers
	Animal Oil and Fat
	Fixed Vegetable Oils

Source: Leamer (1984)

Table 2. Descriptive Statistics: Annual Panel

	No. of Obs.	No. of Countries	Mean	Standard Deviation	Min.	Max.	Percentile 25	Percentile 50	Percentile 75	Years Covered
State Capacity										
Total Tax Revenue (% of GDP)	3,552	125	20.62	10.64	0.09	53.38	12.35	18.43	26.89	1975-2006
Income Tax Revenue (% of GDP)	2,997	125	8.85	8.82	0.00	40.07	2.50	5.18	12.25	1975-2000
ICRG-Gov. Quality (0-100)	3,425	147	55.00	23.00	4.00	100	39.00	53.00	67.00	1984-2008
Commodity Dep. (% of Tot. Exp.)										
Commodity Exports	4,183	190	55.90	31.17	0.00	100.00	26.02	59.35	86.18	1975-2008
Petroleum Exports	3,726	186	13.53	25.77	0.00	99.96	0.08	1.08	9.38	1975-2008
Forest Exports	4,037	188	3.24	5.37	0.00	60.49	0.27	1.31	3.46	1975-2008
Tropical Exports	4,087	190	14.41	20.14	0.00	98.69	1.45	5.06	18.63	1975-2008
Animal Exports	4,164	189	8.28	14.93	0.00	97.58	1.09	2.87	8.29	1975-2008
Cereals Exports	4,134	190	9.31	15.41	0.00	99.88	1.33	3.50	9.17	1975-2008
Raw Materials Exports	4,057	187	9.47	15.92	0.00	98.54	0.76	3.02	9.39	1975-2008
Controls										
Dummy-Ave. $polity2 > 3$ in Prev. 5 Years	5,083	161	0.40	0.49	0.00	1.00	0.00	0.00	1.00	1975-2007
Internal War (0-1)	5,068	171	0.05	0.22	0.00	1.00	0.00	0.00	0.00	1975-2004
External War (0-1)	5,068	171	0.02	0.12	0.00	1.00	0.00	0.00	0.00	1975-2004
Real GDP Per Capita (2000 US Dollars)	5,578	189	6,165	9,264	62.24	72,637	533.72	1,828	7,474	1975-2008

Table 3. State Capacity and Commodity Dependence: Annual Panel OLS Estimations

Dependent Variable	Panel 1: Total Tax Revenue as a % of GDP (t) (1984-2004)							Panel 2: Income Tax Revenue as a % of GDP (t) (1984-2000)						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Commodity Exp. (t)	-0.020** (0.008)							-0.022*** (0.006)						
Petroleum Exp. (t)		-0.022* (0.012)							0.007 (0.009)					
Forest Exp. (t)			0.352*** (0.032)							0.248*** (0.030)				
Tropical Exp. (t)				-0.029*** (0.010)							-0.036*** (0.009)			
Animal Exp. (t)					-0.044** (0.020)							-0.074*** (0.017)		
Cereals Exp. (t)						0.016 (0.011)							-0.006 (0.011)	
Raw Mat. Exp. (t)							-0.023** (0.011)							-0.031*** (0.010)
ICRG	0.264*** (0.013)	0.261*** (0.014)	0.249*** (0.012)	0.268*** (0.013)	0.273*** (0.013)	0.271*** (0.013)	0.270*** (0.013)	0.209*** (0.011)	0.223*** (0.011)	0.199*** (0.010)	0.212*** (0.011)	0.218*** (0.011)	0.216*** (0.011)	0.218*** (0.011)
Dummy ($pol2 > 3$)	3.401*** (0.532)	3.329*** (0.544)	3.191*** (0.503)	3.606*** (0.529)	3.537*** (0.528)	3.426*** (0.533)	3.470*** (0.535)	2.010*** (0.422)	2.302*** (0.444)	1.921*** (0.402)	2.311*** (0.420)	2.198*** (0.419)	2.094*** (0.421)	2.084*** (0.419)
Internal War (t)	-3.579*** (0.695)	-3.389*** (0.683)	-2.921*** (0.637)	-3.371*** (0.713)	-3.553*** (0.690)	-3.285*** (0.694)	-3.341*** (0.697)	-1.647*** (0.484)	-1.307*** (0.501)	-1.220*** (0.426)	-1.450*** (0.515)	-1.774*** (0.489)	-1.561*** (0.487)	-1.321*** (0.487)
External War (t)	-0.540 (1.427)	-0.953 (1.637)	0.438 (1.401)	-0.396 (1.451)	-0.459 (1.438)	-0.495 (1.437)	-0.573 (1.416)	-0.192 (1.148)	-0.867 (1.302)	0.474 (1.125)	0.003 (1.193)	-0.009 (1.157)	-0.174 (1.143)	-0.292 (1.126)
Log of GDP (t)	0.999*** (0.237)	1.270*** (0.238)	1.172*** (0.218)	0.982*** (0.231)	1.037*** (0.227)	1.164*** (0.231)	1.076*** (0.229)	1.390*** (0.177)	1.453*** (0.187)	1.563*** (0.167)	1.342*** (0.176)	1.403*** (0.173)	1.472*** (0.178)	1.443*** (0.175)
No. of Obs.	1451	1402	1445	1451	1451	1451	1444	1157	1118	1151	1157	1157	1157	1151
R-squared	0.601	0.595	0.627	0.601	0.601	0.600	0.598	0.664	0.659	0.682	0.665	0.665	0.661	0.664

Note: The regressions in this table include year dummies. All equations are estimated by OLS. Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 4. Fiscal Capacity and Commodity Dependence: Annual Panel GMM Baseline Estimations

Dependent Variable	Panel 1: Total Tax Revenue as a % of GDP (t) (1976-2006)							Panel 2: Income Tax Revenue as a % of GDP (t) (1977-2000)						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dependent Var. (t-1)	0.975*** (0.017)	0.968*** (0.019)	0.967*** (0.028)	0.948*** (0.028)	0.935*** (0.031)	0.956*** (0.026)	0.967*** (0.032)	0.919*** (0.036)	0.911*** (0.041)	0.882*** (0.045)	0.903*** (0.044)	0.877*** (0.047)	0.902*** (0.044)	0.900*** (0.043)
Commodity Exp. (t)	0.007 (0.009)							0.002 (0.006)						
Petroleum Exp. (t)		-0.013*** (0.005)							-0.006 (0.005)					
Forest Exp. (t)			-0.011 (0.019)							0.046* (0.025)				
Tropical Exp. (t)				-0.011 (0.010)							-0.007 (0.006)			
Animal Exp. (t)					-0.022 (0.014)							-0.003 (0.009)		
Cereals Exp. (t)						-0.008 (0.011)							-0.009 (0.006)	
Raw Mat. Exp. (t)							0.021** (0.009)							-0.007 (0.006)
Dummy ($pol2 > 3$)	0.344*** (0.106)	0.204 (0.130)	0.354*** (0.127)	0.414** (0.163)	0.479*** (0.172)	0.365*** (0.133)	0.354*** (0.133)	0.341** (0.144)	0.314** (0.158)	0.426** (0.170)	0.399** (0.175)	0.470** (0.197)	0.386** (0.167)	0.389** (0.161)
Log of GDP (t)	0.147* (0.079)	0.137 (0.091)	0.128 (0.114)	0.135 (0.122)	0.235* (0.132)	0.134 (0.116)	0.146 (0.136)	0.334** (0.160)	0.373** (0.177)	0.440** (0.172)	0.345** (0.168)	0.481** (0.189)	0.357** (0.182)	0.384** (0.172)
AR(2) test	[0.060]	[0.091]	[0.038]	[0.043]	[0.056]	[0.057]	[0.098]	[0.259]	[0.290]	[0.292]	[0.273]	[0.261]	[0.272]	[0.251]
Hansen J test	[0.918]	[0.901]	[0.714]	[0.835]	[0.872]	[0.814]	[0.605]	[0.411]	[0.429]	[0.325]	[0.549]	[0.479]	[0.641]	[0.521]
No. of Inst.	121	121	121	121	121	121	121	97	97	97	97	97	97	97
No. of Obs.	2172	2029	2151	2165	2169	2164	2150	1764	1652	1749	1761	1761	1759	1743
No. of Count.	102	101	102	102	102	102	101	102	99	102	102	102	102	101

Note: All equations are estimated using Arellano and Bover (1995)/Blundell and Bond (1998) one step system GMM estimator. The lagged values of state capacity are always instrumented with their own second and earlier lags in the differenced equation and with the first lag of their first differences in the levels equation; the instrument matrix is collapsed to avoid instrument proliferation. The commodity dependence variables are always instrumented with their own third lag in the differenced equation and with the second lags of their first differences in the levels equation. The polity2 and log of GDP per capita variables are always considered exogenous. All regressions include year dummies. P-values are reported for the AR(2) test and the Hansen J test. Robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 5. Fiscal Capacity and Commodity Dependence: Annual Panel GMM Robustness Exercises

Dependent Variable	**Panel 1: Total Tax Revenue as a % of GDP (t) (1976-2006)**							**Panel 2: Income Tax Revenue as a % of GDP (t) (1977-2000)**						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dependent	0.954***	0.994***	0.772***	0.861***	0.829***	0.939***	0.788***	0.794***	0.833***	0.684***	0.640***	0.650***	0.644***	0.644***
Var. (t-1)	(0.094)	(0.088)	(0.118)	(0.092)	(0.106)	(0.064)	(0.119)	(0.123)	(0.105)	(0.154)	(0.166)	(0.166)	(0.160)	(0.172)
Dependent	-0.000	-0.045	0.147	0.060	0.090	0.004	0.126	0.065	0.024	0.148	0.194	0.182	0.196	0.190
Var. (t-2)	(0.087)	(0.077)	(0.102)	(0.085)	(0.096)	(0.064)	(0.111)	(0.116)	(0.092)	(0.137)	(0.152)	(0.151)	(0.148)	(0.158)
Dependent	0.016	0.009	0.032	0.012	0.018	0.007	0.030	0.098***	0.098***	0.101***	0.107***	0.101***	0.105***	0.108***
Var. (t-3)	(0.043)	(0.040)	(0.050)	(0.045)	(0.051)	(0.044)	(0.045)	(0.034)	(0.036)	(0.039)	(0.038)	(0.039)	(0.037)	(0.037)
Commodity	0.009							-0.001						
Exp. (t)	(0.009)							(0.005)						
Petroleum		-0.010*							-0.005					
Exp. (t)		(0.005)							(0.005)					
Forest			-0.019							0.024				
Exp. (t)			(0.018)							(0.022)				
Tropical				-0.014							-0.002			
Exp. (t)				(0.009)							(0.005)			
Animal					-0.010							-0.002		
Exp. (t)					(0.011)							(0.009)		
Cereals						-0.004							-0.005	
Exp. (t)						(0.009)							(0.005)	
Raw Mat.							0.016**							-0.003
Exp. (t)							(0.008)							(0.004)
Dummy	0.320**	0.214*	0.405**	0.455**	0.431**	0.339**	0.414**	0.183*	0.153	0.273**	0.258*	0.279**	0.241*	0.247*
($pol2 > 3$)	(0.125)	(0.122)	(0.178)	(0.205)	(0.194)	(0.150)	(0.179)	(0.101)	(0.111)	(0.131)	(0.134)	(0.137)	(0.125)	(0.127)
Log of	0.182**	0.178	0.199	0.182	0.238	0.178	0.234	0.178	0.205	0.266*	0.235*	0.277*	0.218	0.240*
GDP(t)	(0.092)	(0.119)	(0.144)	(0.143)	(0.160)	(0.129)	(0.162)	(0.110)	(0.140)	(0.148)	(0.134)	(0.142)	(0.141)	(0.129)
AR(2) test	[0.213]	[0.135]	[0.869]	[0.574]	[0.806]	[0.292]	[0.940]	[0.757]	[0.860]	[0.400]	[0.286]	[0.300]	[0.268]	[0.299]
Hansen J test	[0.891]	[0.781]	[0.678]	[0.801]	[0.857]	[0.841]	[0.693]	[0.330]	[0.662]	[0.447]	[0.491]	[0.339]	[0.607]	[0.483]
No. of Inst.	120	120	120	120	120	120	120	96	96	96	96	96	96	96
No. of Obs.	2012	1881	1994	2006	2010	2005	1993	1606	1506	1593	1604	1604	1602	1588
No. of Count.	102	101	102	102	102	102	101	102	99	102	102	102	102	101

Note: All equations are estimated using Arellano and Bover (1995)/Blundell and Bond (1998) one step system GMM estimator. The lagged values of state capacity are always instrumented with their own second and earlier lags in the differenced equation and with the first lag of their first differences in the levels equation; the instrument matrix is collapsed to avoid instrument proliferation. The commodity dependence variables are always instrumented with their own third lag in the differenced equation and with the second lags of their first differences in the levels equation. The polity2 and log of GDP per capita variables are always considered exogenous. All regressions include year dummies. P-values are reported for the AR(2) test and the Hansen J test. Robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 6. Investment in Fiscal Capacity and Commodity Dependence: Five-Year Averages Panel OLS Estimations

Dependent Variable	Panel 1: Total Tax Revenue as a % of GDP [T-(T-1)] (1980-2004)							Panel 2: Income Tax Revenue as a % of GDP [T-(T-1)] (1980-2000)						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Commodity	-0.008							-0.008**						
Exp. (T-1)	(0.005)							(0.004)						
Petroleum		-0.010							-0.014**					
Exp. (T-1)		(0.008)							(0.007)					
Forest			0.028							0.027				
Exp. (T-1)			(0.020)							(0.017)				
Tropical				-0.004							-0.000			
Exp. (T-1)				(0.008)							(0.004)			
Animal					0.005							0.004		
Exp. (T-1)					(0.015)							(0.009)		
Cereals						-0.002							0.009*	
Exp. (T-1)						(0.010)							(0.005)	
Raw Mat.							0.007							-0.001
Exp. (T-1)							(0.008)							(0.004)
Dummy	1.426***	1.322***	1.310***	1.445***	1.406***	1.422***	1.405***	0.339*	0.150	0.400**	0.444**	0.432**	0.418**	0.396*
($pol2 > 3$)	(0.346)	(0.365)	(0.338)	(0.340)	(0.341)	(0.341)	(0.355)	(0.205)	(0.233)	(0.201)	(0.196)	(0.197)	(0.194)	(0.208)
Internal	-0.063	0.059	-0.059	-0.085	-0.098	-0.133	0.004	0.334	0.413	0.347	0.326	0.337	0.396	0.330
War (T-1)	(0.649)	(0.663)	(0.635)	(0.642)	(0.649)	(0.663)	(0.647)	(0.348)	(0.373)	(0.348)	(0.351)	(0.362)	(0.362)	(0.355)
External	2.123	1.734	1.970	2.197	2.137	2.209	2.411	0.494	0.122	0.783	0.689	0.649	0.574	0.700
War (T-1)	(1.676)	(1.789)	(1.823)	(1.637)	(1.628)	(1.627)	(1.666)	(1.082)	(1.205)	(1.216)	(1.055)	(1.050)	(1.050)	(1.084)
Log of	-0.099	0.065	-0.028	-0.047	-0.019	-0.030	0.008	-0.001	0.127**	0.028	0.051	0.056	0.091*	0.062
GDP (T-1)	(0.104)	(0.098)	(0.091)	(0.094)	(0.089)	(0.103)	(0.091)	(0.053)	(0.054)	(0.050)	(0.051)	(0.048)	(0.050)	(0.049)
No. of Obs.	367	344	360	366	366	366	357	362	339	355	361	361	361	352
R-squared	0.082	0.096	0.070	0.073	0.072	0.072	0.077	0.082	0.107	0.079	0.071	0.072	0.078	0.071

Note: The regressions in this table include year dummies. All equations are estimated by OLS. Robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 7. Investment in Fiscal Capacity and Commodity Dependence: Five-Year Panel GMM Estimations

Dependent Variable	**Panel 1: Total Tax Revenue as a % of GDP [T-(T-1)] (1985-2004)**							**Panel 2: Income Tax Revenue as a % of GDP [T-(T-1)] (1985-2000)**						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dependent	-0.421**	-0.391*	0.373**	-0.439**	-0.386*	-0.429*	-0.319*	-0.341***	-0.423**	0.014	-0.290**	-0.259	-0.278*	-0.224
Var (T-1)	(0.170)	(0.232)	(0.149)	(0.202)	(0.225)	(0.221)	(0.189)	(0.127)	(0.183)	(0.083)	(0.129)	(0.159)	(0.147)	(0.168)
Commodity	0.010							0.007						
Exp. (T-1)	(0.013)							(0.011)						
Petroleum		-0.054**							-0.039***					
Exp. (T-1)		(0.025)							(0.015)					
Forest			-0.131							-0.111				
Exp. (T-1)			(0.175)							(0.144)				
Tropical				-0.040*							0.014			
Exp. (T-1)				(0.021)							(0.023)			
Animal					0.099							0.045		
Exp. (T-1)					(0.074)							(0.052)		
Cereals						-0.007							0.007	
Exp. (T-1)						(0.030)							(0.012)	
Raw Mat.							0.025							0.012
Exp. (T-1)							(0.027)							(0.025)
Dummy	1.602***	0.651	0.362	1.863***	1.269***	1.381***	1.487***	0.531*	-0.092	0.385	0.408	0.405	0.497*	0.475
($pol2 > 3$)	(0.449)	(0.623)	(0.424)	(0.579)	(0.490)	(0.506)	(0.493)	(0.284)	(0.401)	(0.297)	(0.318)	(0.315)	(0.297)	(0.294)
Internal	1.365	1.045	0.667	2.061	1.301	1.737	-0.426	0.873	2.145	-0.050	1.410	0.445	1.094	0.473
War (T-1)	(2.774)	(2.196)	(2.923)	(2.700)	(3.412)	(2.959)	(2.249)	(1.520)	(1.692)	(2.033)	(1.112)	(1.747)	(1.445)	(1.434)
External	-1.016	-8.617	-4.233	4.819	3.027	-5.779	4.987	-4.408	-6.689	-5.341	-3.902	-0.119	-1.306	-2.302
War (T-1)	(5.233)	(5.730)	(7.538)	(6.017)	(7.395)	(5.327)	(5.589)	(3.607)	(4.806)	(5.949)	(4.375)	(3.744)	(2.940)	(3.549)
Log of	0.079	0.214	0.067	-0.238	0.067	0.030	-0.010	0.116	0.205**	0.117	0.140	0.063	0.068	0.054
GDP (T-1)	(0.150)	(0.135)	(0.127)	(0.184)	(0.134)	(0.153)	(0.106)	(0.124)	(0.097)	(0.110)	(0.170)	(0.082)	(0.078)	(0.078)
AR(2) test	[0.109]	[0.138]	[0.125]	[0.148]	[0.230]	[0.140]	[0.222]	[0.164]	[0.031]	[0.560]	[0.271]	[0.219]	[0.269]	[0.417]
Hansen J test	[0.298]	[0.556]	[0.187]	[0.385]	[0.393]	[0.121]	[0.355]	[0.232]	[0.790]	[0.634]	[0.260]	[0.483]	[0.298]	[0.593]
No. of Inst.	27	27	27	27	27	27	27	27	27	27	27	27	27	27
No. of Obs.	287	269	281	286	286	286	280	282	264	276	281	281	281	275
No. of Count.	91	85	88	90	90	90	89	91	85	88	90	90	90	89

Note: All equations are estimated using the Arellano & Bover (1995)/Blundell & Bond (1998) one step system GMM estimator. The lagged values of the first differences of the fiscal capacity variables are always instrumented with their own second and earlier lags in the differenced equation and with the first lags of their first differences in the levels equation; the instrument matrix is collapsed to avoid instrument proliferation. The lagged values of commodity dependence, internal war and external war variables are always instrumented with their own third lags in the differenced equation and with the second lags of their first differences in the levels equation. The polity2 and lagged log of GDP per capita variables are always considered exogenous. All regressions include year dummies. P-values are reported for the AR(2) test and the Hansen J test. Robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

APPENDIX

Table A1. Descriptive Statistics: Five-Year Averages Panel

	No. of Obs.	No. of Countries	Mean	Standard Deviation	Min.	Max.	Percentile			Years Covered
							25	50	75	
State Capacity										
Total Tax Revenue (% of GDP)	733	125	20.34	10.36	0.88	50.99	12.23	18.19	26.10	1975-2004
Income Tax (% of GDP)	727	125	8.68	8.71	0.00	39.64	2.53	5.01	11.77	1975-2000
Commodity Dep. (% of Tot. Exp.)										
Commodity Exports	964	191	60.62	30.85	0.00	99.97	31.13	68.30	89.34	1975-2004
Petroleum Exports	889	186	14.56	27.03	0.00	99.77	0.17	1.38	10.44	1975-2004
Forest Exports	935	188	3.47	6.17	0.00	52.92	0.22	1.22	3.55	1975-2004
Tropical Exports	944	190	16.23	21.60	0.00	96.41	1.55	5.86	23.13	1975-2004
Animal Exports	959	190	8.16	14.40	0.00	94.76	1.08	2.81	8.39	1975-2004
Cereals Exports	955	191	10.79	16.79	0.00	95.35	1.41	4.14	11.28	1975-2004
Raw Materials Exports	944	188	9.47	16.50	0.00	97.67	0.56	2.78	9.39	1975-2004
Controls										
Dummy-Ave. $polity2 > 3$ in Prev. 5 Years	1,076	160	0.36	0.47	0.00	1.00	0.00	0.00	1.00	1975-2004
Internal War (0-1)	1,175	171	0.05	0.18	0.00	1.00	0.00	0.00	0.00	1975-2004
External War (0-1)	1,175	171	0.02	0.11	0.00	1.00	0.00	0.00	0.00	1975-2004
Real GDP Per Capita (2000 US Dollars)	1,077	187	5,732	8,492	62.24	56,459	519.18	1,723	7,315	1975-2004

Note: Only full quinquenniums periods are considered.

Introducing Income Inequality

The level of income inequality is denoted with ϵ. Each group's income level is expressed as $Y^A = \overline{Y} + \epsilon$ and $Y^B = \overline{Y} - \epsilon$, where $\overline{Y}$ is the average income level. Substituting these equalities into Equation (38) and using $\beta^A Y^A + \beta^B Y^B = \beta^A(\overline{Y} + \epsilon) + \beta^B(\overline{Y} - \epsilon) = \overline{Y} + (\beta^A - \beta^B)\epsilon$, one gets:

$$\frac{\partial \tau_2}{\partial R} = -\frac{\partial H/\partial R_2}{\partial H/\partial \tau_2} = \frac{\phi_1 \alpha_2 V_{G_2G_2}(G_2)[\overline{Y} + (\beta^A - \beta^B)]\epsilon}{\lambda_* F_{\tau_2\tau_2}(\triangle\tau) - \phi_1\alpha_2 V_{G_2G_2}(G_2)[\overline{Y} + (\beta^A - \beta^B)\epsilon]^2} < 0 \tag{44}$$

where:

$$\begin{aligned} H &= \phi_1\alpha_2 V_{G_2}(G_2)(\beta^A Y^A + \beta^B Y^B) - \phi_1\{\overline{\rho}\beta^A Y^A + \underline{\rho}\beta^B Y^B\} \\ &\quad +(1-\phi_1)(\overline{\rho} - \underline{\rho})\{\gamma\beta^B Y^B - (1-\gamma)\beta^A Y^A\} - \lambda_* F_{\tau_2}(\triangle\tau) \qquad (45) \\ G_2 &= \tau_2[\overline{Y} + (\beta^A - \beta^B)\epsilon] + R \qquad (46) \end{aligned}$$

The derivative of $\frac{\partial \tau_2}{\partial R}$ with respect to ϵ gives:

$$\begin{aligned} \frac{\partial \tau_2}{\partial R \partial \epsilon} &= \frac{\phi_1\alpha_2 V_{G_2G_2}(G_2)(\beta^A - \beta^B)}{\frac{\partial D}{\partial \tau_2}} \\ &\quad + \frac{(\frac{\partial H}{\partial R})\phi_1\alpha_2 V_{G_2G_2}(G_2)(\beta^A - \beta^B)2[\overline{Y} + (\beta^A - \beta^B)\epsilon]}{(\frac{\partial H}{\partial \tau_2})^2} \end{aligned} \tag{47}$$

which can be further written as:

$$\begin{aligned} \frac{\partial \tau_2}{\partial R \partial \epsilon} &= \phi_1\alpha_2 V_{G_2G_2}(G_2)(\beta^A - \beta^B) \\ &\quad \times \frac{\lambda_* F_{\tau_2\tau_2}(\triangle\tau) + \phi_1\alpha_2 V_{G_2G_2}(G_2)[\overline{Y} + (\beta^A - \beta^B)\epsilon]^2}{\{\lambda_* F_{\tau_2\tau_2}(\triangle\tau) - \phi_1\alpha_2 V_{G_2G_2}(G_2)[\overline{Y} + (\beta^A - \beta^B)\epsilon]^2\}^2} \end{aligned} \tag{48}$$

Once $|\lambda_* F_{\tau_2\tau_2}(\triangle\tau)| < |\phi_1\alpha_2 V_{G_2G_2}(G_2)[\overline{Y} + (\beta^A - \beta^B)\epsilon]^2|$ and $V_{G_2G_2G_2} = 0$ are assumed, it follows that $\frac{\partial \tau_2}{\partial R \partial \epsilon} < 0$. The assumption here is that the wealthier group is the minority. Therefore, when the wealthier group is in power, it follows that $\beta^A - \beta^B < 0$; and therefore, $\frac{\partial \tau_2}{\partial R \partial \epsilon} < 0$. Similarly, if the poorer group is in power, then $\beta^A - \beta^B > 0$, and $Y^A = \overline{Y} - \epsilon$ and $Y^B = \overline{Y} + \epsilon$, which again leads to $\frac{\partial \tau_2}{\partial R \partial \epsilon} < 0$.