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Natural resources, export structure and investment

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Abstract

We present cross-country empirical evidence on the role of natural resources in explaining long-run differences in private investment as a share of GDP in a sample of 72 developing countries. Our empirical results suggest important differences between oil and non-oil resources. While revenue from oil exports tends to increase private (and public) investment, there is also a robust negative effect from a measure of export concentration. After controlling for these two aspects of export structure, there is little additional information in other measures of resource abundance, or in other suggested investment determinants, such as measures of the quality of institutions, political instability or macroeconomic volatility.

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I. Introduction

Starting with the important contribution by Sachs and Warner (1995, 2001), a large body of empirical research has documented a negative association between natural resource abundance and economic growth. This paradox that countries rich in natural resources tend to have poor growth and development outcomes is commonly referred to as the "resource curse".

There is no single explanation for the tendency of resource-rich countries to have poorer economic performance. These countries tend to suffer from the adverse effects of Dutch disease, revenue volatility and primary commodity dependence. More importantly, resource abundance has also been associated with lower human capital (Gylfason 2001), higher risk of civil war (Collier and Hoeffler 2003), more unequal societies (Gylfason and Zoega 2003), and weaker institutions (Ross 1999).[1]

An important insight of this literature is that the *origin* of weak institutions is often located in natural resource export structures. Resource rich economies offer distinct opportunities for rent-seeking and corruption (Ross 1999), tend to have weaker checks and balances in their political systems (Collier and Hoeffler 2005) and a limited institutional capacity to manage shocks (Johnson et al. 2005). In particular, point-source resources—oil, gas and minerals—are typically associated with concentrated ownership, a rentier class and weak institutions. It has been suggested that the quality of institutions plays a decisive role in determining whether natural resources are a curse or a blessing (Mehlum et al. 2006).

This paper studies a relatively neglected aspect of this literature: the relationship between natural resources and aggregate investment. While much of the resource curse literature has focused on growth, there are relatively few studies analyzing the effects of natural resources on investment levels. Papyrakis and Gerlagh (2004, 2007) suggest that the adverse effects of resource abundance on growth are partly transmitted through lower investment. Gylfason and Zoega (2006) present some preliminary evidence that countries richly endowed with natural resources tend to have lower investment shares in GDP – although, as subsequent discussion in this paper will show, these statistical findings are based on a possibly questionable specification.

Existing empirical research on the relationship between natural resources and investment is unsatisfactory in at least two respects. First, there are concerns surrounding the use of suitable indicators for capturing natural resource abundance. Much like the broader literature on the resource curse, the investment results may be sensitive to the choice of resource measures. Second, existing work is purely exploratory in nature and has made little attempt to control for confounding factors that have traditionally been considered to be important in the empirical literature on investment. This provides one motivation for the more systematic empirical evaluation of the link between resource abundance and investment that we provide in this paper. Another motivation is that the empirical association between resource endowments and investment is not yet settled. In fact, one of the earliest proponents

[1] Interested readers are referred to a more detailed review of this literature in van der Ploeg (2006).

of the resource curse hypothesis, Sachs and Warner (1999), argued that natural resource intensity is unrelated to investment.

Taken together, the limited work that exists on this issue indicates that natural resources can affect growth indirectly via saving and investment. There are many plausible reasons why natural resources might crowd out investment. Many of the mechanisms behind the resource curse that were described above—Dutch disease, rent-seeking, civil war, inequality and weak institutions—are likely to harm the investment climate. Natural resource wealth may also be associated with lower savings and investment, since as Papyrakis and Gerlagh (2007) note, "natural resources provide a continuous stream of future wealth that makes future welfare less dependent on the transfer of man-made capital to future periods (Corden 1984; Gylfason and Zoega 2001)."

Dependence on natural resources can invite greater exposure to commodity price volatility, which can in turn result in higher investor uncertainty and lower levels of private investment.[2] Natural resource abundance can also reduce the competitiveness of other export sectors, preventing these countries from enjoying the benefits of (manufacturing) export-led growth (Sachs and Warner 2001).

This paper is one of the first systematic attempts at studying the relationship between natural resources and aggregate investment. Given the importance of using an appropriate measure of resource abundance, we experiment with a range of alternative measures. In particular, our empirical work will emphasize the considerable explanatory power of two measures, the share of net oil exports in GDP and the export concentration index, in regression models of private investment as a share of GDP. We will pay particular attention to the effects of other potentially important determinants of investment, such as the quality of political institutions, ethnic diversity and openness to trade, while taking care to control for a host of other influences suggested by the earlier literature. These include, among others, political instability, financial development and macroeconomic volatility. The empirical analysis is based on a cross-section of 72 developing countries for the period 1970-1998, for which data on private investment is available. Since our primary interest lies in explaining long-run differences in investment rates across countries, we restrict the empirical focus of this paper to cross-sectional regressions.[3]

The empirical evidence presented in this paper suggests a more subtle relationship between natural resources and investment levels. In analyzing the effects of natural resources, we identify different effects of oil and non-oil resources on private investment. More specifically, a higher share of net oil exports in GDP is associated with *higher* investment levels. Controlling for this oil effect, we also find a robust *negative* association between export concentration and investment shares. After controlling for these two factors, none of the conventional resource measures have any *additional* explanatory power. We take this evidence to suggest that it is the

[2] The empirical link between volatility and private investment is well documented in Aizenman and Marion (1999).

[3] An additional reason is that repeated observations on key variables of interest, capturing such diverse dimensions as endowments, geography and institutions, are either not available or show limited variation over time. Both of these aspects limit the usefulness of panel data methods in this context.

structure of exports, rather than natural resources *per se*, that is relevant for explaining investment.

These effects survive after including a range of other controls. Consistent with the previous literature on investment, we find that the relative price of capital and ethnic diversity are negatively associated with private investment, whereas more open economies tend to have higher investment shares. Strikingly, after controlling for these dimensions, the direct effects of political institutions, political instability and macroeconomic volatility appear to be limited. Our results are also found to be robust to treating export concentration and openness to trade as endogenous variables in our investment models.

Our paper is related to an emerging strand of empirical literature which challenges the resource curse thesis. It complements the findings in Lederman and Maloney (2007), who find that the negative effect of trade structure on growth dominates that of natural resources. Subsequent work has further questioned the existence of a resource curse. Manzano and Rigobon (2007) attribute the resource curse effect to debt overhang, demonstrating that the weak economic performance of resource rich countries is a result of accumulation of foreign debt during periods of high commodity prices.

Another empirical challenge to the resource curse thesis comes from Brunnschweiler (2008), who finds that natural resources have a positive effect on economic growth. Importantly, recent statistical findings have also disputed the harmful effects of natural resources, especially oil, on democracy (Herb 2005; Haber and Menaldo 2007; Brunnschweiler 2008). Our paper extends this recent empirical literature on the resource curse by presenting related evidence on aggregate investment levels.

The rest of the paper is organized as follows. Section II describes the data on natural resources and other key control variables. Section III reports the main empirical results and associated robustness tests. Finally, section IV offers concluding remarks.

II. Data, sample and variables

In this section, we discuss issues concerning the measurement of natural resource abundance and other variables used in our analysis. The core set of regressions reported in this paper is based on a sample of 72 developing countries. We exclude former socialist economies from our sample. Aside from this, the choice of our sample is largely dictated by issues of data availability. The variables we use and their exact sources are documented in Appendix 2. A complete list of the sample countries is provided in Appendix 3.

(a) Measuring natural resource abundance

A central issue in the resource curse literature relates to the measurement of natural resources. In fact, much of the debate on the existence of the resource curse revolves around this measurement issue. This growing body of literature has shown that empirical findings on the resource curse are extremely sensitive to the choice of resource measures. Given this significance, we will discuss in relatively more detail the various natural resource indicators we consider.

It is common in the literature to rely on relative measures of resource abundance. In earlier work, the share of primary commodity exports in GDP (or in total exports), *sxp*, was one of the most widely used proxies for natural resource abundance. The commodity exports measure is a crude proxy and does not directly measure resource wealth. For instance, not all resource rich societies have a high proportion of primary commodity exports. Besides, it may represent other influences: the share of primary commodities in GDP can be driven by policy rather than resource dependence *per se*.

More direct and conceptually appealing indicators of resource abundance have been recently compiled and published by the World Bank (1997, 2005). These are based on the net present value of the stream of rents. Total national wealth is divided into three main components: produced assets, human resources and natural capital. The measure of natural capital is based on agricultural land, pasture lands, forests, protected areas, metals and minerals, and coal, oil and natural gas. Estimates for the value of subsoil assets (metals, minerals, coal, oil and natural gas) are derived by taking present values of the total rents over the projected life of the resource deposit.[4] Two variations of the natural wealth data have been fruitfully employed in the recent literature: the share of natural capital in total wealth (*lncs*) and the value of natural capital per capita (*lncap*), both expressed in natural logs. We have constructed these ratios using the updated wealth data available for 2000.

The wealth data, although more closely tied with the notion of resource abundance, does raise some identification problems in empirical work. For instance, when natural capital as a share of total wealth is used as a measure of resource abundance, a negative correlation might result if the denominator—total wealth—is positively correlated with the dependent variable, growth of real GDP per capita or the investment rate.[5] Using suitable instruments for the natural capital share may be a solution, but good instruments are hard to find. The use of natural wealth per capita may therefore be more appropriate in this context. Studies using this indicator tend to find a positive effect of natural resources on economic growth—see, for example, Brunnschweiler (2008). It is useful to note that natural wealth per capita correlates quite highly with per capita income.[6]

Since specialization in minerals and fuels is often associated with greater economic distortions (Auty, 2000, 2001), it is sensible to focus more directly on measures of these resources. Two measures based on production data for minerals have received particular attention in the literature: the share of mineral production in GNP in 1971 (*snr*) and the share of mining in GDP. As Brunnschweiler (2008) notes, mineral indicators are marred by lack of consistent quality of the data on mineral production, absence of weights to value different minerals and possible endogeneity concerns (raised by the influence of technology and economic development on mineral production).

[4] Yearly production (extraction) of these subsoil assets is valued using estimates of resource rents (net operating surplus less a normal return on produced assets). The return is smoothed over the period 1998-2000 and then capitalized at a 4 percent discount rate over the remaining time to exhaustion. Present value is calculated by assuming an optimal path for unit scarcity rents and a constant revenue stream.

[5] Note that total wealth includes produced capital, and is measured at the end of the period over which investment rates are averaged.

[6] The simple correlation coefficient between the two variables is 0.63.

Amongst the different types of natural resources, oil stands out for its distinct effects on political economy. Relative measures of oil resources have received considerable attention in the economics and political science literatures, partly due to the significantly higher rents that they have generated since the early 1970s. Economies dependent on oil exports seem to have poor institutional outcomes. A popular thesis, proposed by Ross (2001), is that oil fuels authoritarianism. In theory, this may be possible because revenues from oil tend to reduce reliance on taxation, create incentives for rent-seeking and make state repression more likely.

However, existing indicators may not satisfactorily capture this "fiscal impact of oil" (Haber and Menaldo 2007). For example, the ratio of fuel exports to GDP, which is one of the more commonly used measures in the literature, does not properly encapsulate the effect of oil on government revenues. Ross (2006) proposes another related indicator: the ratio of windfall profits from oil to GNP. But, this assumes that all countries tax oil profits identically.[7] Herb (2005) proposes a more theoretically appealing measure that captures the impact of oil on government revenues: the ratio of revenues from petroleum and minerals to total government revenues (*rent*). A related measure constructed by Herb (2005) is the ratio of net oil exports to GDP, where net oil exports are defined as follows:

[(fuel exports/merchandise exports) – (fuel imports/merchandise imports)]

The net oil exports to GDP ratio is denoted as *netoil*. For both of these measures, we use period averages for 1972-98. Herb's measures have recently gained attention in the political science literature, but have not yet made their way into the mainstream economics literature on the resource curse. Our empirical analysis will pay particular attention to these oil-based measures of natural resources.

A different way of characterizing resource-dependent countries is to consider dummy variables based on different resource specializations. Isham et al. (2005) propose several export classifications based on a country's natural resource base. The following are especially relevant for our empirical analysis: dummy variable for point-source resources (fuels, minerals and plantation crops, *respoint*), and dummy variable for coffee and cocoa (*rescoff*).[8] Isham et al. (2005) have convincingly shown that a country's export structure is linked to its institutional quality and economic growth. In particular, point-source resources that have more intensive and localized production patterns are associated with greater opportunities for rent-seeking.

A related export-based measure that will be central to our empirical analysis is UNCTAD's export concentration index, which is denoted as *excon* in our regressions. This is a modified version of a Herfindahl-Hirschmann index, and is defined as:

$$EXCON = \frac{\sqrt{\sum_{j=1}^{N}(E_j/E)^2} - \sqrt{\frac{1}{N}}}{1 - \sqrt{(1/N)}}$$

[7] Windfall profits are calculated as the price received per barrel minus the cost of production per barrel, multiplied by the number of barrels produced.

[8] The classification of export structures is based on UNCTAD's Handbook of International Trade and Development Statistics, 1988.

where exports are disaggregated into N products (239 three-digit SITC product categories in the UNCTAD measure) indexed by j, E is the total value of exports, and Ej is the value of exports of product j. *excon* has been normalized to lie in the range between 0 to 1, where larger values of the index reflect higher concentration of exports in a narrow range of products. We use the average of this measure for the period, 1980-1998 and express it in natural logs.

Table 1 summarizes the basic correlations between the various indicators of natural resource abundance described above. The numbers in Table 1 suggest a positive correlation between primary exports share (*sxp*) and other resource measures, especially share of natural resources (*snr*), net oil exports (*netoil*) and export concentration index (*lexcon*). Amongst the included variables, *lexcon* is more positively correlated with the natural capital share (*lncs*). As expected, variables measuring oil wealth and its effects, *netoil* and *rent*, have a strong positive correlation with the World Bank measure of natural wealth per capita (*lncap*).

(b) Other variables

The main aim of our paper is to investigate the effect of natural resource abundance on levels of investment. Our principal focus will be on investigating the link between natural resources and the share of private investment in GDP. This ties in well with the empirical literature on investment determinants that has mainly focused on private investment. In this regard, we use the disaggregated investment series compiled for the World Bank by Glen and Sumlinksi (1998). We restrict our sample period to 1970-98, the period for which this data is readily available. For the sake of completeness, we consider two other measures of investment as well: the share of public investment in GDP, also from Glen and Sumlinksi (1998), and the broader measure of total gross domestic investment as a share of GDP, obtained from the World Development Indicators. We will use the natural logarithms of these investment shares as dependent variables.

Our empirical investigation considers a wide range of candidate predictors of investment. In choosing these indicators, we were principally guided by the existing literature on investment and, more generally, by the cross-sectional studies of long-run development outcomes. Institutional quality has been stressed as an important investment correlate (Stasavage 2002). The resource curse literature also suggests the quality of political institutions as a channel through which natural resources may have adverse effects on economic performance (e.g. Ross (1999), Collier and Hoeffler (2005), Johnson et al. (2005)), or as a key determinant of whether resource abundance is a curse or a blessing (Mehlum et al. 2006).

The core empirical specification in this paper will thus always include some measure of the quality of institutions. Our preferred indicator is the measure of checks and balances (*checks*) developed by the World Bank's Database on Political Institutions (DPI)—see Beck et al. (2001). The key advantage of this measure is that, unlike many perception-based indicators, *checks* measures a deeper and more permanent feature of political institutions: the extent of political constraints and checks and balances faced by decision makers. The *checks* indicator "counts the number of veto players in a political system, adjusting for whether these veto players are independent of each

other, as determined by the level of electoral competitiveness in a system, their respective party affiliations, and the electoral rules" (Beck et al. 2001). It ranges between 1 and 15, with 15 indicating the highest level of checks and balances. We will use the period average of *checks* for 1975-98.[9]

There are two other basic sources for the data on political institutions. In the course of our empirical work, we will also experiment with a measure of constraints on the executive (*xconst*) constructed by the Polity IV database. We use an average for the 1970-98 period. In some preliminary empirical work, we have also considered Kaufmann et al. (1999)'s "aggregate governance index" (*kkz*), which is a simple average of six separate indicators on voice and accountability, political instability, government effectiveness, regulatory burden, rule of law, and graft.[10]

As well as the quality of political institutions, we also consider a range of possible macroeconomic determinants of investment shares suggested by the earlier literature. These include the relative price of capital goods (*pi_p*), and measures of volatility in several macroeconomic variables, constructed either as standard deviations or as coefficients of variation for the annual series over our sample period. Other variables that we will emphasize in our analysis include the index of ethnic fractionalization (*ethnic*) due to Alesina et al. (1999) and the average trade to GDP ratio, obtained from World Development Indicators.

Our key source for data on financial development is the well-known Financial Structure Database compiled by World Bank researchers (see Beck et al. 1999). This dataset provides around 37 indicators capturing various facets of financial systems. The main indicator that we use in this paper is the ratio of private sector credit to GDP, averaged over the estimation period.[11] Our regression analysis will also include indicators of socio-political instability and geographical characteristics.

III. Empirical results

We present cross-country regression results where the dependent variables are averaged over the period 1970-98. In selecting possible explanatory variables, we have been guided by the previous literature that has considered models of investment in a cross-country regression framework. We emphasize models based on robust predictors, identified through several rounds of model selection procedures. We use both the Bayesian Model Averaging (BMA) and PcGets approaches to model selection.[12] Variables flagged as being important by these procedures are then used in formulating our preferred models. However, these model selection procedures were used mainly as a first step to guide our choice of included variables. This paper will stress additional variable tests to ascertain the robustness of our empirical results to other explanations. The background model selection tests are separately discussed in a companion paper (Bond and Malik 2008).

[9] Data on the checks variable is available from 1975.
[10] These indicators are themselves based on several hundred individual variables measuring perceptions of governance from 37 separate data sources constructed by 31 different organizations.
[11] In earlier investigations we also considered other financial indicators, such as the ratio of liquid liabilities to GDP.
[12] An introductory treatment of BMA can be found in Raftery (1995) and Raftery et al. (2007). For a general description of PcGets, see Campos et al. (2003) and Hendry and Krolzig (2004).

The partial scatter plots reveal strong correlations between export concentration, net oil exports and private investment share. Figure 1 suggests a strong negative correlation between the log of private investment share and the export concentration index. Figures 2 and 3 suggest a strong positive correlation of the net oil exports variable (*netoil*) with both private investment share and export concentration.

III-A. Main findings

We now present the main results of this study. We begin with the results from relatively parsimonious regression specifications that contain our key variables of interest. Columns (1)-(3) of Table 2 present these results for models where the dependent variable is the log of the share of private investment in GDP (*Lprinv*). Our initial specification in column (1) includes five explanatory variables: the relative price of capital goods (*pi_p*), the indicator of political institutions (*checks*), the log of the average trade to GDP ratio (*Lopenwb*), the index of ethnic fractionalization (*ethnic*), and a dummy variable for the East Asia and Pacific region (*reg_eap*).

As expected, the relative price of investment goods, sometimes regarded as a proxy for cross-country variation in the user cost of capital, helps to explain variation in these investment shares. The coefficient is negative and statistically significant, suggesting that countries with a higher relative price of capital goods tend to invest less, on average.

Another key variable included throughout our regression models is the quality of political institutions. The potential importance of political institutions and governance structures in explaining investment rates is suggested by earlier studies, for example Stasavage (2002). Importantly, it has been suggested that the negative impact of natural resources on economic performance may be mediated through their effect on the strength and quality of institutions (Ross 2001; Isham et al. 2005; Collier and Hoeffler 2005). In our exploratory work, we found some weak evidence for various measures of executive constraints. We found the measure of checks and balances (*checks*), developed by Beck et al. (2001), to be particularly informative in the context of explaining these investment shares.

We include this measure of institutional quality in our basic specification in column (1) and find a positive and weakly significant coefficient on *checks*, suggesting that countries with greater checks and balances on the use of power tend to have higher shares of private investment in GDP. One interpretation is that countries with "multiple decision makers" can be expected to offer greater protection of investors from arbitrary actions and opportunistic expropriation on the part of government. We found a similarly positive effect of the quality of political institutions if we replaced the *checks* measure with POLITY IV indicator on constraints on the executive (*xconst*) or Kaufmann et al.'s aggregate governance index (*kkz*).

We also obtain an expected positive coefficient on trade openness, measured by the log of the World Bank measure of trade shares in GDP (*Lopenwb*). Countries that are more open to trade also tend to have high private investment. Another interesting result relates to the effect of ethnic fractionalization. Our results find a strong negative

association between the index of ethnic fractionalization and private investment rates.[13]

This is consistent with the findings of a broader research agenda on the link between ethnic diversity and economic development—see, for example, Easterly and Levine (1997) and Montalvo and Reynal-Querol (2005). In particular, Mauro (1995) suggests potential links between ethnic diversity and investment: ethnic fractionalization can affect investment indirectly by increasing corruption, risk of civil war and political instability. It can also exert a more direct effect on investment by slowing down the diffusion of ideas and technology. Finally, the coefficient on a regional dummy variable for East Asia and Pacific countries is positive and significant, indicating that the included variables do not fully account for the relatively high investment shares in East Asia.

Column (2) turns to the principal objective of this paper: to explore the role of natural resources in explaining cross-country variation in these private investment shares. For this, we include two of our preferred indicators: the log of the export concentration index (*Lexcon*) and the ratio of net oil exports to GDP (*netoil*). We find considerable empirical support for both of these indicators. Countries that derive a greater proportion of their GDP from net oil exports appear to have higher investment levels, as suggested by the positive and statistically significant coefficient on *netoil*. Such a favourable effect of oil revenues on investment is plausible given that countries which experienced oil booms often experienced consequent investment booms. The distinctly positive effect of oil may also be attributed to the capital-intensive nature of oil production.

However, after controlling for this effect of oil, we find that higher export concentration is associated with lower investment shares. This is implied by the negative and statistically significant coefficient on *lexcon*. The effect of export concentration on investment needs to be interpreted carefully, as it could be consistent with several possible explanations. Specialization or dependence on a narrow range of exports may be efficient in the sense that it may be associated with scale economies, high levels of productivity and a higher per capita income. On the other hand, export concentration may negatively affect investment and growth via greater exposure to terms of trade shocks and adverse political economy effects.

The results in Table 2 suggest that these negative effects of export concentration dominate. This negative effect may be a broader manifestation of the harmful effects of resource abundance. For example, *Lexcon* may be acting as a proxy for other resource indicators, with which it is highly correlated.[14] This would also accord well with the contention that natural resource specialization crowds out manufacturing activity, described as a key explanation for the resource curse (Sachs and Warner 2001). Resource abundant countries have not tended to avail opportunities for (manufacturing) export-led growth.

[13] However, contrary to Montalvo and Reynal-Querol (2005), we did not find a similar relationship between their index of ethnic polarization and investment.

[14] Table 1 indicates a high correlation of *Lexcon* with primary exports share, *sxp*, (0.45) and natural capital share, *Lncs*, (0.49). We consider this possibility further in section III-B below.

However, the negative effect of export concentration on the share of private investment in GDP may reflect a wider array of forces than simply natural resource dependence. It is commonly recognized that trade structures narrowly concentrated in a few products, mainly primary commodities, are associated with other development disadvantages, such as vulnerability to external shocks and capture of political institutions. Viewed from this perspective, the negative effect of *lexcon* may be viewed as summarizing the broader impact of trade structure on investment.

The inclusion of *lexcon* and *netoil* in column (2) does not change the sign or statistical significance of the estimated coefficients on the other variables in the conditioning set. The only exception is the coefficient on *checks*, which was marginally significant in column (1) but becomes less informative when these natural resource/export structure variables are added in column (2). Our preferred specification in column (2) has good explanatory power: it explains 68 percent of the total variation in private investment shares.

Column (3) introduces a full set of dummy variables to capture regional effects for South Asia (*reg_sa*), Sub-Saharan Africa (*reg_ssa*), Latin America and Caribbean (*reg_lac*) and Middle East and North Africa (*reg_mena*). These dummy variables are based on the World Bank regional classifications. There does not seem to be any significant additional information in these regional dummy variables. We continue to find a significant negative coefficient on export concentration and a significant positive coefficient on net oil exports. Together with ethnic fractionalization, trade openness and the relative price of capital, these variables account for the relatively low private investment shares observed in Sub-Saharan Africa and South Asia.

For comparison, columns (4) and (5) present the results for models where the dependent variable is replaced with the log of public and total investment shares, respectively. In column (4) we start with the same specification considered in column (2), with the only change that the dependent variable is now the log of the average public investment share in GDP (*lpbinv*). The relative price of capital (*pi_p*), ethnic fractionalization (*ethnic*) and export concentration (*lexcon*) are relatively uninformative in explaining variation in public investment shares. We find a negative and statistically significant coefficient on *checks*, which suggests that the main effect of checks and balances is on constraining public sector capital spending.

There is also a strong positive correlation between trade openness and public investment, consistent with the long-standing claim that more open economies tend to have larger governments (Rodrik 1998). Similarly, the coefficient on *netoil* is positive and significant, suggesting that oil revenues are used to finance public investment. This is also corroborated by case study evidence which shows how oil rents are often channelled through higher levels of public investment and how oil booms are routinely followed by public investment booms (Collier and Gunning 1999). However, it is noticeable that these variables together explain only 21 percent of the total variation across countries in public investment shares in GDP.

Column (5) repeats the same specification for the total investment share, defined here as the log of average gross domestic investment as a share of GDP (*lgdi*). These results are broadly consistent with the findings from our models of private investment shares. Most of our results related to oil abundance, ethnicity, openness and the

relative price of capital continue to hold. Though negatively signed, the coefficient on export concentration loses statistical significance.

Taken together, these results suggest that having exports concentrated in oil is likely to be associated with higher levels of private investment. However, after controlling for this distinct effect of oil, there is a more menacing influence of export concentration on private investment. This can partly be a manifestation of an underlying dependence on natural resources. But it can also arguably indicate the deeper disadvantages of a trade structure unduly dependent on non-oil primary commodities. In subsequent sections, we will check the robustness of these findings to other commonly used measures of natural resources, and additional explanatory variables.

III-B. Robustness to other explanations

This section will explore the robustness of our main results. We will show that our key findings are robust to the inclusion of further natural resource measures, and other possible determinants of private investment shares suggested by the previous literature. In doing so, we consider in particular the role of political instability, macroeconomic volatility, financial development, macroeconomic distortions and geographic characteristics. We also allow for the possible endogeneity of our trade openness and export concentration variables. The analysis in this section focuses on models for the log of private sector investment as a share of GDP.

(a) Other indicators of natural resources

A first and perhaps the most important aspect of robustness relates to the choice of resource measure employed. This becomes all the more important given that the nature of disagreements in this literature largely revolves around the question of measurement. So far, our estimations have relied on the export concentration index and the share of net fuel exports in GDP as the two preferred measures. Here, we compare these results to other alternative measures of resource abundance, especially close proxies for *netoil*.

The choice of resource measures considered in this robustness exercise is partly dictated by the need to keep the sample size as large as possible. Keeping the sample size fixed at 62 countries, we successively include eight additional natural resource indicators. Results from these specifications are presented in Table 3. We begin in column (1) by re-estimating our preferred specification for this reduced sample of 62 countries. The results are broadly similar to those presented in Table 2. As before, coefficients on the relative price of capital, ethnic fractionalization and export concentration are negative and significant. On the other hand, trade openness and net oil exports exert a significant positive effect on private investment shares. Re-estimating the specification in Table 2 on the 62 country sample has the virtue of demonstrating that the results are robust to reducing the sample size.

Recently, some studies have employed natural wealth data from the World Bank to demonstrate a positive effect of natural resources on economic growth (Brunnschweiler 2008). We first consider the possibility that the positive effect of oil is simply a proxy for natural wealth per capita. Adding the log of natural wealth per

capita (*lncap*) in column (2) yields a positive but statistically insignificant coefficient. The negative effect of export concentration and the positive effect of net oil exports remain intact, although the coefficient on export concentration is significant only at the 10% level in this specification.

Column (3) adds a related, though arguably a less appropriate measure of resource abundance, the log of the share of natural capital in total wealth (*lncs*).[15] The inclusion of *lncs* in previous studies has often resulted in a negative correlation with investment and growth (Gylfason and Zoega 2006). We obtain a negative coefficient on *lncs*, but it is insignificantly different from zero, while the coefficients on *netoil* and *lexcon* remain significant at the 1% and 10% levels respectively.[16] The specification used in Gylfason and Zoega (2006) simultaneously includes both *lncap* and *lncs*, obtaining a positive coefficient on the former and a negative coefficient on the latter variable. As the absolute value of these two coefficients is similar, their model in fact suggests a positive effect from the log of total wealth per capita, with the natural capital terms in the numerator of the two ratios cancelling out. Appendix 1 presents results for specifications which include both these natural capital terms, and provides further discussion. The bottom line is that we find these two variables to be both individually and jointly insignificant when added to our main specification.

Column (4) adds the dummy variable for fuel exporting nations (*fuel_exp*) constructed by the World Bank.[17] Again, it does not have any additional explanatory power. Clearly, the continuous measure of oil exports (*netoil*) is more informative than the binary dummy for oil-exporting nations. Next, we include the ratio of petroleum and mineral revenues to total government revenues (*rent*) in column (5). Coming from the same source, Herb (2005), *rent* is a close proxy for the *netoil* variable. The simple correlation between the two variables is 0.87. However, when included together the effect of *netoil* clearly dominates.[18]

Column (6) checks the robustness of our results to another resource measure, the share of mineral production in GNP in 1971 (*snr*). Again, there is no additional information in *snr*: the coefficient on *snr* is negative but statistically insignificant. *netoil* continues to have a strong positive effect and the coefficient on *lexcon* is negative and statistically significant. Column (7) considers another popular measure of natural resources, the share of primary commodity exports in GDP (*sxp*). The coefficient on this variable is insignificant, and its inclusion again has little impact on the two resource effects emphasized in our paper.

Finally, column (8) considers two separate dummy variables for countries whose export structure predominantly relies on point-source resources (*respoint*) and coffee and cocoa (*rescoff*). This is inspired by the suggestion in Isham et al. (2005) that

[15] As discussed in the data section, the presence in the denominator of total wealth, which is the sum of natural, produced and intangible capital, may cause a spurious correlation with the dependent variable, the log of the private investment share.

[16] However, dropping *Lexcon* from this specification does yield a statistically significant negative coefficient on *Lncs*.

[17] The dummy variable equals one if more than 50% of a country's exports consist of oil.

[18] We do find that both *fuel_exp* and *rent* are good proxies for *netoil*, in the sense that the coefficients on these variables become positive and statistically significant if we exclude *netoil* from the specification.

different types of resource endowments can influence economic growth by shaping socio-economic and political institutions. In particular, countries with a point-source or coffee/cocoa type of natural resource base tend to have weaker institutions and poorer economic performance. The results from including *respoint* and *rescoff* in column (8) are reassuring. Neither of thee two variables has any additional explanatory power.

Collectively, the results presented in this section provide solid empirical support for the choice of our main resource variables. The inclusion of a variety of additional natural resource measures suggested in the literature shows that the relevant information for explaining differences in private investment shares is contained mainly in export concentration (*lexcon*) and net oil exports (*netoil*).

(b) Macroeconomic volatility

We now control for possible investment determinants suggested by the literature. Indicators of macroeconomic volatility or uncertainty have been suggested as potentially important determinants of cross-country differences in average investment shares in earlier studies (e.g. Aizenman and Marion (1999), Serven (2003)). Additionally, volatility has also been identified as one of the consequences of specialization in natural resources. Evidence suggests that volatility in resource-rich countries is several orders of magnitude higher than in countries where natural resource exports account for a smaller share in GDP (Ploeg and Poelhekke 2007). It is thus possible that the effect of trade structure highlighted in this paper is merely a reflection of the effect of volatility on investment.

In this sub-section, we consider a wide range of possible volatility measures as additional explanatory variables to test the robustness of our results. Results are presented in Table 4. The revised sample for this empirical exercise, dictated by the availability of data on the volatility measures, is 65 countries. Column (1) again replicates our preferred specification on this reduced sample. Our model explains 68 percent of the total variation in private investment shares. Except for the *checks* variable, coefficients on all other included variables are statistically significant at 1 percent level. In particular, there is a strong negative effect of *lexcon* and a strong positive effect of *netoil* on private investment shares.

We first add a commonly used measure of growth volatility (*grvol*) in column (2). It is defined as the standard deviation of the annual growth rate of real GDP per capita during the estimation period.[19] The inclusion of *grvol* does not alter any of our results and its coefficient is individually insignificant.

Next, we control for volatility of the terms of trade (*vtot*) in column (3). This is measured as the standard deviation of the first log-differences of the annual terms of trade series during the estimation period. The coefficient on *vtot* is negatively signed but insignificant. However, with the inclusion of terms of trade volatility, the

[19] We use the first log-differences to define growth rates.

coefficient on *lexcon* is significant only at the 5% level, as opposed to the 1% level in columns (1) and (2).[20]

Results in columns (4) and (5) indicate that there is also no statistically significant additional explanatory power in two further measures of macroeconomic volatility. These are the standard deviations of the share of government consumption in GDP (*vgcons*) and the ratio of M1 to GDP (*monvol*).[21] In both cases, the significance of the coefficients on our measures of export concentration, net oil exports, and other control variables is found to be robust to the inclusion of these additional volatility measures.[22]

In sum, having controlled for resource abundance, trade, ethnic fractionalization, the relative price of capital and institutional quality, we do not find additional explanatory power in these measures of macroeconomic volatility. One possible interpretation is that volatile outcomes are a symptom of certain deeper characteristics, which may predispose some economies to be more unstable than others. In this context it is interesting to note that resource abundance tends to increase a country's exposure to some economic shocks, and this has been suggested to be an important channel explaining the relationship between resource abundance and poor economic performance (Collier 2006; Ploeg and Poelhekke 2007).

(c) Political instability

A third robustness issue relates to the role of political instability in hampering private investment. Previous empirical research has flagged political instability as a potentially important determinant of private investment shares (e.g. Svensson (1999), Alesina and Perotti (1998), Campos and Nugent (2002)). It has been argued that political instability can delay investment, destroy existing capital stock and result in harmful political uncertainty (Campos and Nugent, 2002). At the same time, civil and political strife has also been regarded as an important consequence of natural resource intensity (Collier and Hoeffler, 2004). Thus, political instability may be an omitted dimension in our empirical analysis.

In order to assess the possibility that our resource indicators are acting as empirical proxies for political instability, Table 4 considers two common measures of political instability as additional explanatory variables in columns (6) and (7). We add the measure of socio-political instability (*SPI*) proposed by Campos and Nugent (2002) in column (6). The *SPI* measure is constructed as a principal component of three underlying counts of the number of political assassinations, revolutions and successful coups in the estimation period. As is standard in the literature, we obtained the comparative data on these individual dimensions of political instability from Arthur S. Banks' Cross National Time Series database.[23] In column (7) we include the log of

[20] When entered on its own in the absence of other variables (not reported in the table), *vtot* has a significant negative association with private investment shares. But the inclusion of *Lexcon* is sufficient for the coefficient on terms of trade volatility (*vtot*) to become insignificantly different from zero.
[21] Both these variables are expressed in natural logs, which resulted in a better empirical fit. For *monvol* we use standard deviation of the residuals of the AR (1) process of M1 to GDP ratio.
[22] Our results are also robust to the inclusion of the coefficient of variation of quarterly inflation rates. Since it significantly reduces the sample size, we do not report the results here.
[23] Data is accessible via the following website: http://www.databanks.sitehosting.net/Default.htm

the weighted conflict index (*lconflict*), which combines a larger number of Banks' indicators. More specifically, the conflict index is a weighted measure of the number of riots, coups, assassinations, general strikes, government crises, purges, revolutions, anti-government demonstrations, and instances of guerrilla warfare. A high value indicates an unstable society.

Neither of these two indicators has a statistically significant coefficient when added to our basic specification. Thus, despite previous empirical evidence on this subject, we do not find any additional role for these political instability indicators in explaining cross-country differences in private investment shares. One possible explanation may be the inclusion of ethnic fractionalization, which has been consistently informative in our regressions.[24] It is often contended that ethnically diverse societies are more prone to conflict or civil strife. Viewed from this perspective, it could be argued that our measure of ethnic diversity captures the relevant information for explaining private investment shares that is contained in these political instability indicators.

(c) Financial development and macroeconomic distortions

Several previous studies have highlighted the possible relationship between private investment and financial development (e.g. Serven 2002; Ndikumana 2005). Column (1) of Table 5 reports that we find a positive but statistically insignificant coefficient on a standard measure of financial development (the ratio of private sector credit to GDP, denoted as *Credit*) in our preferred specification for the log of private investment shares. Again, the coefficients on export concentration (*lexcon*) and net oil exports (*netoil*) remain significant in this specification, although the coefficient on *lexcon* is now significant only at the 10% level.

Column (2) controls for the initial level of development by including the natural log of real GDP per capita in 1970 from the Penn World Tables (*lgdp*). The coefficient on *lgdp* is positive and significant at the 10% level, indicating that a higher starting level of per capita income is associated with a higher share of private investment in GDP. However, the inclusion of *lgdp* does not affect our basic results for net oil exports and export concentration. Column (3) controls for an important macroeconomic distortion, the black market premium, or more generally, the percentage difference between the black market and official exchange rates (*BMP*).[25] The literature on economic growth and investment has often included the black market premium as a general proxy for macroeconomic distortions and protectionist policies. As is clear from the results in column (3), the coefficient on *BMP* is negatively signed but insignificantly different from zero. The inclusion of *BMP* again does not change our key results.

Columns (4)-(6) include three other indicators of macroeconomic policy as additional explanatory variables. With these new controls, the sample size is allowed to reduce to 62 countries. To control for any crowding out effects of public debt on private investment, we include the ratio of debt service payments to total exports (*dserv*) and the ratio of total external debt to GDP (*ledt*) in columns (4) and (5). In order to control for the effects of exchange rate misalignment, we add the natural log of an index of

[24] We also find in our background empirical work that there is little or no additional information another measure of ethnicity, the measure of ethnic polarization, which has been previously related to investment (Reynal-Querol, 2005).

[25] As is standard in the literature, we construct this variable as the log of (1+black market premium).

exchange rate overvaluation (*loverv*) in column (6). Data on the first two indicators comes from the World Development Indicators (WDI), whereas the overvaluation index has been obtained from Dollar (1992) and the Global Development Network (GDN) database. The results reported in columns (4)-(6) do not provide evidence of any additional explanatory power of these macroeconomic indicators. Again the inclusion of these additional controls does not affect our basic results.

(d) Geography

Our next empirical test is to consider the robustness of our findings to the inclusion of selected geographical characteristics that have been previously related to growth (Gallup et al. 1999). There are two important reasons to control for geography. First, given that there is a demonstrable link between geography and economic growth, it may also have a direct influence on investment shares. Second, there is a positive association between resource abundance and measures of tropicality. A large number of resource-rich developing countries are concentrated in tropical areas. This raises the possibility that any effects of natural resources highlighted in our paper could be an artefact of the role of adverse geography.

In either case, geography could be an omitted dimension in our analysis. Furthermore, previous empirical work has not properly investigated the role of geography in explaining private investment shares. We test for this possibility by directly controlling for commonly available geographic indicators in our preferred specification. The results are presented in Table 6. We begin in column (1) by adding the log of minimum distance from major markets (*lmdist*), taken from Radelet and Sachs (1998), as a possible indicator for market access. It is based on minimum distance from one of the major international ports, Rotterdam, New York, Los Angeles or Tokyo. Proximity to international markets can be an important determinant of transport costs and opportunities for export diversification. As is clear from column (1) in Table 6, the inclusion of *lmdist* does not weaken any of our main results.

We add a wide range of other geographic attributes in columns (2)-(7). These are the proportion of the population in Koeppen-Geiger temperate zones (*kgptemp*), latitude or distance from the equator (*eqdist*), a dummy variable for landlocked countries (*landlock*), the log of the Frankel-Romer predicted trade share (*ln_FRtrade*), the percentage of area in the tropics (*tropicar*) and the proportion of land within 100 kilometres of the coast or a navigable river (*lnd100cr*). The source of these geographic indicators is Gallup et al. (1998) and Frankel and Romer (1999). The evidence in Table 6 clearly demonstrates that our results are robust to the inclusion of these geographic characteristics. After controlling for the main variables in our baseline specification, none of these geographic measures has a statistically significant effect on private investment shares.

(e) Instrumental Variables results

The various tests described above indicate a robust partial correlation between the export concentration index and private investment shares. But this correlation does not imply a causal effect. Our final robustness check considers the possibility that our key measure of trade structure, the export concentration index, and the trade openness

variable (*lopenwb*), should be treated as endogenous variables in these models for private investment shares. The ability of countries to engage in international trade and to diversify their export structures may be jointly determined with current levels of investment. In particular, both export concentration and investment can be affected by policy. We consider how our results are affected by treating this measure of export structure as an endogenous variable in our investment models.

The results in Table 6 indicate that several of the geographical variables that we considered as potential explanatory variables for investment shares could safely be excluded from these models. These geographical characteristics are therefore available as instruments for export concentration and trade openness. Here, we consider using the proportion of the population in Koeppen-Geiger temperate zones (*kgptemp*) and the dummy variable for landlocked countries (*landlock*) as possible instruments for the export concentration index (*lexcon*). Both of these variables are correlated with *lexcon*.[26] As proposed by Frankel and Romer (1999), we use the log of Frankel-Romer constructed trade share (*ln_FRtrade*) as an instrument for the trade to GDP ratio (*lopenwb*).

Table 7 presents the results of two-stage least squares (2SLS) estimation of our basic specification for the log of private investment shares, in which these two explanatory variables are treated as endogenous. This specification uses a sample of 70 countries for which data on the geographic instruments is available. OLS estimates of the same specification are reported for comparison, and the first-stage regressions explaining differences across countries in export concentration and trade shares are also reported.[27]

These first-stage regressions indicate that our three instrumental variables have significant and independent explanatory power for both *lexcon* and *lopenwb*, even conditional on the remaining explanatory variables that are included in our investment model. This is confirmed by the Kleibergen-Paap test, which strongly rejects the null hypothesis that the parameters of interest in the investment equation are under-identified. Conversely the Hansen/Sargan test does not reject the null hypothesis that the over-identifying restrictions used here are valid. Taken together, these specification test results suggest that our instrumental variables are both informative and valid.

We find that the 2SLS estimates of the coefficients on *lexcon* and *lopenwb* (and the other explanatory variables) are similar to the OLS estimates, both in terms of signs, magnitudes and statistical significance. These IV results do not suggest that the possible endogeneity of our export concentration or openness measures is likely to be driving the significant negative coefficient found on *lexcon* in our main investment models.

[26] The simple correlation coefficient between *kgptemp* and *lexcon* is -0.52. And, the unconditional correlation between *landlock* and *lexcon* is 0.30.

[27] The 2SLS results and associated specification tests were computed using the ivreg2 command in Stata.

IV. Conclusion

This paper examines a relatively neglected aspect of the literature on the natural resource curse: the relationship between natural resources and investment. We provide one of the first systematic empirical investigations of this subject. In doing so, we rely on cross-section regression models where the main dependent variable is the log of the average share of private investment in GDP. Our results are based on a sample of 72 developing countries during the period 1970-98.

Our empirical approach is distinctive in that we emphasize robust specifications suggested by the BMA and PcGets model selection procedures, and we consider a wider range of candidate predictors of investment than previous studies. Our results highlight a more nuanced role of natural resources, whereby oil and non-oil resources appear to have different effects on investment levels. Specifically, we find a robust positive influence from the share of net oil exports in GDP, and a robust negative influence from a measure of export concentration.

Countries with high oil revenues tend to have high shares of private investment in GDP. This could partly reflect the capital-intensive nature of oil production and related service industries. Oil wealth could also play a role in relaxing financing constraints on investment in other local economic activities. We also find that oil wealth is associated with high shares of public investment in GDP.

The negative relationship between export concentration and private investment shares may reflect more broadly the adverse consequences of a trade structure that is tilted heavily towards primary commodity dependence. To the extent that natural resources have an effect on export structure, they clearly matter for investment. But our results ascribe a more important role to export concentration as an explanation for low investment, rather than natural resources *per se*. These findings are consistent with those of Lederman and Maloney (2007), who find a similarly important role of trade structure in the context of economic growth, and van der Ploeg and Poelhekke (2007), who regard natural resource abundance as a hindrance to export diversification. These results also support the hypothesis that the resource curse will tend to be weaker in countries with more diversified trade structures (Hausmann and Rigobon 2003).

We consider the impact of a variety of different natural resource indicators on our findings. However we find that our two export structure variables, net oil exports and export concentration, tend to dominate other measures of resource abundance or resource dependence in the explanation of cross-country differences in private investment as a share of GDP. Our results also highlight the role of ethnic diversity, trade openness and the relative price of capital in accounting for differences across countries in private investment shares.

The striking aspect of these results is the robustness of our findings to the inclusion of a wide variety of alternative controls. In particular, we do not find any significant additional information in measures of political instability, macroeconomic volatility, financial development, macroeconomic policy and geography. While it would be hazardous to infer any causal relationship from these cross-section regressions, we can be confident that the significant coefficients we find on our key variables are not driven by the omission of a large number of candidate explanatory variables. We also

find no indication that the significant negative coefficient on our measure of export concentration is explained by the potential endogeneity of this variable in our investment models.

In describing these results, one important clarification is in order. While this paper presents new empirical evidence on the relationship between natural resources and private investment as a share of GDP, it does not address another question that is equally, if not more, important: how does resource abundance affect the efficiency, as opposed to the level, of investment? There is a growing body of case-study evidence that notes a "collapse in the efficiency of investment" in resource-rich societies—see, for example, Lal and Myint (1996) and Collier and Gunning (1999). This requires a separate and perhaps more detailed investigation, something we intend to return to in future work.

We should also be cautious in drawing simple conclusions for policy from this largely descriptive empirical analysis. Still the results hint at the potential importance of trade openness and export diversification if the objective is to raise private sector investment levels on a sustainable basis. These considerations may be particularly important in the context of resource-rich developing countries. This raises enormous questions about how such improvements could be achieved, but our findings at least highlight the potential importance of research on these issues. Complementary research on the relationship between natural resources and the allocative efficiency and productivity of investment should also be a priority.

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Figure 1

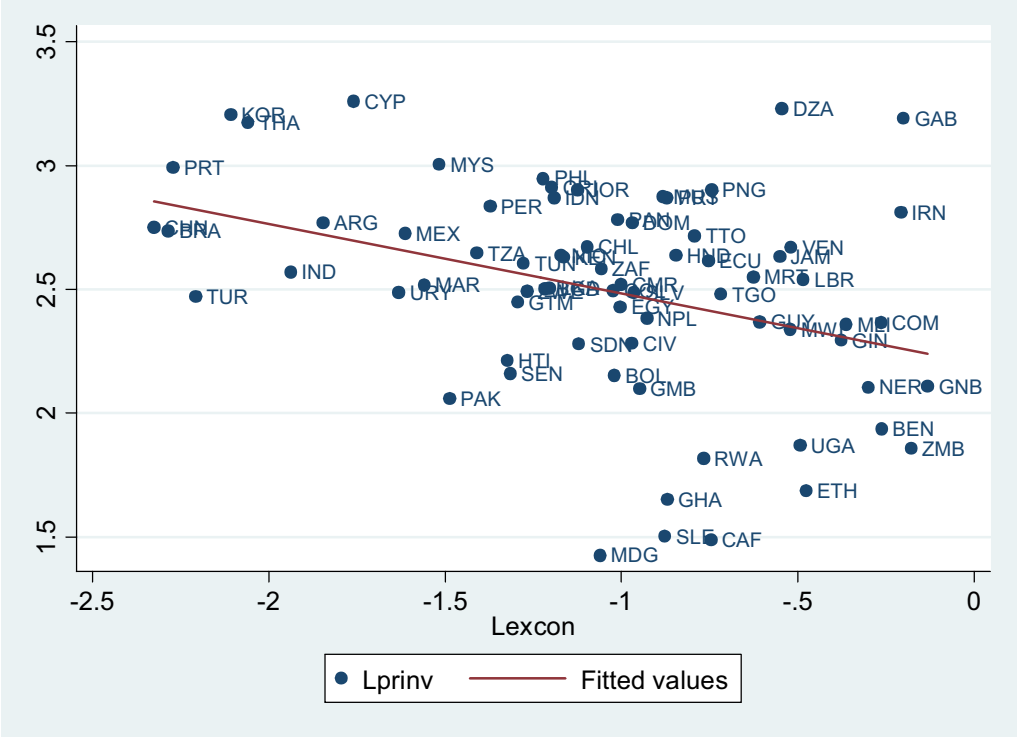


Figure 2

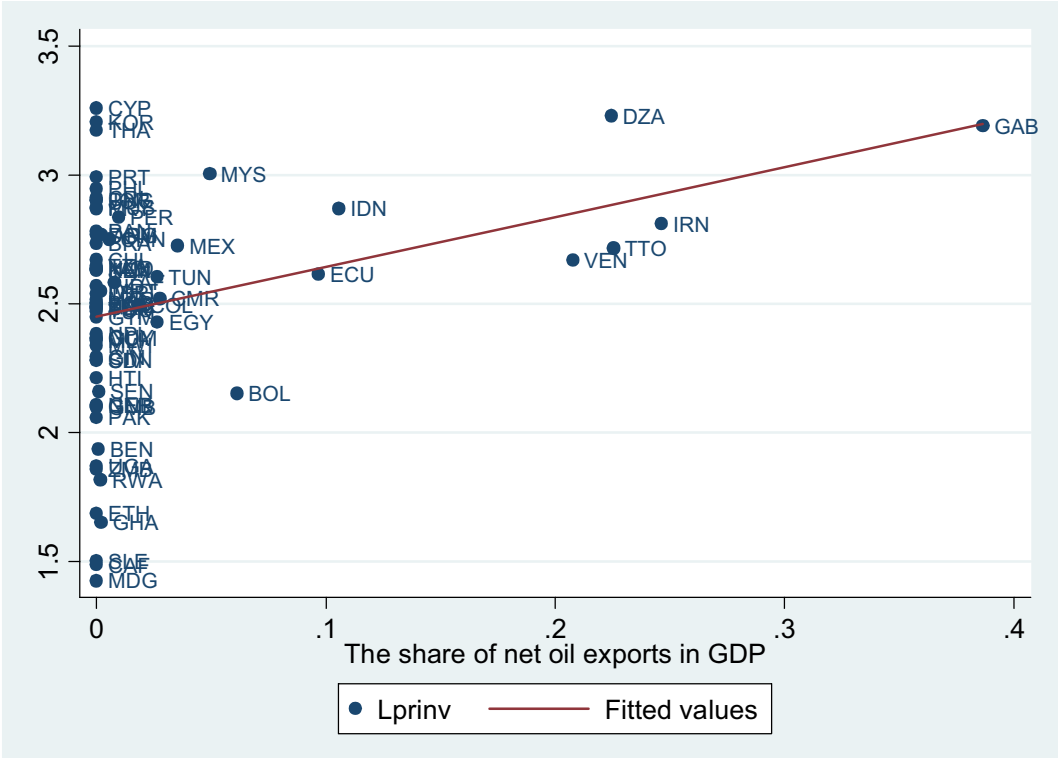
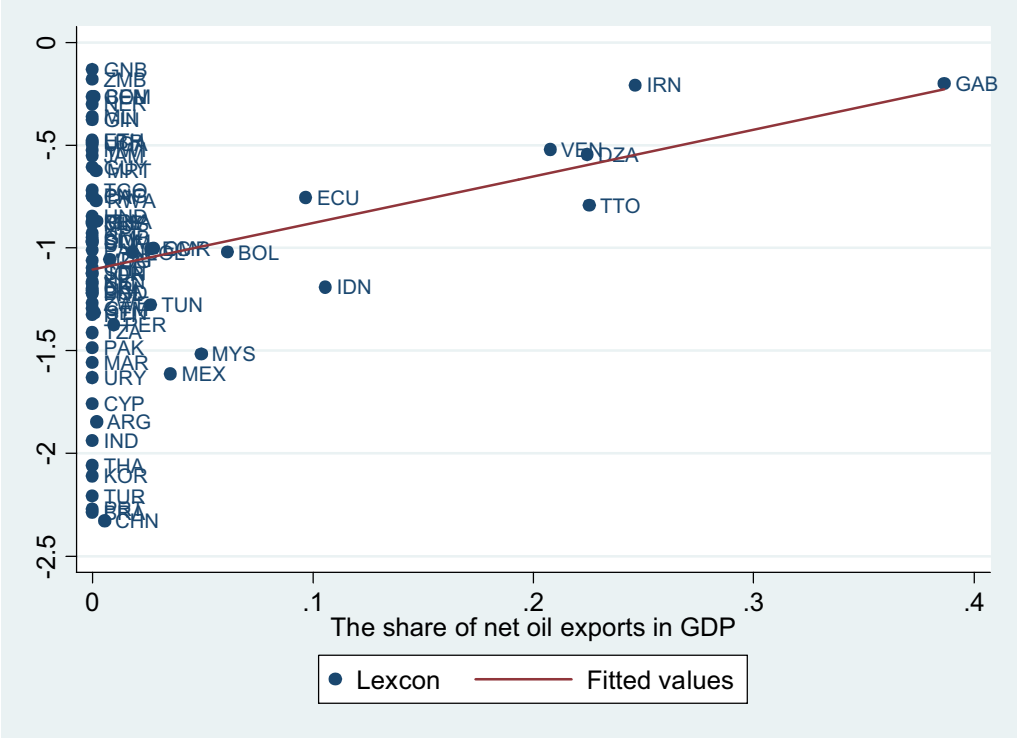


Figure 3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The share of net oil exports in GDP
Lexcon
Fitted values

Table 1: Correlations between selected natural resource indicators

	sxp	Lexcon	Lncs	Lncap	snr	netoil	rent	respoint	rescoff
sxp	1.0000								
lexcon	0.4460	1.0000							
lncs	0.3338	0.4875	1.0000						
lncap	0.3904	0.0380	0.3687	1.0000					
snr	0.5453	0.3443	0.3594	0.3170	1.0000				
netoil	0.4698	0.3286	0.4275	0.6467	0.5172	1.0000			
rent	0.4094	0.3566	0.4443	0.6539	0.5033	0.8862	1.0000		
respoint	0.3907	0.4433	0.1701	0.2954	0.5101	0.3928	0.4993	1.0000	
rescoff	-0.1203	-0.0530	0.0429	-0.1236	-0.2332	-0.1942	-0.2678	-0.4962	1.0000

Notes: Numbers reported are simple correlation coefficients. Correlations are based on a sample of 62 countries for which these indicators are available. See appendix 2 for a description of variable codes.

Table 2: Resource abundance and investment: a first look at the data

	(1)	(2)	(3)	(4)	(5)
Coeff	lprinv	lprinv	lprinv	lpbinv	lgdi
pi_p	-0.210***	-0.163***	-0.157**	0.0222	-0.0900**
	(0.051)	(0.051)	(0.059)	(0.075)	(0.038)
checks	0.0668*	0.0459	0.0455	-0.118**	-0.00998
	(0.039)	(0.033)	(0.032)	(0.057)	(0.027)
lopenwb	0.237***	0.271***	0.263***	0.244***	0.224***
	(0.062)	(0.053)	(0.058)	(0.091)	(0.047)
ethnic	-0.484***	-0.464***	-0.421***	-0.0275	-0.298***
	(0.13)	(0.12)	(0.13)	(0.20)	(0.10)
reg_eap	0.246***	0.171***	0.193	0.157	0.191***
	(0.076)	(0.060)	(0.15)	(0.19)	(0.070)
lexcon		-0.201***	-0.190***	-0.0212	-0.0837
		(0.057)	(0.062)	(0.13)	(0.060)
netoil		2.461***	2.332***	1.064**	1.632***
		(0.39)	(0.44)	(0.45)	(0.28)
reg_sa			-0.0104		
			(0.17)		
reg_ssa			-0.0198		
			(0.18)		
reg_lac			0.0224		
			(0.15)		
reg_mena			0.0615		
			(0.16)		
Constant	1.843***	1.595***	1.600***	1.234***	2.341***
	(0.35)	(0.28)	(0.34)	(0.46)	(0.24)
Observs	72	72	72	72	72
R-squared	0.53	0.68	0.68	0.21	0.58

Notes:
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
See Appendix 2 for variable description

Table 3: Robustness to other natural resource indicators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
pi_p	-0.149**	-0.139**	-0.146**	-0.151**	-0.153**	-0.142**	-0.151**	-0.161***
	(0.057)	(0.060)	(0.057)	(0.057)	(0.063)	(0.062)	(0.058)	(0.057)
checks	0.0412	0.0361	0.0276	0.0425	0.0420	0.0191	0.0403	0.0413
	(0.044)	(0.046)	(0.042)	(0.044)	(0.043)	(0.039)	(0.043)	(0.043)
ethnic	-0.529***	-0.526***	-0.474***	-0.542***	-0.527***	-0.497***	-0.534***	-0.546***
	(0.15)	(0.15)	(0.16)	(0.16)	(0.15)	(0.14)	(0.16)	(0.16)
lopenwb	0.207***	0.205***	0.183***	0.204***	0.205***	0.254***	0.196***	0.209***
	(0.052)	(0.052)	(0.055)	(0.052)	(0.053)	(0.058)	(0.072)	(0.054)
reg_eap	0.215***	0.230***	0.224***	0.203**	0.220***	0.199**	0.217***	0.239***
	(0.076)	(0.083)	(0.075)	(0.081)	(0.081)	(0.075)	(0.079)	(0.075)
lexcon	-0.160**	-0.152*	-0.140*	-0.155**	-0.154*	-0.174**	-0.161**	-0.160**
	(0.077)	(0.079)	(0.080)	(0.077)	(0.083)	(0.073)	(0.078)	(0.079)
netoil	2.473***	2.109***	2.673***	3.000***	2.665***	3.065***	2.428***	2.450***
	(0.39)	(0.56)	(0.40)	(0.89)	(0.76)	(0.64)	(0.47)	(0.45)
lncap		0.0398						
		(0.044)						
lncs			-0.0480					
			(0.040)					
fuel_exp				-0.155				
				(0.27)				
rent					-0.109			
					(0.43)			
snr						-0.686		
						(0.50)		
sxp							0.0838	
							(0.46)	
rescoff								0.0778
								(0.084)
respoint								0.0449
								(0.074)
Constant	1.898***	1.593***	2.133***	1.921***	1.916***	1.752***	1.933***	1.879***
	(0.27)	(0.44)	(0.34)	(0.27)	(0.30)	(0.30)	(0.34)	(0.28)

Observ	62	62	62	62	62	62	62	62
R-squared	0.68	0.68	0.68	0.68	0.68	0.71	0.68	0.68

Notes:
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
See Appendix 2 for variable description
The dependent variable is the log of average private investment share (lprinv).

Table 4: Robustness to measures of macroeconomic volatility and political instability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
pi_p	-0.168***	-0.173***	-0.161***	-0.169***	-0.164***	-0.166***	-0.162***
	(0.055)	(0.054)	(0.059)	(0.058)	(0.055)	(0.057)	(0.058)
checks	0.0395	0.0480	0.0407	0.0389	0.0309	0.0402	0.0381
	(0.037)	(0.035)	(0.038)	(0.038)	(0.037)	(0.038)	(0.037)
ethnic	-0.495***	-0.489***	-0.504***	-0.496***	-0.510***	-0.501***	-0.483***
	(0.14)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
lopenwb	0.259***	0.259***	0.243***	0.257***	0.268***	0.246***	0.280***
	(0.058)	(0.057)	(0.067)	(0.057)	(0.059)	(0.066)	(0.070)
reg_eap	0.199***	0.194***	0.197***	0.200***	0.214***	0.204***	0.186**
	(0.068)	(0.070)	(0.070)	(0.069)	(0.069)	(0.071)	(0.075)
lexcon	-0.203***	-0.215***	-0.183**	-0.203***	-0.205***	-0.200***	-0.198***
	(0.065)	(0.067)	(0.070)	(0.066)	(0.065)	(0.066)	(0.066)
netoil	2.531***	2.498***	2.592***	2.534***	2.549***	2.525***	2.495***
	(0.39)	(0.40)	(0.42)	(0.40)	(0.39)	(0.40)	(0.40)
grvol		0.0656					
		(0.076)					
vtot			-0.369				
			(0.70)				
vgcons				0.00132			
				(0.017)			
monvol					0.0168		
					(0.025)		
SPI						-0.00971	
						(0.031)	
lconflict							0.0191
							(0.036)
Constant	1.666***	1.840***	1.784***	1.673***	1.596***	1.720***	1.427**
	(0.30)	(0.35)	(0.36)	(0.30)	(0.32)	(0.31)	(0.56)
Observ	65	65	65	65	65	65	65
R-squared	0.68	0.68	0.68	0.68	0.68	0.68	0.68

See notes to Table 3.

Table 5: Robustness to financial development and macroeconomic indicators

	(1)	(2)	(3)	(4)	(5)	(6)
pi_p	-0.157***	-0.150**	-0.169***	-0.159***	-0.166***	-0.161***
	(0.057)	(0.059)	(0.056)	(0.055)	(0.057)	(0.059)
checks	0.0484	0.0188	0.0417	0.0332	0.0324	0.0414
	(0.042)	(0.038)	(0.039)	(0.040)	(0.041)	(0.038)
ethnic	-0.467***	-0.406**	-0.513***	-0.531***	-0.508***	-0.502***
	(0.14)	(0.16)	(0.16)	(0.15)	(0.15)	(0.15)
lopenwb	0.200***	0.229***	0.243***	0.287***	0.268***	0.275***
	(0.064)	(0.056)	(0.069)	(0.064)	(0.069)	(0.066)
reg_eap	0.160*	0.284***	0.187**	0.219***	0.217***	0.177**
	(0.080)	(0.078)	(0.073)	(0.069)	(0.071)	(0.080)
lexcon	-0.142*	-0.175**	-0.188**	-0.205**	-0.214***	-0.221***
	(0.075)	(0.067)	(0.071)	(0.078)	(0.075)	(0.070)
netoil	2.350***	2.028***	2.539***	2.521***	2.516***	2.590***
	(0.43)	(0.50)	(0.39)	(0.38)	(0.44)	(0.42)
Credit	0.354					
	(0.24)					
Lgdp		0.0986*				
		(0.059)				
BMP			-0.0124			
			(0.029)			
dserv				0.00350		
				(0.0032)		
ledt					-0.0108	
					(0.060)	
loverv						-0.0460
						(0.12)
Constant	1.824***	1.043*	1.790***	1.492***	1.682***	1.782***
	(0.29)	(0.52)	(0.39)	(0.34)	(0.32)	(0.53)
Observs	65	65	65	63	63	62
R-squared	0.69	0.69	0.68	0.66	0.65	0.67

Notes: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
See notes for Table 3.

Table 6: Robustness to geographical characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
pi_p	-0.168***	-0.169***	-0.166***	-0.170***	-0.151**	-0.167***	-0.167***
	(0.056)	(0.056)	(0.058)	(0.057)	(0.060)	(0.056)	(0.053)
checks	0.0358	0.0236	0.0417	0.0367	0.0244	0.0254	0.0536
	(0.038)	(0.041)	(0.038)	(0.037)	(0.036)	(0.038)	(0.040)
ethnic	-0.513***	-0.501***	-0.474***	-0.491***	-0.535***	-0.495***	-0.582***
	(0.16)	(0.15)	(0.16)	(0.15)	(0.15)	(0.15)	(0.17)
lopenwb	0.264***	0.247***	0.260***	0.247***	0.360***	0.246***	0.296***
	(0.062)	(0.060)	(0.059)	(0.059)	(0.092)	(0.060)	(0.067)
reg_eap	0.201***	0.218***	0.206***	0.202***	0.143*	0.219***	0.208***
	(0.067)	(0.067)	(0.072)	(0.066)	(0.079)	(0.067)	(0.078)
lexcon	-0.207***	-0.216***	-0.196***	-0.176***	-0.192***	-0.213***	-0.202***
	(0.068)	(0.076)	(0.067)	(0.066)	(0.069)	(0.068)	(0.066)
netoil	2.558***	2.582***	2.515***	2.422***	2.430***	2.587***	2.514***
	(0.38)	(0.39)	(0.40)	(0.42)	(0.40)	(0.39)	(0.36)
lmdist	0.0203						
	(0.069)						
kgptemp		-0.0220					
		(0.13)					
eqdist			0.0894				
			(0.32)				
landlock				-0.0792			
				(0.11)			
ln_FRtrade					-0.114		
					(0.082)		
tropicar						0.00624	
						(0.022)	
lnd100cr							-0.00146
							(0.0011)
Constant	1.488**	1.733***	1.632***	1.763***	1.613***	1.725***	1.597***
	(0.70)	(0.30)	(0.35)	(0.31)	(0.31)	(0.30)	(0.29)
Observs	65	64	65	65	65	64	65
R-squared	0.68	0.68	0.68	0.68	0.69	0.68	0.69

See Notes for Table 3

Table 7: IV Results

Dependent variable:	**Log of private investment share**	
	(1)	(2)
Estimator	**OLS**	**2SLS**
lexcon	-.206	-.304
	(3.43)	(2.33)
lopenwb	.264	.243
	(4.94)	(2.89)
pi_p	-.164	-.146
	(3.15)	(2.64)
checks	.037	.025
	(1.09)	(.68)
ethnic	-.458	-.395
	(3.30)	(2.66)
reg_eap	.179	.157
	(2.97)	(1.99)
netoil	2.49	2.70
	(6.56)	(6.43)
First-stage Results for (2)		
	lexcon	**Lopenwb**
ln_FRtrade	.265	.610
	(4.12)	(9.30)
kgptemp	-.747	-.038
	(4.75)	(.22)
landlock	.321	.061
	(3.04)	(.51)
pi_p	.057	-.067
	(.93)	(.90)
checks	-.128	.069
	(1.79)	(1.69)
ethnic	.192	.211
	(1.26)	(.99)
reg_eap	-.137	.526
	(.79)	(5.21)
netoil	2.278	.794
	(3.09)	(2.35)
First-Stage F-Statistic	12.77 (.000)	31.71 (.000)
Hansen J		0.45
Kleibergen-Paap		0.00
Obs	70	70

NOTES:

The 2SLS results treat the log of the export concentration index (*lexcon*) and log of the trade share in GDP (lopenwb) as endogenous explanatory variables, and use log of the Frankel-Romer natural openness measure (ln_FRtrade), proportion of the population in Koeppen-Geigger temperate zones (kgptemp) and dummy variable for landlocked countries (landlock) as additional instrumental variables.

Numbers reported in parentheses are t-statistics. P-values are reported for the Hansen/Sargan J test of valid over-identifying restrictions, and the Kleibergen-Paap test of under-identification.

Appendix 1: Replicating results from Gylfason and Zoega (2006)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Model	lgdi	lgdi	lgdi	lprinv	lprinv	lprinv	lprinv	lprinv
lncs	-0.155***	-0.0341	-0.0501	-0.262***	-0.0920	-0.0940	-0.0553	
	(0.047)	(0.048)	(0.061)	(0.062)	(0.063)	(0.075)	(0.040)	
lncap	0.223***	0.148**	0.0935	0.291***	0.153**	0.0639		-0.00524
	(0.062)	(0.061)	(0.072)	(0.072)	(0.071)	(0.085)		(0.051)
lgdp	-0.112	-0.0907	-0.118	-0.0281	0.0685	0.0372	0.0889	0.113*
	(0.088)	(0.080)	(0.087)	(0.099)	(0.093)	(0.098)	(0.057)	(0.062)
kkz_av	-0.000252	-0.00145	-0.000408	0.0160	0.0139	0.0151	0.0144	0.0156
	(0.0097)	(0.0084)	(0.0080)	(0.013)	(0.011)	(0.010)	(0.011)	(0.0096)
pi_p		-0.0781*	-0.0900**		-0.124**	-0.137**	-0.146**	-0.145**
		(0.043)	(0.037)		(0.059)	(0.055)	(0.055)	(0.055)
ethnic		-0.330***	-0.344***		-0.324**	-0.340**	-0.347**	-0.376***
		(0.11)	(0.10)		(0.14)	(0.13)	(0.13)	(0.14)
lopenwb		0.230***	0.230***		0.154**	0.179***	0.184***	0.229***
		(0.051)	(0.057)		(0.059)	(0.056)	(0.055)	(0.052)
reg_eap		0.200**	0.135*		0.389***	0.271***	0.290***	0.291***
		(0.088)	(0.073)		(0.096)	(0.090)	(0.087)	(0.072)
lexcon			-0.0499			-0.126	-0.153**	-0.189***
			(0.072)			(0.085)	(0.068)	(0.057)
netoil			1.532***			2.170***	2.360***	2.031***
			(0.43)			(0.57)	(0.53)	(0.55)
Constant	2.521***	2.013***	2.646***	1.108**	0.778	1.483**	1.463**	0.980*
	(0.41)	(0.45)	(0.58)	(0.51)	(0.62)	(0.63)	(0.60)	(0.50)
Observs	69	69	69	69	69	69	69	72
R-squared	0.28	0.54	0.61	0.47	0.63	0.70	0.70	0.70

See notes for Table 2. P-values of the F-Test for joint significance of “lncs” and “lncap” are as follows - Column (3): 0.42; Column (6): 0.39.

Description of Appendix 1

Appendix 1 replicates the basic specification used by Gylfason and Zoega (2006), henceforth GZ, using our sample and variables. Column (1) tries to follow as closely as possible the main specification in GZ. The dependent variable is the log of the average share of gross domestic investment in GDP. The two resource indicators included are the log of natural capital as a share of total wealth (*lncs*) and the log of natural capital per capita (*lncap*). Two other controls are included: the log of initial real GDP per capita (*lgdp*) and the Kaufmann et al. (1999) aggregate governance indicator (kkz_av).[28] The sample consists of 69 countries.

The results in column (1) are in broad conformity with the findings reported in GZ (2006). The natural wealth share (*lncs*) has a significant negative coefficient and the natural capital share (*lncap*) has a significant positive coefficient. These coefficients are similar in absolute value, suggesting that these investment shares are explained by the log of total wealth per capita, rather than the natural capital terms in the numerator of these ratios.[29] Like GZ, we do not obtain a significant effect of the institutional indicator (kkz, in our case). Next, in column (2), we add all the main explanatory variables that we have emphasized in our paper, except the natural resource/trade structure indicators. These are the relative price of capital, ethnic fractionalization, trade openness and the East Asia and Pacific dummy variable. As is clear from column (2), these variables are all significant in explaining total investment shares. With the inclusion of these variables, the natural wealth share (*lncs*) loses statistical significance.

Our two preferred natural resource indicators, *lexcon* and *netoil*, are added in column (3). As expected, the coefficient on netoil is positive and statistically significant. The coefficient on lexcon is negative although not significant at conventional levels. However, with the addition of these resource indicators, both *lncs* and *lncap* become unimportant.

Columns (4)–(6) repeat this exercise for models of the log of private investment as a share of GDP. The results follow a similar pattern. The inclusion of *netoil* and *lexcon*, together with our main control variables, again leaves the coefficients on *lncs* and *lncap* individually and jointly insignificant. The net oil exports variable has a strong positive effect on private investment in all specifications. Export concentration is found to have a significant negative effect if we drop the insignificant *lncap* measure in column (7) or the insignificant *lncs* variable in column (8).

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[28] Gylfason and Zoega include the civil liberties index. We include a closely correlated and a stronger indicator, the aggregate governance index. The aggregate governance index also has a better sample coverage.

[29] The model has the form $y = \alpha_1(\ln NC - \ln POP) - \alpha_2(\ln NC - \ln TW) + X\beta + \varepsilon$, where y denotes the dependent variable, NC denotes natural capital, TW denotes total wealth, POP denotes population and the vector X contains the remaining explanatory variables. Imposing the restriction that $\alpha_1 = \alpha_2 = \alpha$, this simplifies to $y = \alpha(\ln TW - \ln POP) + X\beta + \varepsilon$.

Appendix 2: Description of main variables

Variable	Description	Source
BMP	Log of 1 plus black market premium	GDN database
checks	Checks and balances (checks2a), Database of Political Institutions	Beck et al. (2001)
Credit	Credit to the private sector by banks and other financial institutions (series: pcrof), share of GDP	Financial structure database, Beck et al. (2000)
dserv	Total debt service as a ratio of exports of goods, services and income	World Development Indicators
eqdist	Latitude – distance from equator	http://www.cid.harvard.edu
ethnic	Ethnic fractionalization index	Alesina et al. (2003)
export categories	Dummy for fuel, non-fuel primary, and manufactured good exporting countries	World Bank – GDN Database
grvol	Standard deviation the of growth of real GDP per capita	Penn World Tables, release 6.2
kgptemp	Proportion of people in the Koeppen-Geigger temperate zone	CID, Harvard University. Gallup et al. (1999).
kkz_av	Average of six measures of institutional development institutional: voice and accountability, political stability and absence of violence, government effectiveness, light regulatory burden, rule of law, and freedom from graft	Kaufmann et al. (1999)
landlock	Dummy for landlocked country, excluding countries in Western and Central Europe	Gallup et al. (1999).
lconflict	Log of the conflict index, which is a weighted measure of the number of riots, coups, assassinations, general strikes, government crises, purges, revolutions, anti-government demonstrations, and instances of guerrilla warfare.	Arthur Banks Cross-National Time Series Database
ledt	Total external debt as a % of GNI, in natural log	World Development Indicators
lexcon	Natural log of the export concentration index – a modified version of the Herfindahl-Hirschmann index.	UNCTAD Handbook of Statistics
lgdp	Log of the real GDP per capita in 1970	Penn World Tables, release 6.2
lmdist	Log of minimum distance from three main markets: Belgium, Japan or New York.	Radelet and Sachs (1998)
ln_FRtrade	Natural log of the Frankel-Romer measure of natural openness.	Frankel and Romer (1998)
lncap	Log of natural wealth per capita	World Bank (2006)
lncs	Log of the share of natural wealth in total wealth	World Bank (2006)
lnd100cr	The proportion of a country's total area within 100km of the ocean or ocean navigable river	Gallup et al. (1999).
lopenwb	Log of the share of exports plus imports to GDP	World Development Indicators
loverv	Log of the overvaluation index	Dollar (1992); GDN database
lpbinv	log of the ratio of public investment to GDP	GDN database
lprinv	Log of the average share of private investment in GDP	Global Development Network (GDN) database
monvol	S. D. of the residuals of the AR(1) process of the M1 to GDP series	World Development Indicators
netoil	Share of the net oil exports in GDP	Herb (2005)
pci	Political Constraints Index is a structurally derived measure of the feasibility of policy change (the extent to which a change in the preferences of any one actor may lead to a change in government policy).	Henisz (2001), 2002 release.

pi_p	The ratio of price of investment to the price of GDP	Penn World Tables, release 6.2
rent	Ratio of revenues from petroleum and minerals to total government revenues	Herb (2005)
rescoff	Dummy variable for countries with coffee and cocoa resources	Isham et al. (2005)
respoint	Dummy variable for countries with point-source resources: fuels, minerals and plantation crops	Isham et al. (2005)
snr	The share of mineral production in GDP for 1971	Center for International Development at Harvard University (CID), 2002.
SPI	Index of socio-political instability; principal components of	Arthur Banks Cross-National Time Series Database
sxp	Share of primary commodity exports in GDP	Collier and Hoeffler (2004)
tropicar	Percentage area in the tropics	Gallup et al. (1999)
vgcons	S.D. of the ratio of government consumption to GDP	World Development Indicators
vtot	S.D. of the first log-differences of the terms of trade index for goods and services	GDF & World Development Indicators
xconst	Average Constraints on the executive	POLITY IV dataset by Robert Gurr

Dummy variables included for:

reg_eap	East Asia and Pacific
reg_mena	Middle East and North Africa
reg_sa	South Asia
reg_lac	Latin America and Caribbean
reg_ssa	Sub-Saharan Africa

Source: GDN database

Appendix 3: List of 72 countries included in the sample

code	country	code	country
DZA	Algeria	LBR	Liberia
ARG	Argentina	MDG	Madagascar
BGD	Bangladesh	MWI	Malawi
BEN	Benin	MYS	Malaysia
BOL	Bolivia	MLI	Mali
BRA	Brazil	MRT	Mauritania
CMR	Cameroon	MUS	Mauritius
CAF	Central African Republic	MEX	Mexico
CHL	Chile	MAR	Morocco
CHN	China	NPL	Nepal
COL	Colombia	NIC	Nicaragua
COM	Comoros	NER	Niger
CRI	Costa Rica	PAK	Pakistan
CIV	Cote d'Ivoire	PAN	Panama
CYP	Cyprus	PNG	Papua New Guinea
DOM	Dominican Republic	PRY	Paraguay
ECU	Ecuador	PER	Peru
EGY	Egypt, Arab Rep.	PHL	Philippines
SLV	El Salvador	PRT	Portugal
ETH	Ethiopia	RWA	Rwanda
GAB	Gabon	SEN	Senegal
GMB	Gambia, The	SLE	Sierra Leone
GHA	Ghana	ZAF	South Africa
GTM	Guatemala	LKA	Sri Lanka
GIN	Guinea	SDN	Sudan
GNB	Guinea-Bissau	TZA	Tanzania
GUY	Guyana	THA	Thailand
HTI	Haiti	TGO	Togo
HND	Honduras	TTO	Trinidad and Tobago
IND	India	TUN	Tunisia
IDN	Indonesia	TUR	Turkey
IRN	Iran, Islamic Rep.	UGA	Uganda
JAM	Jamaica	URY	Uruguay
JOR	Jordan	VEN	Venezuela, RB
KEN	Kenya	ZMB	Zambia
KOR	Korea, Rep.	ZWE	Zimbabwe