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Abstract. Sachs and Warner (1995) found a negative relationship between natural resources and economic growth, concluding that natural resources are a curse. This explanation for poor economic growth is now widely accepted. We provide an alternative econometric framework for evaluating the resource curse. We focus on resource rents and rent-seeking behaviour, arguing that rent seeking affects corruption and that, in turn, impacts wellbeing. Our measure of wellbeing is the Human Development Index, although we find similar results for per capita GDP. While resource abundance does not directly impact economic development, we find that natural resources are associated with rent seeking that negatively affects wellbeing, with results robust to various model specifications and sensitivity analyses.

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Corruption, Development and the Curse of Natural Resources

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Abstract. Sachs and Warner (1995) found a negative relationship between natural resources and economic growth, concluding that natural resources are a curse. This explanation for poor economic growth is now widely accepted. We provide an alternative econometric framework for evaluating the resource curse. We focus on resource rents and rent-seeking behaviour, arguing that rent seeking affects corruption and that, in turn, impacts wellbeing. Our measure of wellbeing is the Human Development Index, although we find similar results for per capita GDP. While resource abundance does not directly impact economic development, we find that natural resources are associated with rent seeking that negatively affects wellbeing, with results robust to various model specifications and sensitivity analyses.

Résumé. Sachs et Warner (1995) ont trouvé une relation négative entre les ressources naturelles et la croissance économique; la conclusion c'est que les ressources naturelles sont une malédiction. Cette explication de la faible croissance économique est maintenant largement acceptée. Nous offrons un cadre alternatif économétriques pour l'évaluation de la malédiction des ressources. Nous nous concentrons sur les rentes de ressources et de recherche de rente, en faisant valoir que la corruption affecte la recherche de rente et, à son tour, les effets de bien-être. Notre mesure du bien-être est l'indice de développement humain, même si nous trouvons des résultats similaires pour le PIB par habitant. Bien que l'abondance des ressources ne touchent pas directement le développement économique, nous constatons que les ressources naturelles sont associées à la recherche de rente qui affecte négativement le bien-être, avec des résultats robustes aux spécifications des différents modèles et des analyses de sensibilité.

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Introduction

There are many cases in history where natural resources have played an important role in economic development. Among other reasons, Britain and France gained economic prosperity more than a century ago by exploiting their colonies' natural resources. During the 1800s, land was important, and land abundant countries such as Canada, the US and Australia had some of the highest real wages. Britain, Germany and the US relied heavily on coal and iron ore deposits during their industrialization (Sachs and Warner, 1995), and some developed countries such as Canada and Norway continue to rely on natural resources as economic drivers. However, history also tells us that natural resource abundance is not required for prosperity. Switzerland, Hong Kong, Singapore, South Korea and Taiwan have all achieved high per capita incomes despite a relative scarcity of natural resources. Nor does natural resource abundance guarantee economic prosperity. South Africa and Venezuela possess abundant natural resources but neither enjoys a high standard of living, being plagued by corruption, civil unrest and income inequality.

The cursory evidence provided by these examples suggests that natural resources are not a necessary nor sufficient condition for economic development. However, Sachs and Warner (1995) found a negative relationship between natural resources and economic growth, and many economists accepted that natural resources might be an obstacle to economic development (for example, Papyrakis and Gerlagh, 2004). But not everyone agrees. There is contradictory evidence that suggests natural resource abundance might not hinder economic outcomes (for example, Sala-i-Martin and Subramanian, 2003).

We evaluate whether natural resources are a curse or a blessing using a framework that differs somewhat from other research. Our findings are similar to those of Brunnschweiler and Bulte (2008) and others who have critiqued the existence of a resource curse; they also support Barbier (2003), for instance, who argues that corruption is a greater impediment to economic development. The contribution of our paper is threefold: First, we point out that there is much confusion about how one measures resources and their impact on development. We provide consistent economic measures of resources that are related to resource rents, thereby separating resources into agriculture, forestry, petroleum and other resources. Second, we link our resource measures to corruption and economic development, finding not only that corruption is an impediment to development but that natural resources might even contribute to corruption. Finally, we examine the Human Development Index (HDI) as an alternative measure of wellbeing to Gross Domestic Product (GDP).

We begin by reviewing the extant literature, followed by possible explanations for the existence of the curse. We then provide a theoretical discussion on correct specification of the resource curse, our empirical model for evaluating the validity of the resource curse hypothesis, and our findings. We follow with an exploration of the robustness of our results, ending with some concluding remarks.

Evidence For and Against the 'Curse' and Possible Explanations

International evidence

In the resource curse literature, the most commonly cited work is by Sachs and Warner (hereafter S&W) (1995; also 1997, 2001), who found a negative relationship between share of primary exports in GDP and economic growth using cross country regressions. However, the mechanism through which the resource curse operates is unclear. For instance, S&W's measure of 'abundance' (share of primary exports in GDP) can better be interpreted as a measure of 'dependence' (the degree to which the economy depends on natural resources for its economic livelihood). S&W's (1995) results are robust to alternative measures of so-called resource abundance (see, for example, Sala-i-Martin et al. 2003). Yet, two of the alternative measures investigated (share of mineral production in GDP and fraction of primary exports in total exports) are similar to the original measure in that they really capture dependence, not abundance. A third specification (land area per person) does constitute a measure of abundance, but, since not all land is the same, it is a very imprecise measure of primary sector productivity.

Additional support for the resource curse hypothesis is found in Naidoo (2004), who measures extraction of forest resources using forest area cleared. Again, this measure may really reflect the degree of dependence on natural resources. Countries that cleared a large proportion of their forests may have done so out of necessity, because of poverty or population pressure (van Kooten and Folmer, 2004:439-40). Naidoo controls for the absolute size of a country (to distinguish large, resource poor countries from small, resource rich ones), but fails to control for the impact of population when measuring abundance.

Sala-i-Martin and Subramanian (2003) find that, upon controlling for institutional quality, natural resources are not significantly related to economic growth, with the effect dependent on the particular natural resources being considered. Fuel and mineral resources negatively impact institutions (and hence growth), but the impact of other types of resources on economic growth is generally insignificant. This suggests that the curse of natural resources may really be a curse of particular natural resources.

Papyrakis and Gerlagh (2004) concur. After controlling for corruption, investment, openness of the economy, terms of trade and schooling, they find natural resources have a positive impact on growth. Focusing on such additional factors may hold the key to the mystery of the resource curse. However, their metric for abundance (share of mineral production in GDP) measures resource intensity rather than abundance. As shown by Sala-i-Martin and Subramanian (2003), abundance of mineral and fuel resources may not yield the same economic outcome as abundance of other natural resources.

Manzano and Rigobon (2001) build on S&W's model using panel data and alternative measures of the non-resource side of the economy. Interestingly, in every case, the negative impact of the resource curse appears in their cross-sectional work, but is insignificant with a fixed-effects panel model.

Explanations for a resource curse

There are six candidate explanations for the natural resource curse. (1) The Dutch disease phenomenon historically described an appreciation in a country's real exchange rate from a rise in the value of natural resource exports, making international competition more difficult. This occurs if export commodity prices rise rapidly or exports increase perhaps because new resources are discovered (as was the case in the Netherlands with the discovery of natural gas in the late 1950s). More recent variants of this explanation place less emphasis on exchange rate movements and more on factors, such as government policies and market distortions, that encourage growth of the primary sector at the expense of manufacturing (Barbier, 2003; Papyrakis and Gerlagh, 2004).

(2) Barbier (2003) points out that "any depreciation of natural resources must be offset by investment in other productive assets" (p.263). However, he finds that in many developing countries resource rents are not channelled into productive investments, but are dissipated through corruption, bureaucratic inefficiency and policies aimed at rent-seeking interest groups. A major focus of the current research is on links between natural resources and rent-seeking behaviour.

(3) Countries with abundant natural resources may invest less in human capital, with some evidence that public spending on education is negatively related to resource abundance (Gylfason, 2001).

(4) Gylfason (2001, 2002) also considers how abundance of natural resources reduces incentives to save and invest, limiting physical capital formation and economic growth. The demand for capital falls as owners of capital earn a higher share of output, thus lowering real interest rates and reducing investment.

(5) Recent work examines links between civil war and resource rents, as the latter provide income for corrupt governments and make it more desirable to hold political power. Further, existence of resource rents provides an incentive to overthrow the government, while natural resource abundance creates opportunities for looting and extortion, providing insurgents with financial means for rebellion (Collier and Hoeffler, 2004; Lujala et al., 2005). For example, Collier and Hoeffler (2004) find that the share of oil exports in GDP is a significant predictor of conflict, and Fearon (2005) and Lujala et al. (2005) find positive links between secondary diamond production and the incidence of civil war. Clearly, resource characteristics and their ability to generate rents must be examined when investigating the resource curse.

(6) Finally, although S&W (2001) claim that the curse exists independent of commodity prices, others believe it is a result of commodity price volatility. For example, Manzano and Rigobon (2001) argue that high commodity prices in the 1970s encouraged resource-abundant developing countries to borrow heavily. When prices dropped, these countries faced a large debt burden and a lower stream of resource rents to service this debt. The resource curse disappears once this 'debt-overhang' problem is taken into account. Further, Collier and Goderis (2007) show that commodity booms have positive short-term effects on output but may have adverse long-run effects.

Canadian evidence

While Canada is only one country in our study and essentially appears to be unaffected by the resource curse (in our case oil and gas), there are two important aspects. First, using province and state-level data for Canada and the US, Olayele (2010) finds some evidence indicating that production of minerals (including oil and gas) leads to lower GDP. Second, the Canadian dollar has appreciated as a result of increased exports of oil and gas from Alberta, mainly related to oil sands development. While Macdonald (2007) finds no evidence of a 'Dutch disease' phenomenon, he does find that employment in the resource and service sectors has increased, while manufacturing employment has fallen; there has been an increase in inter-provincial migration; and, as a result of the rising Canadian dollar, Canadian consumers have benefitted as their purchasing power has increased as terms of trade have improved.

Defining the "Curse of Natural Resources"

While the resource curse implies a negative relationship between natural resources and wellbeing, one might ask how this relationship is defined. Natural resource *dependence* might result in low levels of wellbeing (however wellbeing is interpreted), or it might inhibit economic growth of total or per capita GDP. Alternatively, *abundance* of natural resources might lead to low wellbeing or inhibit growth. Each of these relationships might operate through any one of the six transmission mechanisms described above. While natural resources might affect economic growth rates, a country with slow economic growth but a relatively high standard of living cannot be considered cursed. Therefore, the most relevant research question should relate to levels of wellbeing and not to economic growth rates (see Bulte et al., 2005).

More importantly, using economic growth to address the resource curse hypothesis may result in spurious correlation between economic growth and natural resources. Suppose abundance of natural resources is good for economic development. As countries experience rising income levels, they tend to find that their economic growth rates decline – developed countries typically grow at relatively low, stable rates. Furthermore, slow stable growth may be desirable (to mitigate inflation, say). If natural resource abundance is good for economic development, most resource abundant countries will be developed nations experiencing relatively slow but stable economic growth. In contrast, resource poor countries will tend to be less developed and may experience more volatile economic growth rates. Hence, spurious correlation may arise from regressing economic growth rates on abundance of natural resources.

While natural resource dependence might prevent countries from achieving a high standard of living, dependence on agricultural products can be accounted for by structural change theories of development. These suggest that development occurs as economies transition away from subsistence agriculture toward industrially diverse manufacturing and service sectors (Lewis 1954), thereby improving a country's total productivity. Countries that do not make this structural transformation are unlikely to have the means to achieve higher productivity and increased standards of living.

The concept of 'value-added' can also explain how resource dependence might inhibit economic development. As activities in the secondary and tertiary sectors of the economy tend to add more value than those in the primary sector, economies with large secondary and tertiary sectors support higher standards of living. Economies with large primary sectors (high dependence on natural resources as a source of income) do not fare as well. Virtually every country that has experienced rapid productivity gains in the past two centuries has done so by industrializing (Murphy et al., 1989). Then the natural resource curse seems to be a certainty, and researching it would not provide particularly novel insights.

Measuring Resource Abundance

Clearly, we need a proper measure of resource abundance. Gylfason (2002) identifies three possibilities: the share of (1) primary exports in total exports or in GDP; (2) employment in primary production; and (3) natural capital in national wealth. Each fails to capture the true notion of resource abundance, as we should think in absolute terms. For example, we could consider the absolute size of a country's inventory of natural resources or natural resources per capita. We should not consider the size of its primary sector relative to the non-primary ones. Resource production as a share of total goods and services production, employment in the natural resource industry compared to other industries, or the value of natural resources compared to the value of all other assets can more accurately be described as measuring the relative degree of resource dependence. The problem is that countries can have abundant natural resources (in terms of available resources per capita) and not have resources make up a large share of exports, employment or wealth. As a country develops other sectors of its economy, the share of natural resources in exports, employment and wealth should fall. Thus, it is important to distinguish between measuring natural resource abundance in relative terms and absolute terms.

Of Gylfason's measures, the first appears to be most common. In their influential paper, S&W (1995) measure natural resource abundance using the ratio of primary product exports to GDP, which leads to endogeneity problems, however. Suppose that the secondary and tertiary sectors grow faster than the primary sector, so that the share of primary exports in GDP declines over time, even if the primary sector contributes positively to economic growth. Thus, economic growth is correlated with a declining share of primary exports in GDP, leading to the conclusion that the primary sector is negatively related to growth. Nonetheless, as long as the primary sector is growing, it is actually contributing positively to growth. This is where the distinction between natural resource abundance and natural resource dependence becomes clear. Natural resource abundance may lead to positive growth, but if this comes at the expense of the secondary and tertiary sectors, this natural resource dependence may decrease the overall rate of economic growth.

Others have also noted problems associated with measuring resource abundance by the share of primary commodity exports to GDP (Lujala et al., 2005; de Soysa, 2002). De Soysa (2002) uses available natural resources per capita as his metric, which is similar to ours. We estimate available resource rents using per capita measures of resource exports and production. The transformation into per capita terms is crucial in determining the extent to which resource rents have the potential to increase average living standards. If resource exports and/or production were measured in aggregate terms, then large countries with large populations would appear resource rich, when, in fact, the potential for resource rents to impact overall standards of living could be quite small. Similarly, small countries with modest populations would appear resource poor, even if the available natural resources per capita were substantial.

Here we consider only natural resources that are openly traded in the global market economy, namely, agricultural output (for example, grain, coffee, beef), forest products (for example, pulp, lumber), fuel (coal, natural gas, crude oil), and ores and metals (for example, gold, diamonds). Early studies treated all natural resources as relatively homogenous, whereas more recent studies indicate the importance of delineating resources (Sala-i-Martin and Subramanian, 2003; Collier and Hoeffler, 2004).

Measuring Wellbeing

How should we specify wellbeing? Development is best viewed as a multi-faceted goal that can only be achieved holistically by increasing material, physical and psychological wellbeing. The common metrics include per capita GDP, the Gini coefficient (a measure of income inequality), infant mortality rates, life expectancy, literacy rates, and rates of enrolment in primary education. To address the resource curse hypothesis properly, therefore, the dependent variable needs to capture this multi-dimensional aspect. A popular development index is the United Nations' Human Development Index (HDI), which equally weights income levels, health and education. We employ both the HDI and GDP per capita to measure average standards of living. Although neither of these measures directly account for the distribution of income, the availability of data measuring income inequality is limited.

Framework for Evaluating the Natural Resource Curse

We begin by considering natural resource rents, which equal the sum of scarcity rents plus differential (or Ricardian) rents (van Kooten and Folmer, 2004: 41-4). Differential rent refers to the excess of the market value of non-marginal units of in situ resources, essentially the area above the all factors variable resource supply curve and below the cost of providing the marginal unit. Scarcity rent is then the difference between output price and the marginal cost of providing the last (marginal) unit multiplied by total output, and arises from the natural or policy-induced scarcity of a resource.

Agriculture is unlikely to result in significant resource rents (with some exceptions), because it requires inputs of labour and capital each year to extract rent, and rent is mainly of a Ricardian nature. There is a risk that output prices fall between the time of planting and harvest, or that adverse weather leads to low yields or crop failure. Further, while agricultural surplus can be a driver of economic development, rents in agriculture are generally too small and/or spread over too many landowners to attract the attention of rent seekers. Thus, it is not surprising that the resource curse literature finds that "the inclusion or exclusion of agriculture does not much alter the basic results" (S&W, 2001: 831).

Forest resources potentially offer more valuable surplus to rent seekers than agriculture generally. Large forest rents are feasible on some sites of mature standing timber, although they are much smaller if the costs of tree planting and waiting for trees to mature are properly taken into account, as with plantation forests. In many regions deforestation occurs because, after rents are captured through harvest, the land is more valuable in agriculture than growing trees. In some countries, forest lands are publicly owned with governments having some success in collecting related rents. Nonetheless, there are situations where illegal logging is rampant because of the lucrative windfalls (for example, Ukraine, Malaysia, Indonesia). In the resource curse literature, forestry is generally included with other resources, ignored entirely, or incorrectly treated because no distinction is made between natural forests that can generate large rents upon being logged and plantation forests that support processing and manufacturing activities.

The extraction of fossil fuels (especially crude oil), uranium, copper, and other valuable metals (especially diamonds and gold) has much greater potential for rent-seeking behaviour. As such activities are spatially more concentrated than in the case of forestry and agriculture, they generate higher rents that are generally easier to capture. Without property rights, enforcement of property rights and independent courts, rent seeking leads to lawlessness and corruption to the detriment of the economy (De Soto, 2000). Resource rents are dissipated in various ways, including bribery, spending on militias to protect beneficiaries from other rent seekers, wealth transfers to private overseas bank accounts and so on. The point is: The existence of resource rents encourages rent seeking, corruption and behaviours that are ultimately detrimental to economic growth and development (Ades and Di Tella, 1999). Natural resources are not a curse, government failure is the problem, with governments not defining and enforcing property rights, nor protecting citizens from theft that is commonly carried out by agents of government. The resource curse literature often hints at this, but fails to expand formally on it.[1]

If social institutions such as civil law and property rights exist, rent seeking and corruption may not occur to the same degree. However, the relationship between rent seeking and corruption and institutional quality is bi-directional. While well developed institutions may reduce corruption, corruption may also reduce the quality of institutions.

Model Specifications

Our framework is a two-equation, fixed-effects system, where for i=1,…,N and t=1,…,T_i:

$$y_{it} = \alpha_y + u_{yi} + \delta_{yt} + \sum_{k=1}^{K_y} \beta_{yk} x_{kit} + \sum_{m=1}^{M_y} \gamma_{ym} z_{mi} + \varepsilon_{1it} \quad (1)$$

$$c_{it} = \alpha_c + u_{ci} + \sum_{k=1}^{K_c} \beta_{ck} x_{kit} + \sum_{m=1}^{M_c} \gamma_{cm} z_{mi} + \varepsilon_{2it} \quad (2)$$

Here y_{it} is a metric of wellbeing (HDI or per capita GDP) of country i in period t and c_{it} is control of corruption; the first equation examines wellbeing while the second models corruption. The regressors consist of time-varying and country-varying variables (x's), and time-invariant but country-varying regressors (z's). A key x variable in the wellbeing equation is control of corruption, while GDP per capita is a factor in the control of corruption equation; this may lead to endogeneity, an issue discussed below.

We use an unbalanced panel with observations on countries for different time periods; the total number of observations is $n = \sum_{i=1}^{N} T_i$. Regressors were chosen on the basis of theory, evidence from the literature, data availability and preliminary data analysis (see below). The parameters β_{yk}, β_{ck}, γ_{ym} and γ_{cm} are assumed not to vary by country or time period, and the errors, ε_{1it} and ε_{2it} are assumed to have zero means with possible country-specific heteroskedasticity and period-specific serial correlation.

We model wellbeing with period effects δ_{yt}, but not so the control of corruption equation.[2] Both equations include country effects, however, that allow for unobserved country-specific heterogeneity in addition to country-specific, time-invariant variables; that is, the total country fixed effects are: $\mu_{it} = \alpha_j + u_{ji} + \sum_{m=1}^{M_j} \gamma_{cm} z_{mi}$ j=y,c; i=1,…, N.

Estimation Issues

We cannot estimate (1) and (2) using traditional fixed-effects estimation because the standard within-estimator or first-difference estimator eliminates the country-effects, not enabling simultaneous estimation of the time-invariant regressor coefficients, γ_{jm}, and remaining unspecified country-effect terms u_{jt}. Instead, we employ Plümper and Troeger's (2007) *fixed-effects vector decomposition* (FEVD), three-step procedure. Briefly, the first stage involves a within-transformation to estimate the β parameters, which are then used to estimate the total country effects μ. A second stage regression provides estimates of the u's, the country-specific unexplained heterogeneity terms, which are then incorporated back into the original regression. The original equation, with the fitted u's incorporated as the unexplained effects, is then estimated by pooled OLS, thus enabling the γ's and β's to be estimated simultaneously.[3] This procedure enables inclusion of time-invariant regressors in the model, along with remaining unexplained country-specific heterogeneity.[4] Substantial gains in precision occur when important country-specific variables are included in the models, along with unexplained, unobserved country effects.

Endogeneity is a possible issue because control of corruption explains wellbeing and per capita GDP is an explanatory factor for control of corruption. To allow for this simultaneity bias, we adopt an approach analogous to two-stage least squares (2SLS). We use the FEVD method to obtain fitted values for control of corruption and per capita GDP by regressing these variables on all exogenous factors. These predictions, by construction uncorrelated with the relevant errors, are then used in (1) and (2) rather than the original, possibly endogenous, explanatory factors. We call this two-stage FEVD (2SFEVD).

Empirical Results

Data and Summary Statistics

Our data are compiled from various sources, with most data directly or indirectly sourced from the World Bank. Detailed definitions of the variables and data sources are provided in Appendix A. We have 362 (=*n*) observations covering 101 (=*N*) countries at possibly four points in time – 1998, 2000, 2002 and 2004.[5] Appendix B contains a list of countries and some descriptive statistics for the variables are provided in Table 1. Monetary values are in constant 2000 US$.

INSERT TABLE 1 ABOUT HERE

As a dependent variable in equation (1), we employ the HDI, a weighted index comprised of income (measured by purchasing power parity GDP per capita), health (measured by life expectancy at birth), and education (measured by adult literacy and gross school enrolment rate). We also provide results using per capita GDP in order to better place our analysis in the existing literature. As to regressors in equation (1), S&W (2001) include investment and degree of openness in their cross-country regressions, and we expect these to also influence cross-country differences in levels of income and wellbeing.

The number of languages in a country could negatively impact both the income and education components of the HDI. More languages may make it more difficult to conduct business (higher transaction costs), and income may be adversely affected. Also, greater diversity of languages makes it harder for governments to deliver educational services, and the education indicators may also be affected. Control of corruption is included in equation (1) because, as discussed above, it is through rent seeking and corruption that natural resources may lower overall levels of wellbeing.

Finally, latitude is used to capture other unobservable cross-country differences, such as geography and climate. It may also be a strong indicator of other important but otherwise unobservable differences across countries. Theil and Galvez (1995) show that differences in latitude can explain up to 70 per cent of the variation in cross-country levels of income. Brunnschweiler and Bulte (2008) use latitude as an instrument for institutional quality. In our data, a scatter plot (available on request) shows clearly that countries farther from the equator (whether north or south) tend to have higher overall standards of living.

In the control of corruption equation (2), exports and production of resources per capita are used as proxies for resource rents. Potential rents from petroleum resources, and ores and metals, are in terms of dollar exports per capita, while those from forest resources are measured by the per capita volume of forestry production (measured in cubic meters). To interpret the resulting coefficients on resource rents, per capita GDP is included; otherwise the values of the resource variables would be a simple indicator of a country's level of income, which is highly correlated with control of corruption.

The control of corruption equation also includes indicators of regulatory quality, ethnic diversity and recent civil war. As corruption is influenced by political competition (Montinola and Jackman, 2002), we also include a qualitative regime variable that measures the relative democracy or autocracy of a country at a given point in time (Center for Systematic Peace, 2009). Regulatory quality indicates the quality of institutions, which may be important in mitigating the effect of resource rents on corruption activities. If the resource curse does exist, countries with well-developed institutions should be able to overcome it.

We also include the country's largest ethnic group as a share of total population. In general, where this group constitutes a smaller proportion of the population, there is more likely to be sizeable secondary and other ethnic groups, which may lead to tensions and a greater risk of internal conflict. Such conflict can lead to rent seeking and corruption as different groups strive for power. Further, if there is civil war, looting of natural resources may be more prevalent, increasing opportunities for bribery and corruption.

Regression Results

As a validity test and before estimating our model, we explore how well our data replicate those of S&W (1995, Equation 1.4, Table 1: 24). The dependent variable is the growth rate of real GDP per capita between 1998 and 2004. Following S&W, we included estimates of initial income, investment, openness and rule of law. Investment, openness and rule of law were measured in the same manner as in our core model. The share of natural resource exports in GDP was derived from the shares of agricultural, fuel, and ores and metals exports in total merchandise exports. With the exception of initial income, the average value of each variable was for the period 1998–2004.

S&W also measure openness and investment as averages over time. They measure openness by the fraction of years during the period that the country met certain 'openness' criteria, and they measure investment by the average investment to GDP ratio. One noticeable difference is that S&W measure natural resource abundance as the share of primary exports in GDP at the start of the time period, while we chose to average the share of natural resources in GDP over time. The reason is that S&W consider a relatively long time horizon (1970-1989), while we consider a period of only seven years (1998-2004). We used the average share of natural resource exports in GDP to minimize the possibility of getting erratic data for a particular country, such as might result from an exogenous weather shock.

S&W (1995) include 62 countries, but they do not indicate which ones; however, S&W (1997) do discuss a number of African countries that are missing from their analysis and make reasonable predictions of growth for those missing countries. With the exception of Mauritius and Togo, the same countries are missing from our data as well. As discussed in Appendix B, our data include 88 countries that represent a wide range of economies. Consistent with S&W, we do not allow for individual country effects. The estimation results are provided in Table 2.[6] Results confirm our prior expectations: consistent with economic theory, the sign on initial income is negative and the signs on investment, openness and rule of law are positive. Note that we are unable to reproduce S&W's finding regarding the natural resource curse – the coefficient on natural resource dependence is insignificant. For comparison, S&W's (1995) results are also provided in Table 2. Their general conclusion regarding the resource curse does not appear to be robust. We investigate this further using our two-equation model.

INSERT TABLE 2 ABOUT HERE

Our 2SFEVD regression results are provided in Table 3. Hypothesis testing revealed that period effects are jointly insignificant in the corruption equation, but statistically significant in the wellbeing (HDI or per capita GDP) equation. Accordingly, we report results with fixed period effects in the wellbeing equation but not in the control of corruption equation.

INSERT TABLE 3 ABOUT HERE

Discussion

We first examine the results with wellbeing measured by the HDI. The log of investment per capita has a positive partial effect on HDI, and the coefficient on the openness variable also has the expected positive sign, indicating that more open countries have higher standards of living; both outcomes accord with S&W. The impact of number of languages was negative, confirming the expectation that an increase in number of languages is associated with decreased levels of income and education, and also lower HDI. The coefficient on latitude was positive, implying that countries farther away from the equator tend to have higher standards of living. Control of corruption was positively associated with the HDI, suggesting that more corrupt countries tend to have lower levels of wellbeing. This finding confirms the first part of the transmission mechanism through which we expect the resource curse (if it exists) to operate.

In comparison to the HDI results, when the dependent variable is per capita GDP, openness has an unexpected effect. In the control of corruption equation, the coefficients on ores and metals exports and fuel exports are negative, while the coefficient on forestry production per capita is positive, implying that different types of resource rents affect control of corruption differently. Regulatory quality is positively associated with control of corruption, indicating that, even if resources are a curse, improved institutional quality can help overcome this obstacle. Countries with better institutions tend to have more control over corruption and rent seeking. Finally, countries with a larger share of their population accounted for by the largest ethnic group (less ethnic diversity) experienced less corruption; countries that experienced civil war and less democracy had more corruption. As expected, increased ethnic diversity and civil war provide opportunities for rent seeking and corruption as different groups try to gain political power. Our results also support previous research that greater democracy leads to less corruption. Overall, we find that rents from natural resources (fuel and ores and metals) are an important part of the resource curse.

To determine the relative importance of our explanatory variables with HDI as the measure of standard of living, we report standardized regression (beta) coefficients in Table 3, as do Bulte et al. (2005). These are computed by multiplying each coefficient estimate from the core model (Table 3) by each variable's standard deviation (Table 1), and then dividing by the standard deviation of the associated dependent variable. Beta coefficients measure the magnitude of each variable in terms of standard deviations, providing one way of ascertaining the relative contribution of the variable to the prediction of the dependent variable. For example, a one standard deviation increase in numbers of languages is associated with a 0.21 standard deviations decrease in the HDI, ceteris paribus. We see that control of corruption has a greater influence over a country's level of wellbeing than investment or openness.

In the control of corruption equation, the regime, ethnic and civil war variables exert the greatest influence on the dependent variable. Although smaller, the beta coefficients on the resource variables are not trivial. Bulte et al. (2005) estimated the impact of point resources

(resources concentrated in a narrow geographic region, including oil, minerals and plantations) on two measures of institutional quality – rule of law and government effectiveness. In the rule of law equation, they obtained a beta coefficient of -0.21 on point resources, and in the government effectiveness equation, they obtained a beta equal to -0.27. In comparison, our beta coefficients on fuel exports and ores and metals exports seem reasonable.

The results suggest that, in determining whether or not natural resources are a curse or a blessing, individual types of natural resources must be considered separately. If resources are aggregated into one measure, the positive and negative impacts of different types would offset each other, providing insignificant results and misleading conclusions. Our results suggest that fuel, and ores and metal, resources can be considered a curse because large rents available from the exploitation of these resources are associated with increased rent seeking and corruption, which in turn lead to lower standards of living.

Support for this belief is provided by Ross (2001) and Fearon (2005): Ross suggests that resource-rich governments use low tax rates and patronage to relieve pressures for greater accountability (the "rentier effect"), while Fearon shows that oil exports are positively related to the risk of internal conflict. We find that institutional quality can offset the impact of the resource curse. As shown, the magnitude of the regulatory quality variable is greater than those of per capita fuel exports, and ores and metals exports, suggesting that improvements in institutional quality can offset the curse associated with these resources. This might explain why some countries, such as Norway, have both high levels of fuel exports per capita and standards of living. On the other hand, forest resources might be a blessing rather than a curse.

Our results also support that corruption impedes development, curbing long-term foreign and domestic investment, distorting technology choices, increasing transaction costs and uncertainty, and leading to inefficient outcomes (Gray and Kauffman, 1998). Tanzi and Davoodi (2001) find that corruption impedes growth of small and medium enterprises and new firms by reducing the rate of return on capital. They also show that corruption reduces the size and quality of investment, with corrupt countries spending less on education and health. Gupta et al. (2001) argue that corruption adversely affects the provision of publicly provided services and has negative consequences for child and infant mortality rates, birth weights and primary school dropout rates.

Robustness

Endogeneity

We modified FEVD to a 2SFEVD approach to allow for possible endogeneity of control of corruption in the wellbeing equations and per capita GDP in the control of corruption equation. We used Davidson and MacKinnon's (1989) auxiliary regression approach to assess the merits of moving from FEVD to 2SFEVD – to address endogeneity concerns. Although outputs are not reported here, we find evidence of endogeneity of control of corruption in the wellbeing equations, but that it is likely not a concern for per capita GDP in the control of corruption equation. Regardless of whether we use FEVD or 2SFEVD, our findings are qualitatively robust, with only the coefficients on per capita GDP and control of corruption (as expected) showing marked changes.

Serial correlation and dynamics

To explore whether there is unaccounted for serial correlation, we test for AR(1) errors as outlined by Wooldridge (2002: 282-83), applied to the residuals from the first-differenced equations. Given our short time dimension, we limit our attention to countries for which data are available for all four periods (see Appendix B). This reduces the total number of countries to 73 (n=292). The results for the balanced panel, given in Tables C1 and C2 in Appendix C, are quite similar to those in Table 3 from the unbalanced panel. This suggests that there is no systematic bias in going to a balanced panel as we drop observations from both developed countries (for example, Canada and Belgium) and developing countries (for example, Cambodia and Ecuador). For the HDI equation, the coefficient on openness doubles but remaining estimates are much the same. In the control of corruption equation, the estimate on GDP per capita doubles but other estimates are similar to those for the unbalanced case. Coefficient estimates for the GDP per capita equation are more sensitive to the countries used, although there are no changes in qualitative results. This leads us to continue to rely on the results in Table 3.

Using the balanced panel, we find evidence for AR(1) errors, which has implications for the confidence intervals reported in Table 3. Researchers then typically proceed in one of three ways: (1) use a robust estimator of the variance-covariance matrix to produce new confidence intervals; (2) re-estimate the equations using a GLS-type AR(1) estimator; or (3) explore whether the correlation arises from omitting a correlated variable or unspecified dynamics. The third response is often dealt with by adding a lagged dependent variable as a regressor. In political science, Beck and Katz (1995; also Beck 2001) are often cited to justify this approach. However, "one would not attempt to use a lagged dependent variable when one has only three observations per unit" (Beck, 2001). As we have at most four periods per country and sometimes less, we do not include a lagged dependent variable in our specifications.

We are also mindful of Plümper et al. (2005), who raise issues with short panels when period dummies and a lagged dependent variable are included in the presence of persistence. Such concerns led the authors to advocate using a GLS-type AR(1) transformation. Although this estimator may not exhibit good properties with a short panel, we report results using this method in Tables C1 and C2.[7] We find minimal numerical differences between estimates with and without the AR(1) correction, leading us to rely on the estimates reported in Table 3 with the unbalanced panel. Our qualitative findings are not altered when using the different interval estimates, although these are usually wider with the AR(1) correction, particularly for the per capita GDP equation.

Tables C1 and C2 also report interval estimates calculated using panel corrected standard errors (for example, Beck and Katz, 1995) to account for cross-country heteroskedasticity. Although this alters precision, and thereby the interval estimates, there are again no changes in our qualitative findings.

Concluding Remarks

We evaluated the natural resource curse by allowing for resource rents to lead to corruption and rent seeking that, in turn, affect standards of living. This contrasts with traditional models that employ the share of primary product exports in GDP to explain differences in GDP growth rates across countries. We also measured resource abundance in per capita terms, rather than as a relative share of GDP. Finally, we examined the effect of natural resource abundance on wellbeing measured by the HDI rather than GDP, although results for per capita GDP are similar to those using the HDI.

Our results show the importance of differentiating between types of natural resources when considering the resource curse hypothesis. Fuel resources, and ores and metals, may be a curse, as they are associated with increased rent seeking and corruption, whereas forest resources may be a blessing as they seem to be linked with decreased rent seeking and corruption. However, we did not distinguish between pristine and plantation forests, with the former capable of generating much greater rents than the latter. Through their impact on rent seeking and corruption, resource rents from petroleum resources, and ores and metals, negatively impact overall standards of living. In our work, the curse of natural resources operates through the impact these resources have on corruption.

These findings imply that reducing corruption will likely overcome the resource curse. Political will is essential: “Attempts to eliminate corruption tend to succeed when reforms ... are supported at the highest levels of government” (Mauro, 1998: 13). Specific policies to reduce corruption include punishing major offenders, creating watchdog agencies, reducing and/or regulating monopolies, reducing trade barriers, reforming incentives and increasing transparency (Gray and Kaufmann, 1998).

Finally, natural resources provide a valuable flow of income to countries. Throughout history, some resource-rich countries have grown rapidly, achieving high standards of living, while others have experienced corruption, civil war and widespread poverty. The links between natural resource abundance and overall standards of living are complicated, and, before making any general claim about whether natural resources are a curse or a blessing, researchers need carefully to consider the mechanisms through which resource rents may help or hinder development. If resource rents are invested in infrastructure and social programs that increase long-term growth and re-distribute wealth appropriately, resource rents may increase standards of living. But if resource rents are captured by special interest groups, dissipated through corruption and rent-seeking behaviours, then they may lower standards of living and increase income inequality. Whether resource rents can improve, rather than inhibit, economic development depends in large part on government institutions and the nature of the resources generating the rents.

Notes

1. S&W (2001, p.48) state: "There is an inverse association between natural resource abundance and several measures of institutional quality." But they do not explain why.
2. The period effects are usually not jointly significant in the control of corruption equation. Regardless, our findings do not qualitatively change when period effects are included.
3. Plümper and Troeger provide a Stata routine (see http://www.polsci.prg/pluemper/ssc.html).
4. This asumes that time-invariant factors are uncorrelated with the unobserved country-specific effects.
5. This is reduced by four observations and one country when the regime variable is included.
6. We follow Louis and Zeger (2009) in reporting confidence intervals of estimated coefficients.
7. The AR(1) adjustment is undertaken at the final stage of the estimation procedure.

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Appendix A

TABLE A1		
VARIABLE DEFINITIONS AND SOURCES		
Variable	Definition	Source
Human Development Index	GDP per capita, adult life expectancy, adult literacy rate, enrolment rate	UNDP *Human Development Reports* http://hdr.undp.org/en/reports
Investment per capita	Gross capital formation (constant $US 2000) per capita	World Bank (2007)
Openness	Trade volume expressed as a percentage of GDP	World Bank (2007)
Number of languages	Number of languages in Ethnologue that exceed 1% of population or 1 million speakers	Fearon and Laitin (2003) http://www.stanford.edu/~jfearon/
Control of corruption	Extent that public power is for private gain, including both petty and grand forms of corruption, as well as “capture” of the state by elites and private interest (index: -2.5 to +2.5)	World Bank (2007)
Latitude	Latitude of the capital city	CIA *World Factbook* https://www.cia.gov
GDP per capita	Constant $US 2000, adjusted for purchasing power parity	World Bank (2007)
Fuel exports per capita	Constant $US 2000 per capita	World Bank (2007)
Ores & metals exports per capita	Constant $US 2000 per capita	World Bank (2007)
Forestry production per capita	Cubic metres of roundwood produced per capita	UNCDB (2007) (http://unstats.un.org/unsd) and World Bank (2007)
Largest ethnic group	Size of largest ethnic group as a share of total population	Fearon and Laitin (2003) http://www.stanford.edu/~jfearon/
Regulatory quality	Ability of government to formulate and implement sound policies & regulations for private sector development (index: -2.5 to +2.5)	World Bank (2007)
Civil war dummy	Internal conflicts with at least 1,000 combat-related deaths per year during 1980-1999	Fearon (2005) http://www.stanford.edu/~jfearon/
Regime	Combined democracy & autocracy score, +10 (strongly democratic) to -10 (strongly autocratic)	Center for Systematic Peace (Polity 2) http://www.systemicpeace.org/polity/polity4.htm

Appendix B: Countries Included

Below we list countries used in our core results reported in Table 3 and the number of observations available for each country. Only countries with observations for all of the four time periods were included in the balanced panel estimation of 73 countries (Tables C1-C2). For our duplicate regression model of S&W (1995), reported in Table 2, those countries denoted with a * plus Georgia, Grenada, Hong Kong, Iceland, Lebanon, Oman, Serbia & Montenegro, and the Slovak Republic (a total of 88 countries) had the required information available.

Albania*(4), Algeria*(4), Argentina*(4), Armenia(3), Australia*(4), Azerbaijan*(3), Bangladesh*(4), Belarus*(4), Belgium*(3), Benin(3), Bolivia*(4), Botswana(2), Brazil*(4), Bulgaria*(4), Burkina Faso*(4), Cambodia(3), Cameroon(2), Canada*(3), Chile*(4), China*(4), Colombia*(4), Costa Rica*(4), Cote d'Ivoire(3), Croatia*(4), Czech Rep.*(4), Ecuador*(3), Egypt*(4), El Salvador*(4), Estonia*(4), Ethiopia(1), Finland*(4), France*(4), Gabon*(3), Gambia(2), Ghana(2), Guatemala*(4), Guinea(2), Guyana(3), Honduras*(4), Hungary*(4), India*(4), Indonesia*(4), Iran*(4), Israel*(4), Japan*(4), Jordan*(4), Kazakhstan(3), Kenya*(4), Korea Rep.*(4), Kyrgyz Rep.*(3), Latvia*(4), Lithuania*(4), Macedonia*(3), Madagascar*(4), Malawi*(4), Malaysia*(4), Mali(2), Mauritius*(4), Mexico*(4), Moldova*(4), Mongolia(3), Morocco*(4), Mozambique(2), Netherlands*(4), New Zealand*(4), Nicaragua*(4), Norway*(4), Pakistan*(4), Panama*(4), Paraguay*(4), Peru*(4), Philippines*(4), Poland*(4), Portugal*(4), Romania*(4), Russian Federation*(4), Senegal*(4), Slovenia*(4), South Africa*(4), Sri Lanka(2), Sudan(2), Swaziland(2), Sweden*(4), Syrian Arab Rep.*(4), Tanzania*(4), Thailand*(4), Togo*(4), Trinidad & Tobago*(4), Tunisia*(4), Turkey*(4), Turkmenistan(1), Uganda*(4), Ukraine*(4), UK*(4), US*(4), Uruguay*(4), Venezuela*(4), Vietnam(3), Yemen*(4), Zambia*(4), Zimbabwe(3)

Appendix C

TABLE C1				
BALANCED PANEL 2SFEVD WITH & WITHOUT AR(1) & PCSE ADJUSTMENTS				
REGRESSOR	HDI EQUATION		GDP PER CAPITA EQUATION	
	WITHOUT AR(1)	WITH AR(1)	WITHOUT AR(1)	WITH AR(1)
Constant	0.634 (0.623,0.644) [0.626,0.642]	0.636 (0.625,0.648) [0.627,0.645]	4339.751 (3917.671,4761.831) [3859.550,4819.952]	4122.274 (3523.299,4721.249) [3446.233,4798.315]
Log investment per capita	5.44E-03 (3.78E-03,7.10E-03) [4.10E-03,6.77E-03]	5.41E-03 (3.59E-03,7.240E-03) [3.90E-03,6.93E-03]	337.418 (269.813,405.023) [263.670,411.166]	374.576 (277.258,471.893) [269.973,479.178]
Openness	1.86E-04 (1.65E-04,2.07E-04) [1.71E-04,2.01E-04]	1.85E-04 (1.62E-04,2.08E-04) [1.68E-04,2.02E-04]	0.782 (-0.410,1.974) [-0.221,1.785]	2.972 (1.166,4.778) [1.108,4.836]
Number of languages	-6.61E-03 (-6.74E-03,-6.48E-03) [-6.75E-03,-6.46E-03]	-6.62E-03 (-6.76E-03,-6.48E-03) [-6.78E-03,-6.46E-03]	-37.183 (-43.574,-30.791) [-42.607,-31.758]	-37.811 (-46.949,-28.674) [-45.672,-29.950]
Latitude	3.22E-03 (3.16E-03,3.28E-03) [3.16E-03,3.28E-03]	3.22E-03 (3.16E-03,3.29E-03) [3.15E-03,3.29E-03]	72.482 (69.490,75.475) [69.657,75.308]	75.339 (70.873,79.805) [70.586,80.091]
Control of corruption	0.026 (0.025,0.028) [0.025,0.027]	0.026 (0.024,0.028) [0.025,0.027]	6920.849 (6837.178,7004.520) [6825.080,7016.618]	7013.885 (6891.210,7136.560) [6875.667,7152.103]
Year 2002 dummy	0.002 (0.000,0.004) [0.000,0.004]	0.000 (-0.002,0.002) [-0.003,0.003]	426.405 (326.281,526.530) [326.330,526.480]	268.769 (175.943,361.596) [175.936,361.603]
Year 2004 dummy	0.014 (0.012,0.016) [0.012,0.016]	0.012 (0.009,0.014) [0.008,0.015]	904.054 (803.399,1004.708) [803.234,1004.874]	662.738 (536.141,789.336) [534.427,791.049]
$\hat{u}$	1.000 (0.986,1.015) [0.985,1.016]	1.002 (0.986,1.017) [0.985,1.019]	1.003 (0.989,1.018) [0.988,1.018]	1.023 (1.001,1.044) [0.999,1.046]
AR(1)		0.110 (0.046,0.174) [0.006,0.214]		0397 (0.316,0.477) [0.282,0.511]

Notes: Cells contain coefficient estimates from 2SFEVD regressions, figures in (.,.) are 90 per cent confidence interval estimates with no cross-country heteroskedasticity adjustment, and figures in [.,.] are 90 per cent confidence interval estimates using cross-country panel corrected standard errors. Estimation uses the 2000, 2002 and 2004 periods and a balanced panel.

TABLE C2		
BALANCED PANEL 2SFEVD WITH & WITHOUT AR(1) & PCSE ADJUSTMENTS		
REGRESSOR	CONTROL OF CORRUPTION EQUATION	
	WITHOUT AR(1)	WITH AR(1)
Constant	-0.825 (-0.870,-0.780) [-0.876,-0.774]	-0.825 (-0.871,-0.778) [-0.877,-0.772]
GDP per capita	2.85E-05 (2.56E-05,3.14E-05) [2.56E-05,3.14E-05]	2.85E-05 (2.55E-05,3.15E-05) [2.55E-05,3.15E-05]
Fuel exports per capita	-9.10E-05 (-1.08E-04,-7.41E-05) [-1.02E-04,-7.99E-05]	-9.08E-05 (-1.08E-04,-7.35E-05) [-1.02E-04,-7.95E-05]
Ores/metals exports per capita	-4.02E-04 (-5.45E-04,-2.59E-04) [-4.88E-04,-3.16E-04]	-4.00E-04 (-5.46E-04,-2.54E-04) [-4.91E-04,-3.09E-04]
Forestry production per capita	0.046 (0.038,0.054) [0.039,0.053]	0.046 (0.038,0.054) [0.039,0.053]
Regulatory quality	0.160 (0.126,0.195) [0.118,0.203]	0.162 (0.126,0.197) [0.118,0.205]
Largest ethnic group	0.705 (0.639,0.772) [0.633,0.778]	0.704 (0.635,0.773) [0.630,0.778]
Civil war dummy	-0.405 (-0.439,-0.371) [-0.442,-0.368]	-0.403 (-0.439,-0.368) [-0.441,-0.366]
Regime	0.035 (0.031,0.039) [0.031,0.039]	0.035 (0.031,0.039) [0.031,0.039]
$\hat{u}$	0.982 (0.941,1.024) [0.945,1.019]	0.981 (0.938,1.024) [0.942,1.020]
AR(1)		0.022 (-0.102,0.145) [-0.164,0.207]

Notes: Cells contain coefficient estimates from 2SFEVD regressions, figures in (.,.) are 90 per cent confidence interval estimates with no cross-country heteroskedasticity adjustment, and figures in [.,.] are 90 per cent confidence interval estimates using cross-country panel corrected standard errors. Estimation uses the 2000, 2002 and 2004 periods and a balanced panel.

TABLE 1					
DESCRIPTIVE STATISTICS OF VARIABLES INCLUDED IN THE MODEL (*n*=362 observations)					
Variable	Mean	Median	Minimum	Maximum	Std.Dev.
Human Development Index	0.717	0.753	0.302	0.965	0.164
Investment per capita	$1,206	$389	$16	$9,901	$1,846
Openness	78.784	70.882	17.250	228.875	38.856
Number of languages	6.713	3.000	1.000	46.000	7.652
Latitude	29.086	31.858	0.217	60.167	17.446
Control of corruption	-0.026	-0.323	-1.324	2.535	0.949
GDP per capita	$8,408	$5,490	$503	$36,451	$8,595
Fuel exports per capita	$231	$26	$0	$8,611	$860
Ores/metals exports per capita	$69	$17	$0	$1,010	$146
Forestry production per capita	1.032	0.577	0.000	10.483	1.669
Regulatory quality	0.156	0.053	-2.569	1.990	0.824
Largest ethnic group	0.673	0.710	0.120	0.998	0.233
Civil war dummy	0.213	0.000	0.000	1.000	0.410
Regime	4.815	7.000	-9.000	10.000	5.777

Notes: Cells contain summary statistics for the variables included in our analysis. For completeness, we report the standard deviation of the binary civil war dummy.

TABLE 2			
TRADITIONAL MODELS OF THE RESOURCE CURSE			
Our Results (*n*=88) Dependent Variable: Growth rate of real GDP per capita, 1998-2004		Sachs & Warner's Results Dependent Variable: Annual growth rate of real GDP per capita, 1970-1989	
Regressor	Estimates	Regressor	Estimates
Constant	0.877 (0.698,1.057)	Constant	12.472 (9.181,15.763)
Log GDP per capita, 1998	-0.374 (-0.445,-0.302)	Log GDP per capita, 1970	-1.921 (-2.433,-1.409)
Log investment per capita	0.341 (0.270,0.412)	Average investment to GDP ratio, 1970-1989	9.085 (3.444,14.726)
Openness	2.39E-04 (-5.02E-05,5.29E-04)	Openness	2.167 (1.229,3.105)
Rule of law	0.035 (0.000,0.070)	Quality of bureaucracy	0.370 (0.175,0.565)
Share of natural resource exports in GDP	-2.29E-04 (-0.003,0.003)	Share of natural resource exports in GDP	-7.806 (-12.220,-3.392)
Adjusted R^2	0.450	Adjusted R^2	0.597

Notes: Cells report coefficient estimates from cross-country growth regressions with figures in parentheses being 90 per cent confidence interval estimates.

TABLE 3			
CORE EMPIRICAL RESULTS, 2SFEVD ESTIMATION (*n*=362)			
Regressor	HDI Equation	GDP per capita equation	Control of corruption equation
Constant	0.613 (0.598,0.628)	-1573.705 (-2116.433,-1030.976)	
Log of investment per capita	5.37E-03*[0.049]* (3.00E-03,7.74E-03)	1165.704*[0.201]* (1082.739,1248.669)	
Openness	9.77E-05*[0.023]* (6.46E-05,1.31E-04)	-7.518*[-0.034]* (-9.114,-5.923)	
Number of languages	-7.76E-03*[-0.363]* (-7.98E-03,-7.54E-03)	-42.530*[-0.038]* (-52.224,-32.836)	
Latitude	3.38E-03*[0.360]* (3.29E-03,3.48E-03)	112.914*[0.229]* (108.458,117.370)	
Control of corruption	0.024*[0.140]* (0.022,0.027)	3761.866*[0.415]* (3651.373,3872.359)	
Year 2000 dummy	0.019 (0.015,0.022)	420.603 (251.473,589.732)	
Year 2002 dummy	0.020 (0.017,0.024)	755.874 (589.199,922.549)	
Year 2004 dummy	0.032 (0.029,0.036)	1195.480 (1023.877,1367.083)	
GDP per capita			1.40E-05*[0.127]* (1.05E-05,1.74E-05)
Fuel exports per capita			-9.02E-05*[-0.082]* (-1.12E-04,-6.90E-05)
Ores/metals exports per capita			-3.97E-04*[-0.061]* (-5.55E-04,-2.39E-04)
Forestry production per capita			0.037*[0.065]* (0.028,0.046)
Regulatory quality			0.142*[0.123]* (0.110,0.173)
Largest ethnic group			0.828*[0.203]* (0.757,0.899)
Civil war dummy			-0.459*[-0.198]* (-0.497,-0.422)
Regime			0.050*[0.307]* (0.047,0.054)

Notes: Cells report coefficient estimates using 2SFEVD with figures reported as (.,.) providing 90 per cent confidence interval estimates, and those in italics as *[.]* giving standardized regression (beta) coefficients for selected regressors.