Corruption, the Resource Curse and Genuine Saving

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Abstract

Genuine saving measures net investment in produced, natural and human capital. It is a necessary condition for weak sustainable development that genuine saving not be persistently negative. However, according to data provided by the World Bank, resource-rich countries are systematically failing to meet this condition. Alongside the well-known resource curse on economic growth, resource abundance might have a negative effect on genuine saving. In fact, the two are closely related, as future consumption growth is limited by insufficient genuine saving now. In this paper, we apply the most convincing conclusion from the literature on economic growth – that it is institutional failure that depresses growth – to data on genuine saving. We regress genuine saving on four indicators of institutional quality in interaction with an indicator of resource abundance. The indicators of institutional quality are corruption, bureaucratic quality, the rule of law and political constraints on the executive. We find that reducing corruption has a positive impact on genuine saving in interaction with resource abundance. That is, the negative effect of resource abundance on genuine saving is reduced as corruption is reduced. We find no robust evidence that the other indicators of institutional quality also have an impact on genuine saving.

Key words: weak sustainability, corruption, institutional quality, resources, curse

JEL-classification: E21, E60, Q32, Q33, Q38, Q48

Abbreviations: Genuine Savings (GS); Genuine Savings Rate (GSR); Net National Product (NNP); International Country Risk Guide (ICRG); Political Constraints (POLCON)

1. Introduction

Genuine saving (hereafter GS) is an established measure of weak sustainable development. Weak sustainable development assumes that different forms of capital are substitutable for each other (Neumayer, 2003)[1]. Development is unsustainable if an economy's total stock of capital is eroded, which, for instance, will occur if the GS rate is (persistently) allowed to drop below zero. Since GS was developed, the World Bank (2004) has made retrospective calculations for more than 150 countries between 1970 and the present day. Although it finds that global GS has been consistently positive, over the whole of this period GS rates have been alarmingly low and consistently negative in certain countries of the world. Significantly, these countries are also often resource-rich.

This observation is strongly reminiscent of the so-called 'resource curse' hypothesis in the economic growth literature: the phenomenon that resource-rich economies generally grow more slowly than resource-poor economies, although, in theory at least, they have the means to invest in productive forms of capital. The link is the failure of resource-rich countries to invest enough of their resource rents in other forms of capital. Unsurprisingly, the resource curse on economic growth has generated a substantial literature over the past half-century or more. Many explanations have been put forward and one can broadly distinguish between more directly economic explanations and *political*-economic explanations that highlight the role of policy and/or institutional failure. Ultimately, it is difficult to resist the conclusion that it is political-economic failures that have been the root cause of slow growth. We draw succour from this finding and examine whether low GS rates in resource-rich countries can similarly be explained by particular political and institutional failings. More specifically, we test whether improving institutional quality in selected, distinct ways leads resource-rich countries to invest their resource rents more sustainably in other forms of capital.

Atkinson and Hamilton (2003) have made a useful first attempt to address these issues. They provide tentative evidence of an interaction between a composite index of general institutional quality, also used by Sachs and Warner (1995), and resource abundance in determining gross saving/investment: resource-rich countries with good quality institutions have enjoyed greater rates of gross investment and saving. We build on Atkinson and Hamilton's (2003) research in several ways. First and foremost, we test whether this interaction holds for genuine saving as well as gross saving/investment. Secondly, we test whether specific aspects of institutional quality are more significant than others in driving up GS. We examine four indicators of institutional quality to assess which aspect of institutional quality it is that matters most: corruption, bureaucratic quality, the rule of law or political constraints on the executive. Thirdly, whereas Atkinson and Hamilton (2003) use a cross-section of period-average data, we use a panel of data spanning up to 155 countries and 31 years. This allows us to estimate the interaction with more sophisticated econometric techniques that allow for country-specific effects, which are likely to be correlated with both resource abundance and institutional quality, and that allow for dynamic effects and the fact that past savings rates might impact on current ones. Our most important result is that resource-rich countries suffer from low GS rates, but that they can improve their performance by fighting corruption, difficult as this may be in actuality.

Section 2 explains GS in more detail, and outlines the empirical finding that resource abundance is negatively related to GS. Section 3 discusses the resource curse in terms of the growth literature. Section 4 explains our empirical strategy, section 5 outlines our results and section 6 provides a discussion.

2. Genuine saving and resource abundance: the unsustainable consumption of resource rents

The origins of GS can be traced back to the work of Solow (1974) and Hartwick (1977), who were concerned with maximising intertemporal social welfare in an economy exploiting a non-renewable resource. Given a range of simplifying assumptions[2], this is realised through an optimal mix of consumption and investment. Total investment across the economy is the sum of net changes in the capital stock valued at its shadow price. If GS is persistently below zero, then the economy is certainly not weakly sustainable (Hamilton and Clemens, 1999). The World Bank calculations of GS, which it now calls "adjusted net saving", includes three forms of capital: produced, natural and human. GS is computed as follows (appendix I provides more details):

GS = investment in produced capital – net foreign borrowing + net official transfers – depreciation of produced capital – net depreciation of natural capital
+ current education expenditures

World Bank GS estimates for the period 1970-2001 have shown significant differences from country to country. One important trend to emerge is that resource-rich countries are the poorest genuine savers (see also Atkinson and Hamilton, 2003). Figure 1 plots period-average GS rates (that is, GS divided by gross national income) against resource abundance for 145 countries. Resource abundance is measured as the average share of fuel and mineral product exports in total exports.

< Insert Figure 1 around here >

With the exception of Algeria and Guinea, for whom GS was just above zero for the period 1970-2001, every country with an average share of fuel and mineral exports in total exports of over 60% had negative GS. In contrast, most resource-poor countries, especially the cluster of countries with an average share of fuel and mineral exports in total exports of under 20%, had positive GS. In Sub-Saharan Africa, it must also be said that net produced capital investment is often negative too. In other words, the total 'man-made' wealth of these countries is also decreasing, and the World Bank's estimates of net natural capital depreciation simply worsen the situation. This is the case in Guinea-Bissau, for example. Nevertheless, one important conclusion we can draw from the World Bank's data is that the countries with the greatest natural resource extraction are also the poorest performers in terms of GS. Put another way, they are failing to invest a sufficient proportion of their resource rents in other forms of capital. This is striking, because it bears a considerable similarity to arguments made with respect to the effect of natural resource intensity on economic growth.

It is important to note that the method the Bank applies to estimate net depreciation of natural capital (price minus average cost times amount of resource extraction) is likely to over-estimate the true extent of depreciation in countries with a large stock of remaining resources (Neumayer, 2000, 2003). This is because contrary to, for example, the user-cost approach of the El Serafy (1981) method, it does not acknowledge that resource extraction carries an element of both capital depreciation and true income. However, lack of reserve data prevents us from adjusting the GS figures and whilst the data published by the Bank are likely to over-estimate natural capital depreciation and therefore under-estimate GS rates in resource-rich countries, it is our view that the main result on the interaction between institutional quality and resource abundance is unlikely to change in qualitative terms if a different method for calculating natural capital depreciation is used.

3. The 'resource curse' hypothesis and policy failure

"One of the surprising features of economic life is that resource-poor economies often vastly outperform resource-rich economies in economic growth" (Sachs and Warner, 1995, p2). Instances of this can be found throughout modern history, but it is especially true of the post-1970 period. Between 1970 and 1993, per capita GDP in resource-rich countries grew around three times slower than it did in resource-poor countries (Auty, 2001). Perhaps this is because resource-abundance masks underlying trends in other determinants of economic growth such as trade policy and government efficiency. However, Sachs and Warner (1995) demonstrated that, even after controlling for these factors, resource-abundance is negatively related to growth. The phenomenon has become known as the 'resource curse'.

The fact that fuel and mineral-rich economies perform especially badly in relation to resource-poor economies (Auty, 2001) is a paradox. On the face of it, countries with abundant fuel and mineral resources ought to be able to sustain rapid growth both in the short and medium-term, as long as they invest the proceeds of their resource windfalls in other productive forms of capital. This is the formal link between the resource curse on economic growth and the negative effect of resource abundance on GS: productive capital investment is insufficient in resource-rich countries. Weitzman (1976) showed that the greater is current investment relative to consumption, the greater is the increase in consumption that can be achieved in the future (see also Ferreira and Vincent, 2003).

A number of explanations for the resource curse have been put forward. We are especially interested in these, because they may help to cast some light on the causes of low GS in resource-rich countries. A popular explanation surrounds the poor economic performance of the natural resources sector – characterised by falling primary resource prices (Prebisch, 1962), vulnerability to short-term price fluctuations (Sala-i-Martin and Subramanian, 2003) and relatively sluggish demand – compared to the manufacturing sector. But we must ask why resource-rich countries have not succeeded in diversifying? They ought to be able to invest their resource rents in other forms of capital, and lay the foundations for faster and sustainable growth.

One reason why they might not is the so-called ‘Dutch disease’, whereby the discovery of new resource stocks leads the real exchange rate (or real wages) to over-appreciate, which perversely causes the tradeable non-resource sector to contract. Many economists believe that the manufacturing sector (and indeed the service sector) produces more positive externalities than the natural resources sector – based on learning-by-doing – and thus the contraction of the manufacturing sector in relative terms could lead to a fall in economic activity in absolute terms (Hirschman, 1958; Matsuyama, 1992). From an investment perspective, there may not be an incentive to invest in manufactures under these circumstances. Resource-rich countries may also lack the incentive to make productive investments in human capital through educational expenditure (Birdsall *et al*., 2001; Gylfason, 2001; Papyrakis and Gerlagh 2004a, 2004b). This may be connected to Dutch disease, insofar as currency appreciation may reduce the relative rate of return to educational investments.

However, it seems plausible that it is a failure of public policy causing this underinvestment. Judicious management of natural resource endowments can prevent the generation of too much income too quickly. In Norway, for example, the government takes around 80% of resource rents in taxes and fees and invests that amount in foreign assets (Gylfason, 2001). Either governments with abundant natural resources are blind to the need to invest in produced and human capital because they see themselves in a ‘comfort zone’, or they may even deliberately neglect to invest. Either way, this leads us more generally to a political-economic explanation of the resource curse.

The potential to ‘cash in’ on natural resources may have an unsettling and inhibiting effect on a country’s polity, leading to injudicious decisions on the economy. The availability of resource rents may give rise to corruption[3]. There are multiple reasons why corruption may in turn slow economic growth (Leite and Weidmann, 1999) by reducing investment and the productivity of investment (Boycko *et al*., 1995; Mauro, 1995; Murphy *et al*., 1991; Romer, 1994). Alternatively, Isham *et al*. (2003) have identified wider political-economic explanations for the resource curse. Firstly, the whole state may be subject to a ‘rentier effect’. States with abundant mineral and oil reserves extract their revenues from resources that are concentrated geographically and in terms of ownership. This reduces their incentive to develop the governance mechanisms that enable general taxation. On the opposite side, since the state sector tends to dominate, citizens have less incentive to form a healthy ‘civil society’, an independent middle class fails to develop, and technocratic and entrepreneurial talent remains captive of state largesse in terms of employment and advancement opportunities (Chaudhry, 1997). In addition, the government can rely on its resource revenues to repress dissent, either through buying off opposition (often with high-profile 'white elephant' infrastructure projects) or through violence. As a result of this, democracy often fails to develop (Karl, 1997; Ross, 2001). More importantly in this context, stifling technocratic and entrepreneurial talent, as well as making unproductive 'white-elephant' investments, will harm the economy.

Secondly, political elites find it relatively easy to control resources and maintain their wealth in a point resource-led economy, but face the prospect of losing their grip through industrialisation and urbanisation (Acemoglu *et* al., 2001; Moore, 1967). It follows that political elites in resource-rich countries resist modernisation pressures for as long as possible, especially investment in the manufacturing sector. Again, in this case civil society fails to develop. The main reason for this is that the concentration of capital ownership among political elites, together with production methods that favour the use of expert (foreign) labour and that are capital-intensive (Auty and Kiiski, 2001), reproduce social inequalities between those inside the elite and those outside it.

Hence we are compelled to test whether the negative effect of resource abundance on GS is explained by policy failure. In particular, we specify a model to explain GS based on the interaction between natural resource endowments and institutional quality. Atkinson and Hamilton (2003) explained variations in gross investment and saving in this way and found a significant positive interaction between resource abundance and general institutional quality. According to their results, resource-rich countries with good quality institutions have enjoyed greater rates of gross investment and saving. We extend their logic to GS and also test whether some elements of institutional quality are more important than others in explaining variations in GS. We test corruption, based on the expectation that it will divert the proceeds of natural resource liquidation away from investment in produced and human capital towards consumption. We also test measures of bureaucratic quality, the rule of law and a measure of constraints on changing existing policy regimes. Following Isham *et al*. (2003), we decline to apportion these three indicators to particular theories. Instead, we test whether it is indeed true that these wider political economy effects depress GS, or whether it is corruption in particular that matters.

4. Empirical strategy

We model variations in GS in a panel of data spanning up to 155 countries and 31 years. We specify a reduced-form model, with a particular focus on the interaction between resource abundance, which should have a negative effect on GS *ceteris paribus*, and indicators of institutional quality. However, it will also be important to capture determinants of gross saving, since GS is itself a 'green' extension of gross saving. Put another way, we want to ensure that the results we get are particular to *genuine* saving and are not spurious. Therefore our first task is to select determinants of gross saving as control variables, based on the extant literature.

Determinants of gross saving

Within the last fifteen years, a number of studies have analysed the empirical determinants of gross private or gross national saving[4] using panel data and reduced-form models (Edwards, 1996; Dayal-Ghulati and Thimann, 1997; Loayza, Schmidt-Hebbel and Servén, 2000; Corbo and Schmidt-Hebbel, 1991; Masson, Bayoumi and Samiei, 1998; Haque, Pesaran and Sharma, 1999; Samwick, 2000). Across all studies, four variables appear to have a robust and significant effect on gross saving: (i) per capita income, (ii) economic growth, (iii) age dependency and (iv) urbanisation. Income per capita and income growth have a positive effect on gross (private) saving. Age dependency has a negative effect on gross saving, and in the empirical studies, urbanisation tends to have a negative effect on gross saving. A number of other variables are tested in the above studies. We choose not to include them for three reasons. Firstly, some are generally insignificant in the empirical literature. These include macroeconomic indicators such as interest rates and terms-of-trade. Secondly, data availability for some variables is very limited. These include detailed indicators of financial liberalisation, social security systems and income inequality. Thirdly, some are components of GS, and therefore including them as independent variables effectively constructs a partial identity with the dependent variable. These include fiscal policy variables such as government consumption and fiscal surplus (see appendix 1).

Hypothesis and data

We test the hypothesis that, after controlling for the determinants of gross saving, *resource-rich countries have lower rates of genuine saving than resource-poor countries. However, this effect is likely due to policy failure and raising political/institutional standards in these countries will lead to greater investment of resource rents in other forms of capital, and to higher rates of genuine saving*.

We test this hypothesis with the following model:

$$GSR_{i,t} = \alpha + \beta_1 \ln Y_{i,t} + \beta_2 Growth_{i,t-1} + \beta_3 Age_{i,t} + \beta_4 Urban_{i,t} + \beta_5 Inst_{i,t}$$
$$+ \beta_6 Rs_{i,t} + \beta_7 Inst_{i,t} * Rs_{i,t} + T_t + \varepsilon_{i,t}$$

for country *i* at time *t*, where ε is an error term. The year dummies *T* allow for global changes in the GS rate over time not otherwise accounted for in the explanatory variables.

GSR is the genuine savings rate. Data are available for the period 1970-2001 and are taken from the World Bank[5]; ln*Y* is gross national income per capita. We take the natural log to account for positive skewness. *Growth* is GDP growth, which is lagged one year to mitigate potential endogeneity bias; *Age* is age dependency; *Urban* is a measure of urbanisation: the percentage of the total population living in urban areas. Data for all these variables are taken from the World Bank's *World Development Indicators Online* database (World Bank, 2004).

Inst is institutional quality. We separately test four indicators of institutional quality. Indices of (i) lack of corruption, (ii) bureaucratic quality and (iii) the rule of law are taken from the International Country Risk Guide (ICRG). These are scaled from 0, which indicates poor quality institutions (e.g. the highest corruption, the lowest bureaucratic quality and the absence of rule of law) to 6, which indicates high quality institutions (e.g. the lowest corruption, the highest bureaucratic quality and full rule of law)[6]. The indices are compiled in an attempt to assess the investment risk faced by multinational companies and are based on expert judgements. Insofar as they ought to be positively related to investment, they are promising for our purposes. Unfortunately, the ICRG variables are only available for the period 1984 to 2001. In addition we therefore test a measure of 'political constraints' (POLCON) developed by Henisz (2000), which is available over the full period. POLCON is an indicator of the ability of political institutions to make credible commitments to an existing policy regime, which Henisz argues is the most relevant political variable of interest to investors. Building on a simple spatial model of political interaction, the index makes use of the structure of government in a given country and the political views represented by the different levels of government (i.e. the executive and the lower and upper legislative chambers). It measures the extent to which political actors are constrained in their choice of future policies by the existence of other political actors with veto power who will have to consent. Using information on party composition of the executive and the legislative branches allows taking into account how alignment across branches of government and the extent of preference heterogeneity within each legislative branch impacts the feasibility of policy change. Scores range from 0, which indicates that the executive has total political discretion and could change existing policies at any point of time, to 1, which indicates that a change of existing policies is totally infeasible. Of course, in practice agreement is always feasible, so the maximum score is less than 1.

Rs is a measure of resource abundance, which we take to be the combined share of fossil fuel and mineral products in total exports (World Bank, 2004). This is similar to the measure used by Sachs and Warner (1995) in their seminal paper and the most widely used measure in the literature on the resource curse. The difference is that we do not include agricultural products, the inclusion of which has been widely criticised, as Sachs and Warner (2001) themselves admit. Ideally, one would want to measure resource abundance with measures of resource stocks, as others have noted before (Stijns 2002; Bulte, Damania and Deacon 2005). However, no comprehensive data on resource stocks exist. A priori, it is not clear how resource abundance will affect the GS rate. On one hand, large rents from resource extraction will boost the gross saving rate, which “anchors” the genuine savings rate since it is the starting point for adjustments (see Atkinson and Hamilton (2003) for evidence). On the other hand, as mentioned already, in subtracting the full resource rents from gross savings, the World Bank employs a method for calculating the value of natural resource stock depreciation that is likely to represent an over-estimate and is thereby under-estimating the GS rate in resource abundant countries (see Neumayer 2000, 2003). However, other methods for accounting for natural resource stock depreciation are contestable as well and/or are extremely data-intensive. For example, the El Serafy (1981) method requires information on resource stocks, which are difficult to get, as mentioned above. Our expectation is that resource abundance as measured by the combined share of fossil fuel and mineral products in total exports will be negatively associated with the GS rate – an effect that is potentially exaggerated in the World Bank data. More importantly, we expect the negative effect of resource abundance to be moderated by the degree of institutional quality. For this conditional effect, the fact that the GS rate is likely to be under-estimated for resource abundant countries should not matter much.

ln*Y*, *Growth*, *Age*, and *Urban* are the control variables. *Inst*, *Rs* and its interaction term are the main variables of interest. As noted above, we expect *Rs* to have a negative effect on GS. However, if raising the standard of institutions in resource-rich countries reduces the unsustainable consumption of resource rents, then we would expect the interaction term *Inst***Rs* to be positive. *Rs* is the predictor variable and *Inst* is the moderator variable, such that the negative relationship between resource abundance and GS becomes more positive – i.e. improves – the better are the political institutions. Where the interaction term is significant, one cannot interpret the coefficients on the individual components *Rs* and *Inst* in the conventional way. Instead, the coefficient on *Rs* in a model with a significant interaction term *Inst***Rs* is the slope of *Rs* on GS when *Inst* is equal to zero.

Estimation strategy

We first estimate the model with fixed effects, a design that allows for unobserved time-invariant variation in country-specific factors, with robust standard errors. Secondly, we estimate the model using the Arellano-Bond linear, dynamic panel-data estimator (Arellano and Bond, 1991). This estimator provides a dynamic framework in which present GS can be determined by past levels of GS and the explanatory variables. This accounts for the inertia that is almost certainly present in the determination of saving rates (Loayza *et al*., 2000). The Arellano-Bond estimator is a generalised-method-of-moments (GMM) estimator. It is constructed by first-differencing, producing:

$$GS_{i,t} - GS_{i,t-1} = \beta'(X_{i,t} - X_{it-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1})$$

where X is a vector of explanatory variables. Although the Arellano-Bond estimator has advantages over a static fixed effects estimator, it also suffers from problems. First-differencing wipes out the country fixed effects, but the lagged dependent variable is by definition correlated with the error term such that further lags of the dependent variable and first differences of the exogenous explanatory variables are used as instruments. This leads to rather inefficient estimation with high standard errors if Arellano and Bond's (1991) one-step estimator with robust standard errors is used. The two-step estimator is much more efficient, but can under-estimate the size of standard errors in small samples. As a result of this, we report estimation results from both the one-step and the two-step estimator. Moreover, whilst first-order serial correlation is expected, second-order serial correlation indicates that the original error term is serially correlated, which renders the estimations inconsistent. In all our estimations reported below we can reject the hypothesis of second-order serial correlation at conventional levels of significance.

One potential problem is that institutional quality might be endogenous. In other words, while institutional quality affects the GS rate, the GS rate might also affect institutional quality. In econometric terms, this would mean that institutional quality is correlated with unobserved variables that enter the error term. As long as these unobserved variables are time-invariant, this is not a problem since we use fixed-effects or first-differenced models. It is possible, however, that unobserved variables vary over time. Ideally, one would tackle this problem with the help of the instrumental variables regression technique. The problem is that potential instruments such as geography and historical information on settler mortality suggested by the literature on the effect of institutions on growth are all time-invariant and are used in cross-sectional regression analysis (Acemoglu et al. 2001, Rodrik et al. 2004, Glaeser et al. 2004). It is not possible to estimate a fixed-effects instrumental variable regression model with instruments that do not vary over time and we believe that controlling for fixed effects is of paramount importance to our estimations. Even if one could find appropriate time-varying instruments, instrumental variable regression would also be difficult due to the fact that the endogenous variable is interacted with resource exports, a variable assumed to be exogenous.

5. Results

Table I reports summary statistics and a bivariate correlation matrix. Although the lack of corruption, bureaucratic quality and rule of law indices are all compiled by ICRG, the correlations between them are not especially high. In particular, the strength of correlation between lack of corruption and bureaucratic quality and between lack of corruption and the rule of law is only moderate (0.54 and 0.52 respectively). The correlations between POLCON and the ICRG indices are also moderate. Therefore there may indeed be a possibility of detecting different effects between the various measures of institutional quality and GS.

< Insert Table I around here >

Table II presents the static fixed effects estimations, with columns 1-4 reporting results for each of the four indicators of institutional quality. Looking initially at the control variables, GNI per capita and GDP growth are significant and positive determinants of the GSR in all models. Age dependency is significant and negative only in model 4a and urbanisation is not significant in any model. In terms of our main hypothesis, the explanatory variable of interest is the interaction effect between the various indicators of institutional quality and resource exports. The interaction between lack of corruption and resource exports (column 1) is positive and significant at the 5% level. The specific interpretation of this variable is that the negative relationship between resource exports and the GSR diminishes – i.e. becomes more positive – the less corruption there is. Reducing corruption by one index point increases the slope of resource exports on the GSR by 0.029 units.

< Insert Table II around here >

The coefficient on resource exports shows the slope of resource exports on the GSR at an index score of 0. Therefore, a one percentage point increase in the resource exports to total exports ratio leads to a decrease in the GSR of 0.28 percentage points in countries with the most corruption. We can make use of the interaction-term coefficient to estimate the slope of resource exports on the GSR at higher scores on the index. At the mean corruption index score of 3.6, a one unit increase in resource exports leads to a decrease in the GSR of only 0.18 percentage points (0.28-3.6*0.029), and at the maximum index score of 6 (i.e. at the lowest level of corruption), a one unit increase in resource exports leads to a decrease in the GSR of just 0.11 percentage points (0.28-6*0.029). Reducing corruption from the maximum to the minimum reduces the negative effect of resource abundance on the GSR by 61%.

The interactions between bureaucratic quality and resource exports (column 2), between the rule of law and resource exports (column 3) and between POLCON and resource exports (column 4) are not statistically significant. There is no evidence here that improvements in these aspects of the political economy will lead to a higher GSR.

Table III reports the results of our estimations with the Arellano-Bond model. In this case, the GSR is also regressed on itself and is positive and highly significant in all cases. This can account for the inertia inherent in the determination of the GSR that we mentioned earlier. Of the control variables, GNI per capita and urbanisation are insignificant, GDP growth is significant and positive, while age dependency is sometimes significant and negative. The resources export variable is negative throughout and statistically significant with few exceptions. The interaction effects between our institutional variables and resources exports are not significant in one-step estimation (columns 1a to 4a). However, both the interaction effect between lack of corruption and resource exports (column 1b) and between rule of law and resource exports (column 3b) are positive and significant in two-step estimation. According to these estimations, for a one index point reduction in corruption, the slope of resource exports on the GSR increases by 0.023 units. The respective increase is 0.016 for a one index point improvement in the rule of law. When corruption is at its highest – at an index score of zero – a one percentage point increase in the ratio of resource to total exports leads the GSR to fall by 0.21 percentage points. At the mean corruption index score of 3.6, a one unit increase in resource exports leads to a decrease in the GSR of 0.15 points, and at the maximum index score of 6 (i.e. in the least corrupt state), a one unit increase in resource exports leads to a decrease in the GSR of merely 0.07 points. When the rule of law is at its worst value of zero, a one percentage point increase in the ratio of resource to total exports leads the GSR to fall by 0.19 percentage points. At the mean index score of 4.05, a one unit increase in resource exports leads to a decrease in the GSR of 0.13 points, and at the maximum index score of 6 (i.e. when there is full rule of law), a one unit increase in resource exports leads to a decrease in the GSR of 0.09 points.

Looking at figure 1 shows that our measure of resource abundance is highly skewed. Most countries have modest values of resource to total exports ratios (and mostly positive GS rates), whereas two dozens or so countries have a very high resource exports to total exports ratio (and mostly negative GS rates). One might be concerned that the skewness of this variable influences our results. In sensitivity analysis, we have therefore taken the natural log of the resource abundance variable and re-estimated all the models. Results were little affected in qualitative terms. Interestingly, the interaction term between lack of corruption and the log of resource exports is now statistically significant even in Arellano and Bond’s (1991) one-step estimator. One might be further concerned not only about outliers in terms of resource abundance, but about outliers more generally. If we additionally exclude from the sample observations that have at the same time high residuals and high leverage on the regression results following a criterion described in Belsley, Kuh and Welsch (1980), then again our results hardly change.[7]

6. Conclusion

The World Bank's own estimates show that it is the most resource-abundant regions of the world that have been the poorest genuine savers over the last thirty years. This amounts to an unsustainable consumption of resource rents. More should have been invested in other forms of capital, if these regions were to pursue a more sustainable path. There are strong connections between this finding and the so-called 'resource curse' hypothesis in relation to economic growth. That is, resource-rich economies have historically grown more slowly than resource-poor economies, particularly in the last thirty years or so. This is apparently paradoxical, since resource extraction should generate the income to make productive investments in other forms of capital. Resource-rich countries fail to do this. Although some direct economic explanations of the resource curse have been put forward in the past with a modicum of success – most notably 'Dutch disease' effects – it is ultimately policy failure that underpins the curse. This has inspired us to test whether improving institutional quality has a positive effect on the relationship between resource abundance and GS.

We have presented evidence on the relationship between institutional quality, resource abundance and GS. We asked the question, does improving the quality of various aspects of a country's political and bureaucratic institutions (both subjectively and objectively determined) mitigate the negative effect of resource abundance on the GSR? Atkinson and Hamilton (2003) paved the way for our paper by offering tentative evidence of an interaction between institutional quality in general and resource abundance in determining gross saving/investment: resource-rich countries with good quality institutions have enjoyed higher rates of gross investment and saving.

However, they did not address GS itself, nor did they control for country-specific fixed or dynamic effects. Also, institutional quality is a broad concept and we have attempted to discriminate between different aspects. There are persuasive theoretical and empirical arguments in the literature that suggest corruption may be a major explanatory factor in the resource curse. They often describe a process in which investment is either misdirected or discouraged altogether. A failure to invest resource rents would depress GS, *ceteris paribus*. In addition, there are arguments for wider political economy effects, summarised in Isham *et al.* (2003). These explain the resource curse in terms of the control exerted by political elites over resource rents. There is little incentive to develop a competent government bureaucracy and to diversify the national economy into other sectors, a process that the political elites resist through a combination of undemocratic decision-making and repression of more-or-less violent forms.

Therefore we have tested four competing indicators of institutional quality in the framework of our hypothesis. We have tested corruption using the ICRG index. In addition, we have tested bureaucratic quality and rule of law indices, also from ICRG, and POLCON (Henisz, 2000), an indicator of political constraints on decision-making. On the basis of our evidence, we suggest that corruption is a significant cause of a low GSR in resource rich countries. In almost all the models we have specified, the negative relationship between resource exports and the GSR improves as corruption is reduced. There is also some limited, but not robust, evidence that improving the rule of law might have a similar effect as reducing corruption. Neither of the remaining two aspects of institutional quality seem to matter.

In a nutshell, the message of our paper is that resource-rich countries can improve their weak sustainability performance by fighting corruption, difficult as this may be. They should ratify and take serious steps to implement the recently negotiated UN Convention against Corruption (www.unodc.org/unodc/en/crime_convention_corruption.html). It is also encouraging to see that the World Bank has promised as part of its Extractive Industries Review to require lending countries to undertake proper and transparent revenue accounting (www.worldbank.org/ogmc/), but one wished it had taken a more outspoken view toward the need to fight corruption in resource-rich countries. This is not to say that countries should only focus on anti-corruption measures: there are many other very persuasive reasons why all aspects of institutional quality should be improved. Indeed, improvements on one dimension are almost certain to lead to improvements in others. Nevertheless, in order to put themselves on a more sustainable investment pathway, we recommend that resource-rich countries strive to reduce the corrupt practices that stymie investment and make it unproductive.

NOTES

[1] As opposed to *strong* sustainable development, which assumes natural capital is either partly or wholly non-substitutable.

[2] See Dietz and Neumayer (2004).

[3] Known as rapacious rent-seeking behaviour (Lane and Tornell, 1995; Torvik, 2002).

[4] Where gross national saving = gross private saving + gross public saving.

[5] http://lnweb18.worldbank.org/ESSD/envext.nsf/44ByDocName/GreenAccountingAdjustedNetSavings

[6] Until 1996, bureaucratic quality was scored 0-4. We rescale this data to lie between 0 and 6. However, none of the observations in our sample actually have a score of zero.

[7] The leverage of an observation is a multivariate measure of the distance between its *X* values and the sample means. Observations with a DFITS that is greater in absolute terms than twice the square root of *k/n* are excluded, where *k* is the number of independent variables and *n* the number of observations, and where DFITS is defined as the square root of $(h_i/(1 - h_i))$, where h_i is an observation's leverage, multiplied by its studentized residual.

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Figure 1. Resource abundance and genuine saving between 1970 and 2001 (data from World Bank 2004).

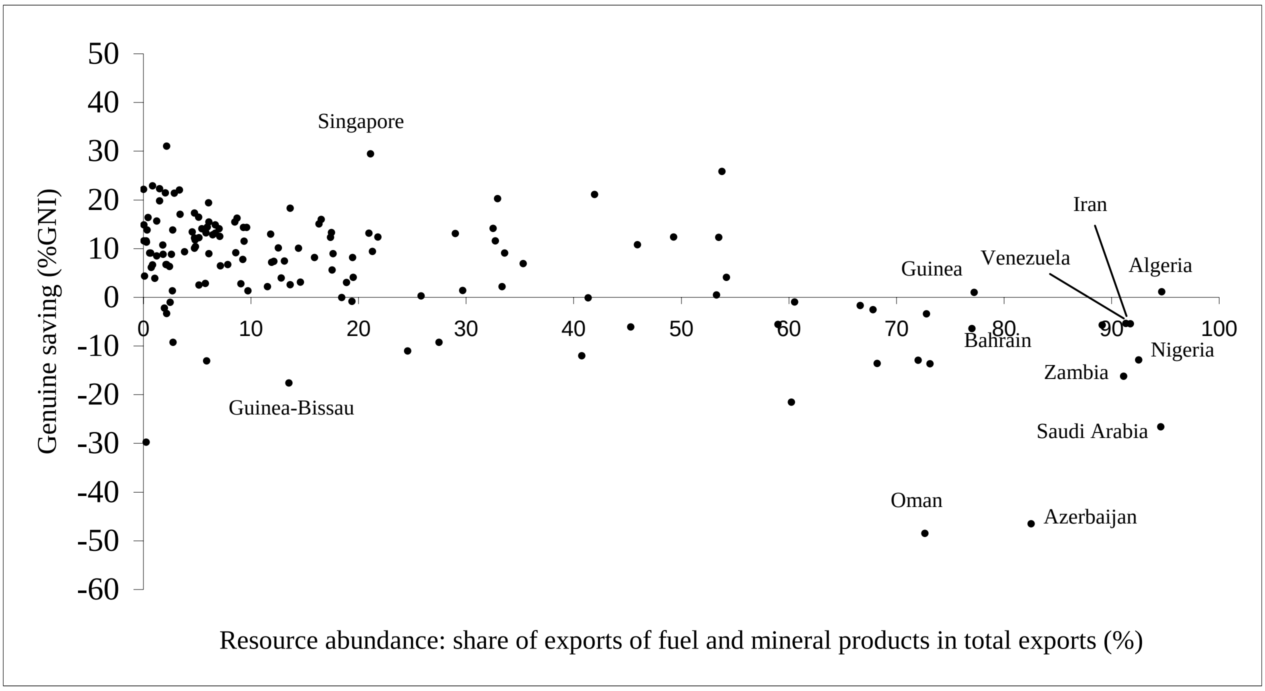

Table I. Summary statistics and correlation matrix (N = 1938).

	N	Mean	Std. Dev.	Min.	Max.
Genuine Saving/GNI	1938	8.05	11.19	-54.89	44.32
GNI per capita (ln)	1938	7.82	1.45	4.70	10.69
GDP growth (lagged one year)	1938	3.54	4.57	-26.48	33.99
Age dependency	1938	0.68	0.18	0.37	1.14
Urbanisation	1938	58.31	22.86	4.56	100
Resource exports	1938	21.73	26.73	0.002	98.9
Lack of corruption	1019	3.60	1.37	0	6
Bureaucratic quality	1145	3.97	1.42	1	6
Rule of law	1145	4.05	1.54	0	6
POLCON	1938	0.44	0.34	0	0.89

	GS/GNI	GNI per capita	GDP growth	Age dependency	Urbanisation	Resource exports	Lack of Corruption	Bureaucratic quality	Rule of law	POLCON
Genuine Saving/GNI	1.00									
GNI per capita (ln)	0.18	1.00								
GDP growth	0.15	-0.07	1.00							
Age dependency	-0.34	-0.73	-0.03	1.00						
Urbanisation	-0.01	0.77	-0.09	-0.56	1.00					
Resource exports	-0.62	-0.12	-0.03	0.25	0.11	1.00				
Lack of corruption	0.03	0.53	-0.07	-0.31	0.28	-0.18	1.00			
Bureaucratic quality	0.31	0.77	0.00	-0.64	0.48	-0.29	0.54	1.00		
Rule of law	0.17	0.70	0.03	-0.62	0.46	-0.16	0.52	0.70	1.00	
POLCON	0.25	0.60	-0.08	-0.57	0.41	-0.34	0.37	0.58	0.57	1.00

Table II. Static fixed effects estimates (robust standard errors in parenthesis).

	'Lack of corruption'	'Bureaucratic quality'	'Rule of law'	'POLCON'
	1	2	3	4
GNI per capita (ln)	4.096**	3.453**	3.500**	5.108**
	(1.059)	(1.105)	(1.063)	(0.620)
GDP growth $_{t-1}$	0.149*	0.145*	0.148**	0.151**
	(0.059)	(0.057)	(0.057)	(0.042)
Age dependency	-8.695	-6.083	-5.844	-16.312**
	(5.765)	(5.537)	(5.654)	(3.669)
Urbanisation	-0.082	-0.045	-0.046	0.049
	(0.090)	(0.090)	(0.090)	(0.053)
Resource exports	-0.279**	-0.137**	-0.163**	-0.111**
	(0.041)	(0.042)	(0.047)	(0.021)
Institutional quality	-0.367	0.391	0.266	-0.296
	(0.287)	(0.351)	(0.270)	(0.950)
Resource exports *	0.029*	-0.021	-0.009	-0.002
Inst. quality	(0.013)	(0.011)	(0.012)	(0.034)
R^2 within	0.20	0.20	0.20	0.21
N observations	1036	1158	1158	1938
N countries	99	107	107	118

Note: Dependent variable is GSR (GS/GNI). Year dummies included, but coefficients not shown. * Significant at 5%, ** at 1%

Table III. Dynamic Arellano-Bond estimates (robust standard errors in parenthesis).

	'Lack of corruption'		'Bureaucratic quality'		'Rule of law'		'POLCON'	
	One-step	Two-step	One-step	Two-step	One-step	Two-step	One-step	Two-step
	1a	1b	2a	2b	3a	3b	4a	4b
$(GS/GNI)_{t-1}$	0.356**	0.367**	0.359**	0.386**	0.353**	0.357**	0.431**	0.407**
	(0.093)	(0.024)	(0.077)	(0.033)	(0.081)	(0.021)	(0.056)	(0.041)
GNI per capita (ln)	0.761	0.980	-0.269	-0.501	-0.246	-0.133	0.492	-1.139
	(1.912)	(1.121)	(2.195)	(1.200)	(2.002)	(1.106)	(1.496)	(1.503)
GDP growth $_{t-1}$	0.189*	0.165**	0.185*	0.189**	0.187*	0.182**	0.173**	0.139**
	(0.084)	(0.021)	(0.076)	(0.019)	(0.074)	(0.015)	(0.050)	(0.022)
Age dependency	-32.655*	-18.748	-28.770*	-17.747	-28.890*	-21.586*	-16.213	-12.284
	(15.588)	(10.351)	(14.279)	(14.237)	(14.017)	(9.371)	(9.497)	(14.429)
Urbanisation	-0.088	-0.000	-0.118	-0.095	-0.151	-0.058	0.074	-0.299
	(0.184)	(0.126)	(0.175)	(0.150)	(0.163)	(0.124)	(0.134)	(0.199)
Institutional quality	0.304	-0.057	0.037	0.108	-0.064	-0.160	-3.899*	-2.994
	(0.325)	(0.404)	(0.622)	(0.373)	(0.471)	(0.369)	(1.566)	(3.107)
Resource exports	-0.201*	-0.211**	-0.129	-0.137**	-0.174	-0.192**	-0.108**	-0.164**
	(0.083)	(0.033)	(0.079)	(0.037)	(0.090)	(0.026)	(0.039)	(0.035)
Resource exports *	0.013	0.023**	-0.002	-0.003	0.014	0.016*	0.056	0.019
Inst. quality	(0.014)	(0.009)	(0.017)	(0.009)	(0.021)	(0.008)	(0.047)	(0.051)
Wald Chi^2	257.2	70919.0	254.9	8201.9	261.9	3545.4	1060.4	28449.4
2^{nd} order serial	-1.63	-1.67	-1.32	-1.32	-1.25	-1.22	-0.22	0.31
autocorrelation	(0.1033)	(0.0948)	(0.1864)	(0.1863)	(0.2113)	(0.2218)	(0.8236)	(0.7557)
N observations	844	844	844	844	844	955	955	1629
N countries	90	90	90	90	90	98	98	109

Note: Dependent variable is GSR (GS/GNI). Year dummies included, but coefficients not shown. * Significant at 5%, ** at 1%

Appendix I. World Bank estimates of GS.

Investment in produced capital, net foreign borrowing and *net official transfers* are obtained from the national accounts. Although *depreciation of produced capital* is not, estimates can be derived from data on produced capital formation. The World Bank uses estimates made by the United Nations Statistics Division. Note that net investment in produced capital and foreign assets are aggregated across both the private and public sectors. This means that we are not able to use government consumption or investment to explain GS rates.

Net depreciation of natural capital can be divided at a basic level into resource extraction on the one hand and environmental pollution on the other. The latter is conceptualised as the use of sink capacity in order for it to be equivalent to capital depreciation. The Bank estimates resource extraction for a range of fossil fuels (oil, natural gas, hard coal and brown coal), minerals (bauxite, copper, iron, lead, nickel, zinc, phosphate, tin, gold and silver), and one renewable resource (forests). Depreciation of natural capital due to resource depletion is computed as the product of price minus average costs of extraction multiplied by the volume of extraction: (P-AC)*R, where P is the resource price, AC is average cost and R is the volume of extraction (in the case of a renewable resource R represents harvest beyond natural regeneration). Average costs are used instead of the theoretically correct marginal costs due to a lack of data. Environmental pollution is taken to be the estimated damage cost of carbon dioxide emissions, where each metric tonne of carbon emitted is valued at US$20. This value is taken from Fankhauser (1995) and is below the median of the more recent meta-analysis of studies estimating the marginal damage of carbon contained in Tol (2005). Note that we omit the damage cost from carbon dioxide emissions from the estimation of GS, following Ferreira and Vincent (2003). This is justified because the damage cost of climate change to the environmental capital stock of a country is not equivalent to the damage of its emissions. Instead, it is the global concentration of carbon dioxide in the atmosphere, a function of global emissions, which matters in combination with the country-specific vulnerabilities to climate change, which are difficult to model. Empirically, it makes almost no difference to our estimations if the cost of carbon dioxide emissions is included in the GS measure.

Investment in human capital is calculated as net educational expenditures. This includes both capital expenditures as well as current expenditures that are counted as consumption rather than investment in the traditional national accounts.