Oil, Gas and Minerals: The Impact of Resource-Dependence and Governance on Sustainable Development[1]

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Abstract

It has often been argued that oil, gas and minerals may have a negative impact on development as measured by income per capita. This does not say much about sustainability, which is critical for developing countries whose economic growth derives primarily from the exploitation of exhaustible resources. We take adjusted net savings (ANS) per capita as an indicator of weak sustainability to examine the link between resource dependence and sustainable development, and look at specific governance and armed violence indicators. Since it is hard to disentangle the direct effect of governance on development in empirical studies, we use the relative size of the youth bulge as instrument. Our results highlight a negative relationship between natural resource exraction and ANS but indicate that this is not inevitable. Effective checks on the power of the executive appears to be critical for sustainable outcomes. Effective legislative chambers, an independent judiciary and broad acceptance of established institutions all have a positive impact on ANS per capita. Our results further confirm that armed conflict and armed violence as measured by the homicide rate have a negative impact on ANS. We conclude that extractive industries and donor agencies should expand their focus from community-development programmes to strengthening checks-and-balance mechanisms, and suggest avenues to make extractive resources a stake for peace rather than for violent rent seeking.

Key words: Resource curse, Governance, Genuine savings, Sustainable development, Dynamic panel data
JEL classification: Q56, O13, O43, O44

1. Introduction

Intuition suggests that states with abundant sub-soil assets in the form of oil, gas and minerals are in a position to draw large revenues from extraction that can be mobilized for economic development. In other words, resource abundance should be a blessing. Experiences to date display a mixed record. Industrialized countries like Australia, Canada and the United States succeeded in turning resource extraction into economic growth and development. More recently, developing countries like Botswana, Chile, Malaysia or South Africa reached the upper-middle income status, in part thanks to the extraction of natural resources. But other resource-rich economies such as Bolivia, the Democratic Republic of the Congo, Niger or Turkmenistan did not emulate these successes.

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This paper looks at the variables that help to explain different outcomes of extraction in terms of sustainable development as measured by adjusted net savings (ANS). The empirical literature so far tends to focus on the impact of resource richness on economic growth and income per capita. While this is an important metric for economic development, it does not say much about sustainability, which is critical in the case of exhaustible resources like oil and minerals whose production is bound to peak and cease at some point in time. Consistent with the resource-curse literature, the paper considers a range of governance and institutional indicators to assess the nexus between the extraction of resources and development outcomes. It examines the interactions between resource dependence, the quality of institutions and governance, armed violence and sustainable development in developing countries.

Our dynamic panel data analysis covers 96 developing countries over 24 years, from 1984 to 2007. We rely on the System GMM estimator (Arellano and Bover, 1995) to address the dynamic process between national income, resource extraction, investment and saving. Furthermore, we instrument armed violence and governance by the relative size of the youth bulge (15-24 year old). In this approach we follow Urdal (2004) who provided strong evidence that the size of the youth bulge affects a country's propensity for conflict, which is consistent with historical research on violence (Muchembled, 2008). Instrumenting the endogenous governance indicators with the time-varying size of the youth bulge allows to fully exploit the panel dimension of the dataset and leads to the following results: Specific governance variables yield a positive impact on sustainable development, like effective legislative chambers and the acceptance of established institutions while armed conflict has a strong, negative impact. Yet, other governance indicators do not have predictive power for ANS, including the level of (perceived) corruption and democracy.

The paper is structured as follows. Section 2 presents the capital approach to economic development and looks at the case of resource-rich upper-middle income countries. Section 3 provides the theoretical background on the economics and politics underlying our empirical model presented in section 4, together with the data and indicators. Section 5 discusses the results and section 6 concludes.

2. From Extraction to Development

Today, the vast majority of resource-rich economies are in the developing world (IMF 2007:62-63). And yet, the relationship between extraction and development is a controversial issue. There is little consensus about the transmission channels from the exploitation of non-renewable natural resources to sustainable development outcomes, and about the prerequisites to escape the resource curse, let alone if the curse argument is a valid one (Papyrakis and Gerlagh, 2004). Recent research shows that extractive booms have been more of a curse than a blessing for several resource-rich countries like the Democratic Republic of the Congo, Equatorial Guinea, and Nigeria. The main symptoms involve Dutch disease, rentier-state dynamics, rent-seeking behavior and armed violence (Mehlum et al., 2006; Collier and Goderis, 2008; Carbonnier 2007 and 2011).

2.1. The resource curse

Early contributions to the resource curse literature focused mainly on economic explanations including terms of trade, price volatility, the enclave nature of the extractive sector, and Dutch disease. Yet, as Ross (1999:307) puts it

> [T]o explain why these hardships lead to persistently slow growth – the resource curse – we must also explain why governments fail to take corrective action. Governments play an exceptionally large role in the resource sectors of almost all developing countries and, at least in theory, have the policy tools to mitigate each of these hardships.

Research has come to stress the political dimension of the resource curse, looking in particular at the role of the state. The rentier state theory, for example, holds that mineral rents reduce the necessity of the government to levy domestic taxes, rendering leaders less accountable to citizens and more prone to rent-seeking, corruption and patronage politics (Mahdavy, 1970; Beblawi and Luciani, 1987; Yates, 1996; Karl, 1996; Clark, 2007). Other authors highlighted that oil may hinder democracy (Ross, 2001) and that presidential democracies are more likely to face a resource curse than parliamentarian democracies (Andersen and Aslaksen, 2008).

While there is a consensus on the positive correlation between institutional quality and the development outcome of resource extraction, authors disagree on which specific institutions matter, and on whether the quality of institutions prior to windfall revenues is decisive or whether extractive rents deteriorate otherwise good institutions (Sala-i-Martin and Subramanian, 2003; Mehlum et al., 2006; Robinson et al., 2006; Pessoa, 2008; Collier, 2007; Brambor, 2008). A recent survey of the resource-curse literature concludes:

> The proposition that oil abundance induces extraordinary corruption, rent-seeking, and centralized interventionism and that these processes are necessarily productivity- and growth-restricting is not supported by comparative or historical evidence (...) The extent to which mineral and fuel abundance generate developmental outcomes depends largely on the nature of the state and politics as well as the structure of the ownership in the export sector. (Di John, 2011)

2.2. A capital approach

Most of the empirical literature on the resource-curse follows Sachs and Warner by assessing development outcome in terms of GDP growth (Sachs and Warner, 1997) and neglects variations in stocks. Under this logic, the exploitation of fossil fuels and minerals translates into immediate GDP growth without considering the concomitant depletion of the natural capital base. The exploitation of oil, gas and minerals in low-income countries offers a time-bound opportunity to mobilize domestic finance for development. The extractive rent will die off at some point, depending on the abundance of such exhaustible resources and the extraction pace (Stevens, 2011). In the long run, the development outcome hangs to a large extent on the allocation of the resource rents. In fragile states, the rents are all too often misappropriated, squandered in patronage politics and political repression rather than invested in infrastructure, health services and education. The rent tends to be perceived as a prize that can be captured through corruption and armed violence (Humphreys et al., 2007). The construction of lavish presidential palaces and monuments across gas-rich Turkmenistan may have contributed to GDP growth, but not to sustainable development.

This paper adopts a capital approach to capture the linkages between resource extraction and sustainability (Hamilton 2004:31), incorporating natural capital in calculating national income and wealth (Goodwin, 2007). We consider genuine savings as a measure of the development outcome, building on the idea that the total amount of capital in the economy should not be eroded over time. Hartwick (1977) sought to identify conditions under which constant consumption could be maintained indefinitely using the input from a finite stock of non-renewable resources. The 'Hartwick rule' not to erode the overall capital base while exploiting natural resources requires investing the resource rent in productive physical, human and social capital (Solow, 1974; Hartwick, 1977; Perman et al. 2003:89). Thus, genuine savings rather than GDP growth allow long-run economic sustainability (World Bank, 2006).

Genuine saving is often referred to as an indicator of "weak sustainability" since it rests on the unrealistic assumption that natural capital can be fully substituted by produced and human capital (Everett and Wilks, 1999; Thiry and Cassiers, 2010). In contrast, "strong sustainability" requires preserving the entire ecosystem for future generations. Genuine savings as an indicator of weak sustainability is nonetheless consistent with the UN definition of sustainable development as "development that ensures non-declining per capita national wealth by replacing or conserving the sources of that wealth; that is, stocks of produced, human, social and natural capital." (United Nations et al., 2003:4). The concept of wealth is based on a comprehensive list of assets which includes produced, natural, and intangible capital, ie. human and social capital (Goodwin, 2007). Resource extraction hence corresponds to a decumulation or disinvestment since it reduces the stock of natural capital. Genuine savings can nonetheless be maintained or even grow with compensatory capital accumulation.

Several efforts were made to develop indicators of sustainable development, based on the premise that sustainable development requires non-declining wealth per capita, that is non-declining physical, natural, human and social capital per person (Arrow et al., 2003). Dasgupta et al. (2002) and Hamilton (2002) show that assessing the development outcome of extractive activities through such a capital approach yields different results from considering GDP. Several countries with strong GDP growth actually record negative per capita net savings growth. Resource-rich countries that see their non-renewable resource capital base decline through extraction do not only have to define efficient extraction policies, but also strategies to maintain adjusted net savings for future generations. The World Bank has defined and calculated the ANS for 209 countries from 1970-2008 using the following formula (Bolt et al., 2002):

$$ANS_{it} = \underbrace{(GS_{it} - DEPC_{it})}_{\widehat{=}\text{Net Savings}} + EE_{it} - RRD_{it} - CD_{it}, \qquad (1)$$

where ANS_{it} is the adjusted net savings of country i at time t. It is composed of gross national savings GS_{it} net of the depreciation of produced capital $DEPC_{it}$, augmented by (non-fixed capital) expenditure on education EE_{it} and reduced by the rents from depletion of natural capital[2] and damages from carbon dioxide emissions CD_{it}.

We consider ANS as a proxy for sustainable development outcomes, based on the principles of environmental accounting or green national accounts that have been found to be significantly correlated with aggregate welfare (Gnègnè, 2009) and particularly useful to highlight resource-curse syndroms. Looking at oil and development in Nigeria for instance, the World Bank contends that, according to conservative estimates, the country could have accumulated a stock of produced capital by the year 2000 five times higher than the actual stock, had the country wisely reinvested its oil rents. As a consequence, oil would play a much smaller role in a more diversified Nigerian economy (World Bank, 2006). In 2007, Nigeria was enjoying a substantially higher GDP per capita than resource-poor countries like Vietnam and Laos but ranked lower on the Human Development Index (HDI) scale. Since the HDI includes health and education indicators in addition to income, one would expect lower public expenditure

[2]Natural capital includes gas, coal, forest, oil, metals and minerals such as bauxite, copper, gold, iron ore, lead, nickel, phosphate rock, silver, tin and zinc.

in health and education in Nigeria than in Vietnam and Laos. But Nigeria actually allocates a greater share of public expenditure to public health than Laos and a greater share to education than Vietnam (Carbonnier et al., 2010). Understanding these apparent paradoxes requires looking deeper into the quality of investments, public expenditures and services. Besides, Nigeria and many other resource-rich developing countries experienced or still experience high levels of armed violence related to rent-seeking behavior, which shortens planning and investment horizons (Geneva Declaration, 2010).

The World Bank ANS data have recently started to be used more often in the resource curse literature (e.g. Stoever, 2011; Barbier, 2010; Van der Ploeg and Poelhekke, 2010; Van der Ploeg 2010; Dietz et al., 2007). Previous studies looking at the determinants of net savings use the ANS ratio as dependent variable, that is ANS as percentage of national income. This raises endogeneity issues, especially when putting national income as one of the explanatory variables of the empirical model. This is why we consider per capita ANS in order to have a dependent variable that is free of the income metric. Following Barbier (2010), we exclude CO^2 damage from the ANS calculation since it suffers from methodological flaws and data are missing for most countries for the pre-2000 period. This may partly compensate for the fact that the World Bank's genuine saving figures based on market rather than accounting prices are susceptible to downwards bias (Van der Ploeg, 2010).

Figure 1 shows a negative relationship between genuine saving as a percentage of GDP and resource dependence, which is supported by several studies (Atkinson and Hamilton, 2003; Neumann, 2004; Dietz et al., 2007). Controlling for country-fixed effects and time-fixed effects, we find a negative and significant correlation of 0.77, which echoes the results of a World Bank study (World Bank, 2006) and is not surprising. Extracting oil, gas and minerals might increase GDP but reduces genuine savings *ceteris paribus*. Investment in education can play a critical role in partly offseting this impact (Gylfason, 2001). If we further consider the correlation between the sum of gross saving and education expenditures with resource rents, we find a positive with-in country correlation with a coefficient of 0.26.

2.3. The case of resource-rich UMICs

Over the last four decades, some developing countries managed to benefit from their mineral wealth to spur economic and social development. Today for example, Botswana, Chile, Colombia, Peru, and South Africa rank among upper-middle income countries (UMICs) with varying degrees of economic diversification and may offer useful lessons and insights for low-income countries (LICs) that are rich in fossil fuels and minerals. Figure 2 shows that all five countries registered an increase in per capita GDP over the sample period (1984-2007), although reflected more markedly with the commodity price boom in Colombia, Peru and South Africa since 2002. Chile started from the second highest level of GDP per capita in 1984 and has the highest level of GDP per capita in 2007. It experienced an average annual GDP growth of 4.45% over the whole period. Botswana experienced with 4.59% the strongest average annual GDP, ranking second in absolute terms in 2007 yet starting from the lowest level in 1984. The picture looks quite different with regard to the evolution of ANS per capita (Figure 3). Botswana shows a remarkably robust growth in ANS per capita while it remains very sluggish in the other four countries, including Chile. South Africa exits the sample period with a per capita ANS lower than in 1984, raising doubt about the sustainability of the development path.

How comes Botswana stands out as an exception and outperformed its peers, multiplying several times its

ANS per capita over the period? What explains in particular the fact that it does much better than Chile in terms of ANS per capita growth, which is not the case for GDP per capita? First, Chile's natural capital depletion increased in recent years to reach over 15% of GDP while it remained below 10% for Botswana. Second, Chile's national savings are just slightly higher than mineral depletion whereas net national savings in Botswana increased from \$143m in 1984 to \$3.68 bn in 2007, or nearly 30% of GDP. Third, Chile invested less in education relative to its GDP than Botswana: \$5.23bn or 3.6% of its GDP against more than 6% of GDP for Botswana. Consequently, Chile maintained a stable level of ANS per capita whereas Botswana's increased mainly due to investments in education and national savings.

Botswana elaborated an explicit policy of reinvestment of all its resource rents and established an indicator to monitor the policy implementation in the early 1990s: the "Sustainable Budget Index" (SBI), which loosely follows the Hartwick-Solow rule (Lange, 2004:259; Lange and Hassan, 2003). The SBI is the ratio of non-investment spending to recurrent (non-mineral) revenue. An SBI value below 1 means that current government consumption is sustainable because it is financed entirely out of revenues other than from minerals and that all the government revenues from minerals are invested rather than consumed. Accordingly, an SBI value greater than 1 means that consumption relies in part on the exploitation of exhaustible resources, which is fiscally unsustainable (Lange and Hassan, 2003). In 2007 the Botswanian government started to work on a more sophisticated formula to address SBI weaknesses such as the lack of clarity on what can be registered as investment and, more importantly perhaps, the quality of investments (Bank of Botswana, 2007).

In trying to explain the Botswanan success story compared to other African countries like Nigeria, Acemoglu et al. (2002) point to the fact that Botswana enjoyed already relatively solid private property institutions before diamond mining started in 1967. Botswana's political system, in part inherited from the pre-colonial era, was more inclusive and placed more effective constraints on the political elite than in other African countries.

3. The Economics and Politics of the Resource Curse

Our econometric model is based on the neoclassical, long-term growth framework. Saving is the fraction of output that is not consumed and depends on GDP as well as on the exogenous population growth (Solow, 1956 and 1974). In a first attempt to identify the determinants of genuine savings, Dietz et al. (2007) provide a brief overview of the major empirical studies on savings and argue that the most significant and robust explanatory variables for ANS include GDP per capita and growth and show that, counter-intuitively, interest rates and terms of trade do not appear to be significant. Hence, in our empirical model presented below with ANS per capita as dependent variable, we control for GDP per capita as well as for population and GDP growth. The variables of interest are extractive resource dependence and a series of governance and armed violence indicators that are included in turn in the set of covariates.

The resource-curse literature highlights four critical institutional variables: (i) political constraints on the executive power and effective checks and balances, (ii) the level and type of corruption, (iii) regime types, and (iv) armed violence and conflict. The first widely-cited example of the resource curse is the rapid decline of early modern Spain in the seventeenth century. Castile suffered from Dutch disease and the rentier-state syndrome as a direct result of the extraordinary amount of precious metals it extracted from its Latin American colonies. Drelichman and Voth (2008) show how the silver windfall eroded Spanish institutions at a critical point in time.

The country was evolving in the direction of limiting the power of the king in favor of the Cortes, a quasi-parliamentary body with representatives of the main cities of Castile, in which an emerging merchant class was to gain influence (North, 1973). But the revenues from the Latin American silver bonanza, which amounted up to a third of Spain's total revenues, allowed the king to set policies unchecked by any powerful actor outside the monarchy and to embark in costly war enterprises. This turned out to be fatal in Spain's competition with England and Flanders who succeeded in establishing effective checks-and-balance mechanisms on the power of the executive.

Kolstad and Wiig (2009), Rothstein and Teorell (2008) and others analyze institutions and the quality of governance from a political economy perspective, looking at different indicators and causal mechanisms to better understand which institutional variables play a major role in the extraction-development nexus. Rothstein and Teorell argue that impartiality in the exercise of governmental power is key to the quality of governance: "When implementing laws and policies, government officials shall not take anything about the case into consideration that is not beforehand stipulated in the policy or the law." We select specific governance indicators that serve as proxy for impartiality-enhancing institutions, drawing primarily from the Polcon V database. The database provides several measures of institutionalized constraints using a spatial model of political interaction that incorporates information on the number of independent branches of government with veto power, the effectiveness of legislative chambers, the independence of the judiciary, the strength and independence of sub-federal entities and the acceptance of these institutions by the population (Henisz, 2000, 2002 and 2006).

The level of corruption is a direct measure of impartiality whereby corruption can be defined as a violation of the impartiality principle (Kurer, 2005; Rothstein and Teorell, 2008). Barbier (2010) compares the effect of corruption on ANS in African and Asian resource-dependent economies between 1970 and 2003. In the case of African countries, it seems that it is corruption rather than resource dependency *per se* that negatively affects the ability to reinvest resource rents in productive and human capital, at least in the short term. Corruption does influence long-run growth in adjusted net saving rates in both Asian and African countries. Dietz et al. (2007) test the impact of institutional quality on ANS in resource-rich countries using indicators for corruption, bureaucratic quality, rule of law and political constraints on the executive. They find that it is primarily the level of corruption that has a robust impact on ANS in interaction with resource dependence, measured as share of exports. In contrast, Boos (2011) finds that bureaucratic quality exerts a greater influence than corruption. In our model, we use the corruption indicator from the Political Risk Index, which provides a combined expert-based measure of a country's rule of law and extent of government corruption.

The recent literature on resource dependence and political regime has produced mixed results regarding the effect of institutions and institutional quality. Mavrotas et al. (2011), for example, demonstrate that both point- and diffuse-type natural resource dependence retard the development of democracy and good governance. Stoever (2011) finds a significant positive relationship between good institutions and sustainability as measured by ANS. Using the unweighted average of the six (composite) indicators combined to the Worldwide Governance Indicators for the years 1996 to 2007, the quality of governance tends to have a greater influence on non-physical capital, that is [dis-]investment in human capital and natural capital than on physical capital. Andersen and Aslaksen (2008) find no resource curse in democracies with a parliamentary form of government while the poor performance of resource abundant presidential and non-democratic regimes leads to lower growth, understood as consequence of a less rigid budget constraint in presidential regimes. Collier and Hoeffler (2009) test the impact of democracy in resource rich economies on GDP growth from 1970-2001. They find that while the combination of high natural resource rents and open democratic systems in developing countries has been growth reducing, the existence of solid checks-and-balance mechanisms tends to offset this effect. The problem, they argue, is that political constraints are undersupplied in nascent democracies and further tend to be eroded by extractive resource rents in the medium to long-term. Cabrales and Hauk (2011) further show that weak institutions tend to lead to revolutions associated with resource discoveries. Tsui (2011) finds that the discovery of 100 billion barrels of oil pushes downward a country's democracy level by almost 20 percent, using the Polity IV Index in relation to indicators of oil endowment and discovery, oil quality and cost of exploitation. In our model, we test how far the nature of the regime impinges upon genuine savings by including Polity2 (Polity IV) as a measure of autocracy and democracy.

The relationship between resource dependence and armed conflict has been subject to controversies in the academic literature over the past years. Several authors argue that resource dependence tends to prolong armed conflicts (Di John, 2007), and that there is a link between the quality of governance, resource richness and conflict. Teorell (2009) finds some support for the hypothesis that civil war is associated with the lack of impartial institutions. Brunnschweiler and Bulte (2008) argue that there is no evidence of a causal relationship between natural resource dependence and armed conflict, and that resource abundance is actually associated with a reduced probability of civil war. Van der Ploeg and Rohner (2010) draw another conclusion by treating resource extraction as endogenous on the basis that fighting does affect the extraction pace. Whereas Lujala (2009) emphasizes that the location and type of resource matters, others link resource dependence and ethnic exclusion. Basedau and Richter (2011) argue that only situations of low abundance of oil per capita in combination with either high dependence of natural resources or geographical overlap of ethnic exclusion with oil reserve areas within autocracies provide conditions for the onset of civil war. To test the impact on ANS, we include in our model two violence indicators. The first indicator is drawn from the Uppsala Conflict Data Program and the second one builds on original data about armed violence (homicide rates) provided by the Small Arms Survey.

4. Econometric Specification and Data

We carry out a dynamic panel data analysis looking at 96 developing countries over 24 years, from 1984 to 2007. Our analysis relies on data from the World Bank's World Development Indicators. Among the 96 countries we analyze, we have 33 LICs, 34 LMICs and 29 UMICs. LICs make up for 34.38% of the observations meaning that they represent roughly one third of the sample and are not systematically underrepresented. A comprehensive list of countries and the number of observations per country can be found in table 1. The sample is restricted to developing countries because we aim at analyzing whether there are systematically different development outcomes for resource-rich developing countries versus resource-poor ones.

Our empirical analysis faces several endogeneity issues. We first address shocks that are time-varying but common across countries by including 23 year dummies. Heterogeneity across countries is dealt with by including country fixed effects. Second, since the data generating process is dynamic, current observations of the dependent variable depend on past realizations. Therefore, we include a lagged value of the dependent variable in the set of covariates. Third, some explanatory variables are predetermined and we do not have exogenous instruments for all of them. To tackle the endogeneity of the GDP measures we include only the lagged values of log per capita GDP and GDP growth. Thus, our basic econometric model looks as follows:

$$
\begin{aligned}
ANS_{it} = \quad & \beta_1 \, ANS_{i,t-1} + \beta_2 \, GDP_{i,t-1} + \beta_3 \, POP_{it} + \beta_4 \, RR_{it} + \\
+ \quad & \beta_5 \, GOV_{it} + \lambda_t + \nu_i + \varepsilon_{it}, \qquad (2)
\end{aligned}
$$

where our dependent variable ANS_{it} is the log per capita genuine savings of country i at time t. As per capita ANS is highly skewed we take its log expression. On average log ANS per capita is 4.50, which means that the average country has an ANS per capita of US$ 89.75. The variation of log per capita ANS with a standard deviation of 1.40 is large relative to the mean (see descriptive statistics in Table 2), which indicates large ANS fluctuations across time and countries. By definition, ANS can also be negative as illustrated by the minimum value in our dataset, namely -2.02.

The list of control variables includes the lagged dependent variable $ANS_{i,t-1}$, and the lagged level of log per capita GDP and lagged GDP growth as denoted by the matrix $GDP_{i,t-1}$. We further include population growth, population density and the percentage of the population living in rural areas; these variables are all collected in the matrix POP_{it}. Our measure of resource richness RR_{it} is export-based. It is a binary variable taking on the value of one whenever a country's exports from natural resources such as fuel, oil gas and minerals is at least 5 percent of GDP.

We further select a set of governance indicators GOV_{it} and include them independently in order to be able to account for the fact that they are endogenous. We first consider the extent of institutionalized constraints on the executive. The descriptive statistics in table 2 show that 79% of all country-time pairs have effective legislative chambers. However, an independent judiciary can only be found in 29.5% of the cases. We also consider a variable that takes on the value one if either effective legislative chambers or an independent judiciary exist and the value two if both are present. Besides, we analyze a measure on the acceptance of established institutions, which varies between 0 and 6 reflecting the degree to which the citizens of any country are willing to accept the established institutions. We further test the impact of corruption using a corruption index which also ranges from 0 to 6. Last but not least we consider a well-established measure of democracy, namely the Polity2 variable that ranges from -10 (strong autocracy) to +10 (strong democracy). With an average of 2.14 we have a very low level of democracy in the sample. However, the variation is considerable, it is roughly three times the mean.

Next to the effect of governance on sustainable development, we also want to analyze conflict and violence. For the occurrence of armed violence we have two measures. We use the standard conflict indicator from the UCDP/PRIO Armed Conflict Database (Harbom et al., 2009) that takes on the value one if there are at least 25 battle-related deaths in a given year. In 11.4% of our observations we witness violence that amounts to an armed conflict. In order to get a finer measure of the intensity of armed violence including urban and gang-related violence, we examine the homicide rate provided by the Geneva-based Small Arms Survey. However, this indicator is available only for a subsample of 84 countries, including those countries with only one observation, and for a subsample of 63 countries if we only include countries with at least two observations.

Besides, time-fixed effects are captured by λ_t and country-fixed effects by ν_i. Despite the lag transformation and the inclusion of the time- and country-fixed effects, estimating the above model with OLS does not do justice to the dynamic nature of the data. Therefore, we transform equation (2) in its difference form to dispose the country-fixed effects ν_i. The transformed disturbance $\Delta\varepsilon_{it}$ depends on ε_{it} and ε_{it-1}. Consistent estimates of the coefficients $\beta = (\beta_1, \beta_2, ..., \beta_5)'$ can be obtained for initial conditions $X_{i1} = (GDP_{i,0}, POP_{i1}, RR_{i1})'$ that are uncorrelated to subsequent disturbances ε_{it} for $t = 2, 3, \ldots, T$. Accordingly, the lagged level of $X_{i,t-2}$ is uncorrelated with $\Delta\varepsilon_{it}$ and serves as instrument. All lags dating back further than $(t-2)$ can also serve as instruments. Then, the first-differenced GMM estimator introduced by Arellano and Bond (1991) exploits the following moment condition:

$$E[ANS_{i,t-s}\Delta\varepsilon_{it}] = E[Z_i'\Delta\varepsilon_i] = 0, \tag{3}$$

for $t = 3, 4, \ldots, T$ and $s \geq 2$, where $\Delta\varepsilon_i = (\Delta\varepsilon_{i3}, \Delta\varepsilon_{i4}, \ldots, \Delta\varepsilon_{iT})'$ and Z_i is a $(T-2) \times m$ matrix of initial conditions. We consider the collapsed version of Z_i that restricts the instrument counts. Furthermore, we allow only for up to four periods of lagged instruments to be included. Our choice of the reduced instrument set is inspired by Roodman (2009) who shows that over-specified GMM systems might be severely biased. The (up to) four previous observations of log per capita ANS, log per capita GDP, GDP growth and population variables as well as resource-richness are collected in column vectors and combined to the matrix Z_i. Applying this instrumentation strategy gives credit to the dynamic data generating process while respecting the GMM assumption of large N and small T.

The difference estimator by itself suffers from one major limitation. It performs poorly when the series under study are (close to) random walks or when the variance of the individual effects increases relative to the variance of the transient shocks. As a consequence, past levels have little information about future changes in the variables as these changes represent the stochastic innovations. This means that the first differences instrumented with past levels will not identify the coefficients as the lagged levels are only weakly correlated with the first-differences. To circumvent this problem Arellano and Bover (1995) offer system GMM as solution. *In addition to* instrumenting first differences with lagged levels, levels are instrumented with differences. The system GMM has smaller finite sample bias and greater precision when using persistent series. This implies that a *second* moment condition can be exploited:

$$E[\Delta\, ANS_{it-1}(\mu_i + \varepsilon_{it})] = 0, \tag{4}$$

for $i = 1, 2, \ldots, N$ and $t = 3, 4, \ldots, T$. Thus, the system estimator relies on a stacked dataset with twice the observations –the transformed and the untransformed ones– of each individual country i. However, the second moment condition employs the untransformed country observations and does not account for country-level fixed effects. Therefore, we also include regional-fixed effects in our final specification. These regional-fixed effects are only exploited in the second moment condition as they are nested within the country-fixed effects. In the second moment condition the regional-fixed effects eliminate variation stemming from regional heterogeneity. In grouping our countries into regions we apply the definition given by the UNDP that classifies the countries of the world into 22 regions following sub-continental geography.

Furthermore, we do not instrument governance with its lagged observation but an exogenous instrument. The relative size of the youth bulge serves to identify the quality of governance. While *a priori* the size of the youth cohort does not have a direct impact on per capita ANS, it has been shown that the size of the youth cohort directly influences the propensity of conflict in a country (Barakat and Urdal, 2009; Urdal and Hoelscher, 2009; Urdal, 2004). We extend this rationale arguing that the relative size of the youth bulge can also be used to instrument governance since developing countries that have not, or have just started their demographic transition, displaying a higher share of young people tend to have weaker institutions and governance than those countries that have already moved towards a bigger share of the adult population. Our results confirm this intuition. As shown in equation (2) we include population growth, density and the percentage of the rural population in the set of covariates to account for demographic dynamics and to justify the use of the relative youth bulge as instrument. By analogy we follow Miguel and Roland (2011) who show that their use of a distance-based instrument is only valid when controlling for other distances in the structural equation.

5. Presentation and Discussion of Results

Starting with our choice of instument, we can verify that simple, "first-step" correlations show the expected sign. We find a negative correlation between the relative size of the youth bulge and all our governance indicators except corruption. Obviously, the intensity of the correlation varies. It is highest in absolute terms between the youth bulge and the Polity2-indicator, followed by the measure of the existence of legislative chambers. Thus, in line with our theoretical considerations we find that societies that have a relatively larger share of young people perform relatively worse in terms of governance and tend to be more corrupt as good practices seem not to be established, yet. We find a positive correlation between both the conflict dummy and the homicide rate and the youth bulge. This finding supports earlier research by Urdal (2004) that argues that the bigger the relative size of the youth bulge, the higher the propensity for conflict (compare bottom of Tables 3 - 5).

We present the dynamic panel data results in tables 3 - 5. In the first two tables we contrast different governance indicators and their explanatory power for genuine savings. In table 5 we present the specification that analyzes the connection between our measures of armed violence and ANS. Across specifications and indicators we only provide two-step estimates of the GMM models which make use of the efficient variance-covariance matrix. At the bottom of each table we present the number of observations, countries and instruments. All specifications with governance indicators cover the period 1984 to 2007, the specifications with measures of armed violence are restricted to the period 2003 to 2007 due to the lack of data availability for earlier periods. According to the Arellano-Bond test all empirical specifications are properly identified, we fail to reject validity of system GMM. Furthermore, the Hansen test fails to reject the validity of the instruments. Thus, it seems that the lagged dependent variables and the relative size of the youth bulge identify the endogenous variables properly. In two cases the p-value of the Hansen test is high (over 90%), indicating that the test is loosing its power to reject the null hypothesis of the invalidity of the instrument set. Yet, we only observe this for the homicide rate which is the "weakest" variable in our dataset because of a much lower number of observations.

In interpreting the results we start with some general observations that hold across all specifications. Our lagged dependent variable (lagged log per capita ANS) shows only a moderate level of persistence. Across specifications the coefficient associated with log per capita ANS is significantly lower than 0.5. The intuition one gets from the descriptive statistics and from the five case studies, namely that ANS varies substantially across countries and over time, is confirmed by the dynamic analysis. In turn, the lagged level of log per capita GDP has a high predictive power for contemporaneous genuine savings. In virtually all specifications the coefficient is more than twice as large as the coefficient associated with lagged log per capita ANS. Thus, income dynamics appear much more reliable in predicting genuine savings than past levels of ANS, which confirms the rationale for taking ANS per capita as dependent variable. GDP growth is also associated with a positive coefficient but turns out not to be significant. None of our covariates of population dynamics turns out to be significant. Nevertheless, we include them in the empirical specification with regard to both our choice of instrument and insights from neo-classical growth theory (Solow, 1956). Across all specifications and no matter what specific governance or armed violence indicator is included, we find a negative impact of resource richness on sustainable development as measured by ANS. The coefficient associated with resource richness is always significant at least at the 10% level, except for two out of the three specifications in which we consider armed violence (homicide rate). Moreover, the coefficient associated with resource-richness is similar in absolute terms to the one associated with the lagged dependent variable indicating the high economic relevance of the resource-curse.

We further test for the sensitivity of our results with respect to different resource-richness thresholds. Thus, instead of using the 5% of exports cut-off point we define higher and non-linear versions, including intensity specifications. We could not detect any non-linearities, which stronly supports the resource-curse argument with regard to ANS per capita. Yet, when we test the sensitivity of these results by changing the outcome variable from ANS to income the results with regard to the resource-curse do not hold through in our sample. Similar to many previous studies we take the log of GDP per capita and GDP growth as dependent variables to see whether the resource curse spells out as well. Employing exactly the same specification with four lags of the covariates as instruments the impact of resource-richness on log per capita GDP is -0.006 and is neither statistically nor economically significant. The same holds for GDP growth: While the actual coefficient estimate is bigger in absolute terms it lacks statistical significance as well. Consequently, our findings indicate that clear-cut resource-curse dynamics are at works when taking a capital approach but not so much when considering income flows. This result comes at a surprise with respect to much of the previous literature. From revisiting the literature we get the impression that previous status feature spurious results as they fail to address cross-country heterogeneity and issues of endogeneity.

Turning now to the interpretation of the different governance indicators, we present in table 3 results for the Polity2 indicator as in Kaufmann et al. (2008), the corruption indicator from the Political Risk Service database, and the acceptance of established institutions. We find no statistically significant relationship between ANS and democracy as measured by the Polity2 variable nor for corruption. The latter result comes as a suprise since the same corruption index has repeatedly been found to have a significantly negative impact on development in resource-rich economies, including when looking at genuine savings (Dietz et al., 2007). However, as already pointed to earlier, Dietz et al. take another specification of ANS which might suffer from endogeneity bias. Although the Polity2 indicator as a measure of institutional democracy versus autocracy (Marshall et al., 2010) does not seem to be related to sustainable development, our results indicate that people's acceptance of governance institutions matter more than the level of democracy *per se*, as we can see from column 3 of table 3. The coefficient associated with the acceptance of established institutions is economically and statistically significant indicating the importance of perceptions. The concrete mechanisms between a high acceptance of existing institutions and ANS or sustainable development policies deserves further investigation.

The formal regime type and the perception of corruption do not seem to matter as much as the existence of effective checks on the otherwise unrestrained power of the executive. We present results in table 4 for a range of indicators from the Polcon V database. The first dummy variable related to the existence of effective legislative chambers appears to matter much for sustainable development. We find that an effective legislative increases log genuine savings by 1.111. An independent judiciary also seems to be favorable to sustainable development. However, the coefficient associated with an independent judiciary is only significant at a *p*-value of 10.4%. We also consider the combined index of the existence of an effective legislative and an independent judiciary, which is significant at the 11.9% level. This set of results shows that the effectivenss of the legislative authorities and of the policies they set in place has high explanatory power for long-run sustainability, and that the credibility of the judiciary may play a critical supporting role.

It might be argued that our choice of instrument has no identifying power. However, when we employ empirical specifications with the lagged endogenous variable as instrument we do not get any better identification; in fact, in most cases we are not able to identify any effect. This holds true across specifications and governance indicators. This admittedly crude robustness check shows nevertheless that institutions are endogenous and failure to account for their endogenous nature biases the results (Acemoglu et al., 2001).

In table 5 we present results for the impact of conflict and violence on genuine savings, taking only the period 2003-2007 for which we have sufficient homicide rate data. Again, we use the relative share of the youth bulge as instrument. We find the expected result for armed conflicts, which are associated with a decrease in ANS per capita of -0.806. The result is significant at the 1% level. Once conflict is accounted for in the regression the negative impact of resource richness on sustainable development no longer spells out significantly. This result clearly shows the detrimental impact of conflict on long-term sustainability.

As the conflict dummy itself is often criticized a rather crude measure of armed violence we also test for a link between genuine savings and the homicide rate, taking new data made available by the Geneva-based Small Arms Survey. This is all the more relevant as extractive operations are often associated with socio-environmental conflicts within host communities that do not amount to an armed conflict but cause serious disruption in many resource-rich developing countries. Including the homicide rate in our set of covariates by replacing the conflict dummy, our sample size drops from 396 to 273 observations. This is a considerable reduction in the sample size, namely 31.06%, and it cannot be argued that countries drop out in a random fashion. Nevertheless, we find a negative coefficient associated with the homicide rate, but its significance level increases to 16.4% (Table 5, specification Homicide rate' (1)). Moreover, the Hansen test is close to one indicating that it looses all power to reject the null of non-overidentification, and this sample includes all countries including those for which we have only one homicide observation. Reducing the sample to countries for which we have at least two homicide observations in the period 2003-2007 we are left with 252 observations and 63 countries. Again, results show that the coefficient associated with the homicide rate is negative but it has no predictive power for sustainable development outcomes (Table 5, specification 'Homicide rate' (3)). However, there is a non-negligible problem with the homicide rate data whose availability is systematically higher for middle-income countries. Only 23.4% of the observations in the homicide specification come from LICs and, for this sub-sample of countries, our youth-bulge instrument might no longer be a good identification strategy because of the reduced sample variation. Therefore, we also look at a specification in which we identify the impact of the homicide rate by using its lagged value. Here the homicide rate turns out to be statistically significant, however, the economic significance is close to zero (Table 5 'Homicide rate' (2)). Moreover, the Hansen test is again close to one. While it seems that the homicide rate is an interesting variable to be exploited in future anaylses, to date we cannot establish a clear link between non-conflict violence and sustainable development.

6. Conclusion

We have examined the dynamic relationship between resource extraction, institutional quality, armed violence and sustainable development with a panel data covering 96 developing countries over 24 years. While the literature shows mixed outcomes of resource dependance on GDP growth and income per capita in developing countries, our results do not support the resoure-curse argument with regard to GDP but highlight a clear negative relationship between resource dependence and sustainable development as measured by genuine savings per capita. This is not surprising to the extent that, *ceteris paribus*, natural resource extraction reduces genuine savings. Yet, as the Bostwana example illustrates and our results indicate, this relationship can be averted if appropriate governance mechanisms and institutional arrangements are nurtured.

There is general agreement that governance matters a great deal for development, especially in resource-rich economies. Yet, it is hard to disentangle the direct effect of governance on development outcomes in empirical studies. In a novel approach we use the relative size of the youth bulge as instrument not only for armed conflict but also for the quality of governance to assess its impact on sustainable development. The presence of effective checks and balances restraining the power of the ruling elite seem to be critical to help reverse the negative development outcome of extraction. Effective legislative chambers together with an independent judiciary appear to be the most significant institutional variables, especially when these insitutions enjoy broad acceptance among the population. In our model, effective constraints on the executive show to be much more important determinants of sustainable development than indicators of democracy and even corruption when looking both at the relevant p-values and coefficient sizes. Our finding echoes explanations on the dynamics that presided over the decline of Spain in the sixteenth and seventeenth century in conjunction with the massive mineral exploitation in the Latin American colonies.

Beyond governance, our results show that armed conflict has a detrimental impact on genuine savings. The results for armed violence as measured by the homicide rate remain inconclusive, the period under review for which data is available being probably too short to draw conclusion. At the moment results hint at the fact that armed violence may negatively affect sustainable development outcomes. Since the number of armed conflicts has been declining in the aftermath of the Cold War while armed violence has become more pervasive, the relationship between natural resource extraction and armed violence in general requires further research, in particular with detailed country case studies that uncover the specific dynamics at work around extraction sites as well as at the sub-national and national levels in conjunction with rent-seeking dynamics.

Our results challenge the policies and programmes of extractive industries and aid agencies in resource-rich countries. Companies tend to invest in community-relation and community-development programmes, often with a view to securing their licence to operate on the ground. While some of these programmes may effectively meet the objective of providing essential services to host communities and improving the overall relations with them, multinational extractive industries tend to substitute state institutions whose popular acceptance may diminish further as a result. The same applies to non-governmental organizations supported by international aid agencies to deliver basic public services. Our results call for increased focus on strengthening checks-and-balance mechanisms, in particular with regard to the capacity of parliaments to exert effective constraints on the executive and on supporting the emergence of a credible judiciary. Some companies have taken steps in the right direction, for instance by supporting efforts to strengthen the judiciary in oil-rich countries, as has been the case of the Norwegian oil company Statoil in Venezuela with the support of local branches of the United Nations Development Programme and Amnesty International (Neset, 2003). This type of engagement may be politically sensitive, but appears highly relevant to promote more sustainable development outcomes. In the newly independent Republic of South Sudan for instance, oil plays a dominant role in economic development. Once economic sanctions are lifted, oil companies may support the international community in building effective legislative and judiciary institutions beyond their usual focus on host-community relations. They may also indirectly contribute to reducing the incentives for violent rent seeking by providing credible information on the likely amount of oil reserves and annual export flows, and thus on revenues to be reasonably expected in the coming years. Managing expectations may help rally former enemies around a development vision in which they feel that they can get their fair share in a peaceful context and that aggressive rent seeking would be counterproductive.

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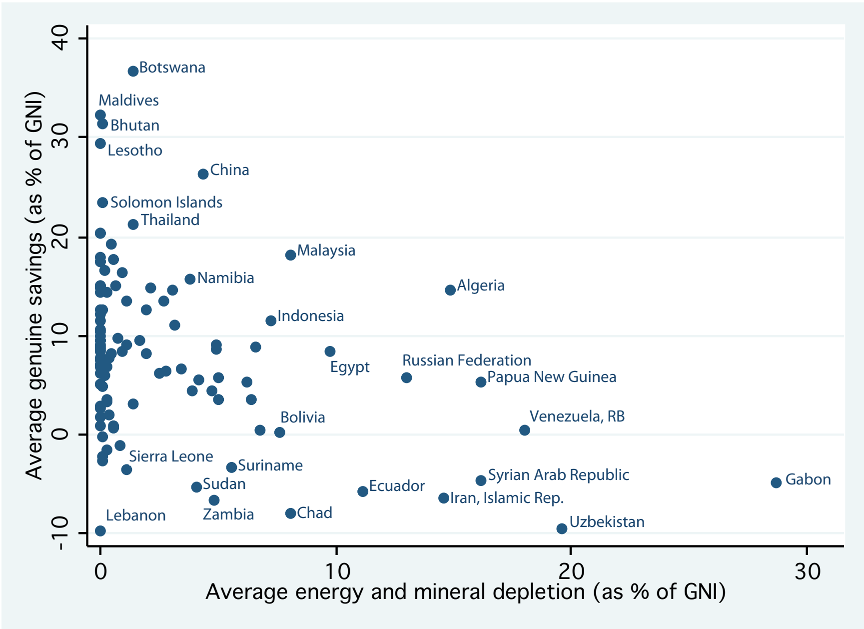

Figure 1: Relationship between genuine savings and depletion of energy and minerals for the sample of LICs, LMICs and UMICs in the period 1984-2007.

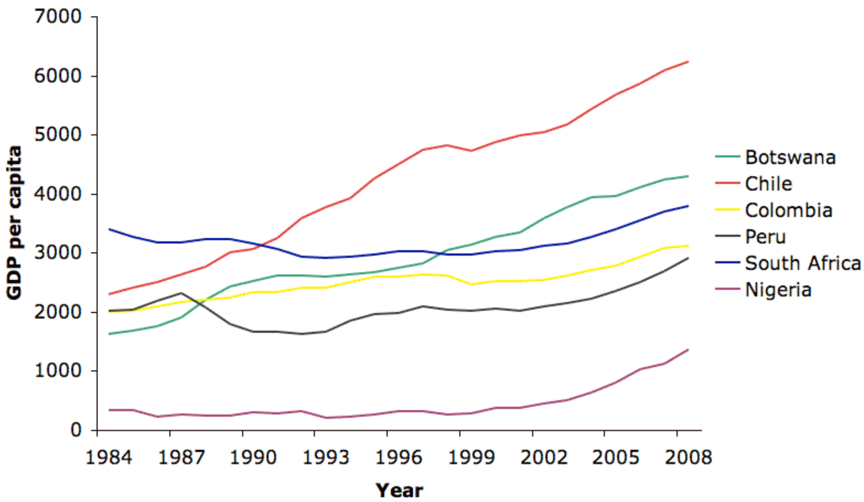

Figure 2: Evolution of GDP per capita over the period 1984-2007 for six selected countries.

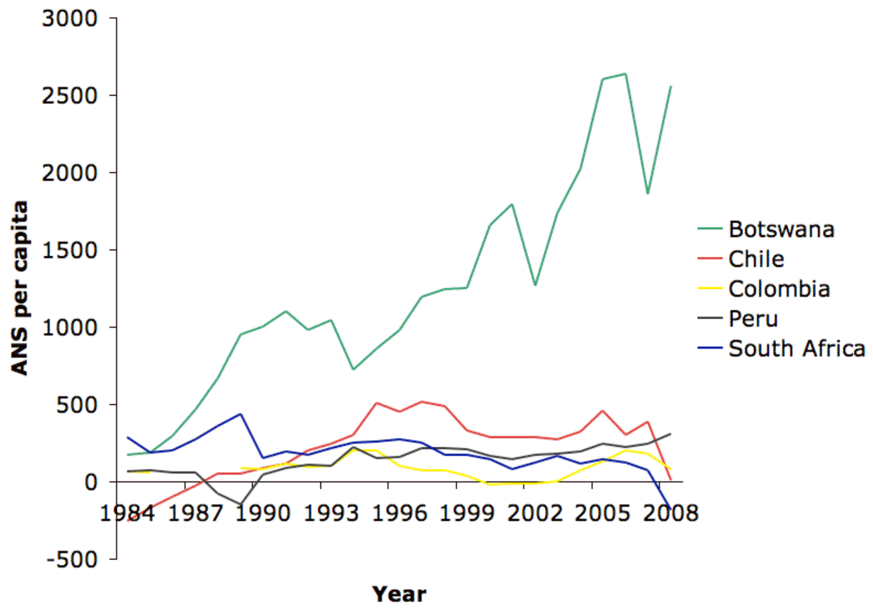

Figure 3: Evolution of ANS per capita over the period 1984-2007 for five selected countries. ANS is not available for Nigeria.

Country	Obs.	Country	Obs.	Country	Obs.
Albania	16	Gabon	7	Nepal	24
Algeria	19	Gambia, The	20	Nicaragua	14
Argentina	22	Georgia	9	Niger	5
Armenia	5	Ghana	21	Pakistan	24
Bangladesh	24	Guatemala	15	Panama	24
Belarus	16	Guinea	16	Papua New Guinea	18
Benin	13	Guinea-Bissau	13	Paraguay	24
Bhutan	9	Guyana	12	Peru	21
Bolivia	11	Honduras	24	Philippines	24
Botswana	24	India	24	Romania	12
Brazil	24	Indonesia	21	Russian Federation	10
Bulgaria	21	Iran, Islamic Rep.	8	Rwanda	24
Burkina Faso	19	Jamaica	22	Sierra Leone	6
Burundi	6	Jordan	24	Solomon Islands	9
Cambodia	6	Kenya	24	South Africa	24
Cameroon	21	Kyrgyz Republic	11	Sri Lanka	24
Central African Republic	9	Lao PDR	7	Swaziland	17
Chad	7	Lesotho	24	Syrian Arab Republic	3
Chile	19	Lithuania	14	Tajikistan	10
China	24	Macedonia, FYR	15	Tanzania	15
Colombia	16	Madagascar	13	Thailand	24
Comoros	20	Malawi	14	Togo	13
Costa Rica	24	Malaysia	24	Tunisia	24
Cote d'Ivoire	14	Mali	20	Turkey	24
Djibouti	14	Mauritania	8	Uganda	13
Dominican Republic	24	Mauritius	24	Ukraine	10
Ecuador	9	Mexico	22	Uruguay	24
Egypt, Arab Rep.	20	Moldova	11	Uzbekistan	2
El Salvador	22	Mongolia	16	Venezuela, RB	10
Eritrea	11	Morocco	24	Vietnam	14
Ethiopia	11	Mozambique	6	Zambia	4
Fiji	20	Namibia	17	Zimbabwe	20

Table 1: Alphabetical list of the 96 LICs, LMICs and UMICs that are considered in the regression analysis. For each country the maximum number of available observations is also presented.

Variable	Obs	Mean	Std. Dev.	Min	Max
Log ANS pc	1564	4.497	1.401	-2.017	7.878
Log GDP pc	1564	6.875	1.058	4.718	9.144
GDP pc growth (%)	1564	2.085	4.885	-46.892	37.839
Population growth (%)	1564	1.816	1.248	-8.271	11.181
Population density	1564	101.702	149.923	1.270	1211.896
Rural population (%)	1564	55.308	21.306	7.020	94.980
Resource richness	1564	0.230	0.421	0	1
Effective legislative chambers	1559	0.790	0.408	0	1
Independent judiciary	1531	0.295	0.456	0	1
Legislative and judiciary	1531	1.085	0.705	0	2
Acceptance of institutions	1250	3.183	1.198	0	6
Corruption	1235	2.669	0.988	0	6
Polity2	1564	2.141	6.399	-10	10
Conflict dummy	402	0.114	0.319	0	1
Homicide rate (per 100,000 inhabitants)	273	9.456	11.234	0.200	64.550
Youth bulge (%)	1561	10.457	9.250	0.136	23.200

Table 2: Descriptive statistics

	Polity 2	Corruption	Acceptance of institutions
Log ANS pc (Lag)	0.405***	0.362***	0.328***
	(0.073)	(0.110)	(0.109)
Log GDP pc (Lag)	1.204***	1.262***	0.458
	(0.316)	(0.339)	(0.436)
GDP pc growth (Lag)	0.007	0.013	0.007
	(0.007)	(0.008)	(0.007)
Population growth	-0.043	0.013	0.059
	(0.045)	(0.123)	(0.107)
Population density	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)
Rural population (%)	0.004	0.019	-0.018
	(0.017)	(0.018)	(0.021)
Resource richness	-0.401***	-0.307*	-0.344**
	(0.151)	(0.156)	(0.143)
Governane indicator	0.074	0.117	0.457**
	(0.060)	(0.340)	(0.196)
Observations	1564	1235	1250
Countries	96	73	73
Instruments	64	64	64
Years	1984-2007	1984-2007	1984-2007
AR(1) test in $1^{st}\Delta$ (p-value)	0.000	0.000	0.000
AR(2) test in $1^{st}\Delta$ (p-value)	0.332	0.194	0.152
Hansen test (p-value)	0.566	0.327	0.603
Correlation (Governane, Youth Bulge (Lag))	-0.147	0.260	-0.028
Lag structure	4 lags, collapsed	4 lags, collapsed	4 lags, collapsed

Table 3: Dynamic panel data estimates relying on System GMM are presented for three different policy indicators, namely: Polity2, Corruption and Acceptance of established institutions. Two-step estimates are shown. Robust standard errors are in parentheses. The lower part of the table shows the number of observations, countries and instruments, the Arellano-Bond specification tests (p-values) and the Hansen test (p-value). The relative size of the youth bulge is taken as exogenous instrument for the respective governance indicator. All specifications include time-fixed effects and regional dummies. ***, **, * incidate significance at the 1, 5 and 10% level respectively.

	Legislative chambers	Independent judiciary	Legislative chambers & independent judiciary
Log ANS pc (Lag)	0.396***	0.389***	0.376***
	(0.067)	(0.069)	(0.067)
Log GDP pc (Lag)	1.046***	0.832***	0.931***
	(0.182)	(0.229)	(0.208)
GDP pc growth (Lag)	0.007	0.007	0.006
	(0.004)	(0.006)	(0.006)
Population growth	-0.031	-0.023	-0.029
	(0.038)	(0.053)	(0.051)
Population density	0.001	0.001	0.001
	(0.000)	(0.000)	(0.001)
Rural population (%)	0.002	-0.009	-0.006
	(0.013)	(0.011)	(0.014)
Resource richness	-0.302**	-0.329**	-0.293*
	(0.142)	(0.133)	(0.154)
Governane indicator	1.111*	0.797^a	0.465^b
	(0.583)	(0.486)	(0.296)
Observations	1559	1531	1531
Countries	95	95	95
Instruments	64	64	64
Years	1984-2007	1984-2007	1984-2007
AR(1) test in $1^{st}\Delta$ (p-value)	0.000	0.000	0.000
AR(2) test in $1^{st}\Delta$ (p-value)	0.438	0.450	0.470
Hansen test (p-value)	0.782	0.569	0.609
Correlation (Governance, Youth Bulge (Lag))	-0.087	-0.026	-0.063
Lag structure	4 lags, collapsed	4 lags, collapsed	4 lags, collapsed

Table 4: Dynamic panel data estimates relying on System GMM are presented for three different policy indicators, namely: Legislative chambers, independent judiciary and the sum of the two. Two-step estimates are shown. Robust standard errors are in parentheses. The lower part of the table shows the number of observations, countries and instruments, the Arellano-Bond specification tests (p-values) and the Hansen test (p-value). The relative size of the youth bulge is taken as exogenous instrument for the respective governance indicator. All specifications include time-fixed effects and regional dummies. ***, **, * incidate significance at the 1, 5 and 10% level respectively. Superscripts ^{a}, ^{b} indicate significance at the 10.4 and 11.9% level respectively

	Conflict dummy	Homicide rate (1)	Homicide rate (2)	Homicide rate (3)
Log ANS pc (Lag)	0.334***	0.076	0.078	0.142
	(0.105)	(0.159)	(0.160)	(0.154)
Log GDP pc (Lag)	1.099***	1.661**	1.674**	1.117**
	(0.370)	(0.657)	(0.638)	(0.521)
GDP pc growth (Lag)	0.004	0.035**	0.038***	0.030**
	(0.017)	(0.013)	(0.014)	(0.016)
Population growth	0.016	0.900*	0.417	0.735*
	(0.146)	(0.491)	(0.426)	(0.406)
Population density	0.000	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.001)
Rural population (%)	0.005	0.005	0.028	0.007
	(0.020)	(0.029)	(0.037)	(0.039)
Resource richness	-0.210	-0.403	-0.617**	-0.392
	(0.247)	(0.328)	(0.271)	(0.334)
Conflict dummy	-0.806***	-0.036[a]	-0.033*	-0.033
	(0.182)	(0.025)	(0.018)	(0.047)
Observations	396	273	288	252
Countries	87	84	88	63
Instruments	46	46	50	46
Years	2003-07	2003-07	2003-07	2003-07
AR(1) test in $1^{st}\Delta$ (p-value)	0.002	0.076	0.066	0.068
AR(2) test in $1^{st}\Delta$ (p-value)	0.358	0.301	0.329	0.267
Hansen test (p-value)	0.792	0.927	0.908	0.653
Correlation (Governane, Youth Bulge (Lag))	0.051	0.145	–	0.115
Lag structure	4 lags, collapsed	4 lags, collapsed	4 lags, collapsed	4 lags, collapsed

Table 5: Dynamic panel data estimates relying on System GMM are presented for two indicators of violence, namely: a conflict dummy and the homicide rate. Two-step estimates are shown. Robust standard errors are in parentheses. The lower part of the table shows the number of observations, countries and instruments, the Arellano-Bond specification tests (p-values) and the Hansen test (p-value). The relative size of the youth bulge is taken as exogenous instrument for the respective conflict and violence indicators. Three specifications are presented for the homicide rate. Specification (1) includes all homicide observation between 2003 and 2007 and instruments the homicide rate with the relative size of the youth bulge, specification (2) instruments with the lagged observation of the homicide rate and specification (3) uses a subsample of countries for which at least two observations are available. All specifications include time-fixed effects and regional dummies. ***, **, * incidate significance at the 1, 5 and 10% level respectively. Superscript [a] indicates significance at the 16.4% level