

Resource Intensity, Institutions, and Development

ERWIN H. BULTE

Tilburg University, Netherlands

RICHARD DAMANIA

University of Adelaide, Australia

and

ROBERT T. DEACON *

University of California, Santa Barbara, USA

Summary. — We examine the relationship between resource abundance and several indicators of human welfare. Consistent with the existing literature on the relationship between resource abundance and economic growth we find that, given an initial income level, resource-intensive countries tend to suffer lower levels of human development. While we find only weak support for a direct link between resources and welfare, there is an indirect link that operates through institutional quality. There are also significant differences in the effects that resources have on different measures of institutional quality. These results imply that the “resource curse” is a more encompassing phenomenon than previously considered, and that key differences exist between the effects of different resource types on various aspects of governance and human welfare.

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1. INTRODUCTION

Conventional economic reasoning suggests that increasing a country's stock of assets provides greater opportunities for economic growth. Somewhat paradoxically, a substantial body of empirical evidence demonstrates that natural resources tend to hinder, rather than promote economic growth. The seminal and influential studies of [Sachs and Warner \(1997, 2001\)](#) show that after controlling for a wide variety of variables, an increase of one standard deviation in natural resource intensity leads to a reduction of about 1% per year in economic growth. This result has been coined the “resource curse,” and it inspired a large volume of subsequent empirical research. While the results are robust with respect to the inclusion of many conditional variables, they have also been challenged (e.g., by [Manzano & Rigobon, 2001](#), who focus on debt overhang, and [Stijns, 2002](#), who emphasizes learning processes).

Economic growth *per se* is a poor indicator of welfare. It is conceivable that even if natural resources are a curse for economic growth narrowly defined, they may lead to improvements in other aspects of welfare—such as the prevalence of poverty, malnutrition, and infant mortality. It is an open question to what extent growth dividends, if any, percolate to other perhaps more vulnerable members of society.

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The record of growth in recent decades shows that many countries with low per capita growth rates have succeeded in providing food security and meeting basic nutritional needs, while others with higher growth rates have failed (Thomas, Daclam, Dhareshwar, Kaufman, & Lopez, 2000). The link between resource abundance and underdevelopment is therefore unknown, *a priori*.

The main objective of this paper is to analyze whether the negative statistical relationship between natural resource abundance and economic growth has a parallel in measures of *economic underdevelopment and welfare*. While underdevelopment and welfare clearly are not independent of economic growth, there are important differences between these variables. Underdevelopment and welfare indicators are typically expressed as “levels,” whereas economic growth is measured as a change in levels over time.¹ Levels capture differences in economic performance over long time periods, and are directly relevant for welfare as measured by the consumption of goods and services (Hall & Jones, 1999). Empirical work by Easterly, Kremer, Pritchett, and Summers (1993) reports relatively low correlation of growth rates across decades, suggesting that differences in growth rates across countries may be transitory and that a focus on “levels” may be appropriate. Moreover, underdevelopment and welfare indicators capture distributional considerations that are not captured by aggregate growth statistics. For example, some indicators capture the population share for which the so-called basic human needs are met. This information complements income growth statistics to provide a more complete picture of the effect of resources on well being in society (also see Acemoglu, Johnson, & Robinson, 2001b, and in particular Davis, 1995, who compares indicators of development for mineral and nonmineral exporters, finding no evidence that mineral exporters perform worse).

The paper is organized as follows. In Section 2, we review the theoretical and empirical literature on the relationship between resource abundance and economic growth. Building on this literature, we develop an empirical model to analyze the impact of resources on underdevelopment and welfare. This model is outlined in Section 3. In Section 4, we present the empirical results and discuss the main implications for development policies. Section 5 concludes.

2. THE RESOURCE CURSE AND ITS IMPLICATIONS

Why might resource-rich countries grow slower than resource-poor ones? In the 1950s, several “structuralist” explanations were developed, focusing on declining terms of trade for primary commodities (e.g., Prebisch, 1950), sharp fluctuations in the prices of such commodities, or lack of linkages between resource extraction enclaves and the rest of the economy (Hirschman, 1958). None of these explanations have stood the test of closer empirical scrutiny (e.g., Behrman, 1987; Cuddington, 1992; Dawe, 1996; Fosu, 1996; Lutz, 1994; Moran, 1983; Tan, 1983).

In more recent times, economists and political scientists have advanced new theories to explain the disappointing growth performance of resource-rich countries, and these theories appear to be converging. In this section, we briefly review the main economic explanations for the resource curse: Dutch disease models, rent seeking models, and institutional explanations.²

One class of hypotheses, of which the Dutch disease is most famous, postulates that a resource boom will divert a country’s resources away from activities that are more conducive to long run growth. A resource boom causes a country’s exchange rate to appreciate, which in turn induces a contraction in its manufacturing exports, or draws capital and labor away from manufacturing, raising manufacturing costs as a result (Neary & van Wijnbergen, 1986). But this in itself need not induce lower growth rates, since growth in the resource sector could more than offset stagnation in manufacturing. To explain why resource booms may generate lower growth, it is often assumed that the manufacturing sector is the main “engine of growth,” because it either generates positive externalities or is subject to increasing returns to scale at the level of the sector (Matsuyama, 1992; Sachs & Warner, 1999; Torvik, 2001).³

There is little empirical support for the Dutch disease as an explanation for the resource curse. Perhaps this comes as no surprise. An overview of different case studies in Auty (2001a) demonstrates how complex and diverse the experiences of different resource-rich countries are. There are many exceptions to the resource curse both in the developed and developing world—countries that have used their resources to build modern and successful economies. In recent statistical analyses, terms of trade effects typically do not appear as significant determi-

nants of growth rates either (Leite & Weidmann, 2002; Sala-I-Martin & Subramanian, 2003).

The second category of explanations revolves around the potentially destructive role of rent seeking in resource-rich countries. Rent-seeking models are built on the assumption that resource rents are easily appropriable, which in turn leads to bribes, distortions in public policies, and a diversion of labor away from productive activities and toward seeking public favors (Torvik, 2002). The available evidence suggests that resources are a curse to development only for some countries and not for others, however, so the basic rent-seeking explanation is too blunt. There have been attempts to enrich rent-seeking models with multiple equilibria, where comparative statics are conditional on the specific equilibrium that prevails. In such systems, the effect of resource abundance on growth becomes context-specific and essentially determined by "initial conditions" (e.g., Acemoglu, 1995; Baland & Francois, 2000). Mehlum, Moene, and Torvik (2002) point out that the growth effects of resource abundance might depend on a country's governance institutions and carry out an institution-specific analysis of the resource curse, regarding institutions as pre-determined or "fixed".

The third category of explanations also sees a connection between resources and institutions, but finds that the type of resource matters and regards the form of government (and its policies) as the salient institutional feature. For example, Atkinson and Hamilton (2003) argue that the curse might follow from host countries' inability to manage resource revenues sustainably, resulting in lower or negative rates of "genuine savings" (savings adjusted for resource depletion). In other words (macroeconomic) policies matter. Interestingly, in his examination of transition economies, Auty (2001a, 2001b) argues that resource-rich countries, especially those with the so-called "point resources" like oil fields, tend to be dominated by factional and predatory oligarchic polities, governments that promote narrow sectional interests (see also work by the political scientists Karl, 1997, and Ross, 2001b). Countries well endowed with point resources, then, are expected to have "bad policies," and suffer from the so-called rentier effects, repression effects, or policies that postpone the transition to competitive industrialization and diversification of the economy.⁴ One possible outcome, then, is that the resource sector supports a bur-

geoning nontradable sector made up of infant industries and an inflated but unproductive public sector.

There is now ample empirical support for the key role that political and institutional variables play in economic growth. Leite and Weidmann (2002, hereafter LW) were among the first to show that resource abundance is a major factor shaping the institutional context. LW demonstrated that there is no *direct effect* of resource wealth on economic performance, but there is an important *indirect effect*: resources affect the level of corruption, which in turn determines growth. In other words, resource abundance could help shape the "social infrastructure," the importance of which has been demonstrated by Hall and Jones (1999).

This important result has been confirmed and placed in a more general context in two recent papers by Isham, Woodcock, Pritchett, and Busby (2003, hereafter IWPB) and Sala-I-Martin and Subramanian (2003, hereafter SS). IWPB and SS do not only examine corruption, arguably just one dimension of institutional quality, but instead try to find alternative and broader governance indicators (see our own analysis below). They find that when we fail to control for institutional quality, there is a negative relation between resource abundance and economic growth.⁵ However, *given* a certain level of institutional quality and price volatility, natural resources appear to have no separate direct effect on growth. Institutional quality does affect growth, and is negatively correlated with "point resources" such as fuels and mineral measures (the indirect effect of resources). Food and agricultural products, which are diffuse natural resources, are *not* significantly correlated with institutional quality.

The latter observation suggests that "point" or concentrated resources result in "worse" institutions, but "diffuse" resources do not.⁶ Point resources are extracted from a narrow geographic or economic base and include oil, minerals, and plantations. The fact that these resources are spatially concentrated implies that they can be protected and controlled at a relatively modest cost. An abundance of these resources is typically associated with inequality in terms of power and the division of the surplus, and often is accompanied by vertical relationships between agents (shareholders, managers, laborers). Diffuse resources, on the other hand, are spread thinly in space, and harvested or utilized by agents characterized by

horizontal relationships of rough equality. Formal theories for this phenomenon are scarce.

The overall picture that emerges is that the direct effect of resource wealth on economic growth disappears whenever institutional quality is controlled for, however, an important indirect effect exists. Certain types of resource wealth negatively affect the quality of institutions, and institutional quality in turn is an important determinant of economic growth.⁷ We will refer to this as the LW-IWPB-SS approach in what follows, and explore to what extent its implications carry over to indicators of human welfare and development, which represent levels rather than growth rates.

3. DATA AND EMPIRICAL PROCEDURE

Our aim is to explore the impact of natural resources (NR), possibly channeled through institutional quality (IQ), on several human development indicators (DI). The multivariate analysis extends work by Davis (1995), who compares development performance of mineral exporters and nonmineral exporters. The basic maintained hypothesis is that human development is affected by institutional quality and by income per worker. This is consistent with results on public goods provision reported in Deacon (2003). Both IQ and GDP per capita (GDP/cap) are, in turn, potentially affected by natural resource wealth, implying an indirect link between DI and NR. Our empirical approach allows us to examine these indirect links and to test for the presence of an additional direct link, i.e., an association between NR and DI when holding IQ and income per worker constant.

We run three different regression equations. First, akin to early empirical work on economic growth, we explore the reduced form association between NR and DI when IQ and current GDP are *not* included as explanatory variables, and explore whether a “resource curse” emerges for our set of development indicators. Our reduced form “development equation” is specified as follows:

$$DI = a_0 + a_1 * \text{conditioning variables} + a_2 * 1970 \text{ GDP/cap} + a_3 * NR + e. \quad (1)$$

In light of earlier evidence discussed above, we consider both point and diffuse resources. The conditioning variables include factors other than NR that are hypothesized to deter-

mine growth of GDP or the development of IQ. The NR coefficient should capture indirect resource-development associations that operate through the channels of institutional development or growth of GDP, plus any direct association that may be present. An important control variable that we use when estimating (1) is 1970 per capita income. This allows us to capture the initial short-term windfall gains of a resource boom, and isolate them from long-run “erosive” impact of resource wealth on institutional quality (see Karl, 1997, for a discussion of these dynamic processes). In keeping with the underlying causal story, a current measure of DI is used, while NR is measured at a point in the past.

Second, we attempt to unravel the determinants of institutional quality. Here, the specification we adopt is motivated by the work of SS:

$$IQ = b_0 + b_1 * NR + b_2 * 1970 \text{ GDP/cap} + b_3 * \text{enrollment} + b_4 * \text{investment price} + b_5 * \text{English fraction} + b_6 * \text{European fraction} + e. \quad (2)$$

Current institutional quality is expected to depend on an indicator of historic resource abundance and several control variables: initial GDP/cap, 1960 school enrollment which proxies initial period human capital, the 1970 relative price of investment goods and the fraction of population speaking English or another major European language as first language. (SS provide a discussion that motivates the choice of these conditioning variables.)

Finally, we test for the presence of a direct effect of NR on DI, i.e., an effect that is not transmitted through either IQ or GDP per capita. As noted earlier, we model DI as determined by current IQ and current GDP per capita and include NR as an additional determinant to test for the presence of a direct resource-development effect:

$$DI = c_0 + c_1 * NR + c_2 * IQ + c_3 * \text{GDP/cap} + e. \quad (3)$$

Earlier work by SS and others revealed that per worker GDP is not independent from institutional quality. Guided by empirical results of SS we express current GDP/cap as a function of exogenous factors plus IQ, and substitute these factors in (3).⁸ Institutions thus potentially affect development through two channels: a di-

rect governance effect and an indirect effect through per worker income—both effects are captured by coefficient d_2 in Eqn. (3') that we estimate:

$$DI = d_0 + d_1 * NR + d_2 * IQ + d_3 * \text{conditioning variables} + e. \quad (3')$$

The conditioning variables in (3') are those nonresource factors thought to determine either GDP growth or institutions. The variables we include here are 1970 GDP per capita and 1970 price of investment goods. In addition, we test to see if our results are sensitive to the conditioning variables included, and the inclusion of other ones.

Eqn. (3') is a counterpart to the usual growth models estimated by other researchers. The hypothesis that natural resource abundance has no (or a diminished) direct effect on DI, once IQ is controlled for, is tested by checking the significance and magnitude of d_1 .

Definitions, sources, and summary statistics for the variables used in empirical work are presented in Tables 6 and 7. The current DI variables we employ are the percentage of the population that is undernourished, the UN Human Development Index (HDI),⁹ life expectancy at birth, and the percentage of the population without access to an improved water source (No Water). As IQ variables, we consider current (1998) values of the World Bank's: rule of law (RL) indicator and indicator of Government effectiveness (GE). RL is an index that measures the extent to which agents abide by the rules of society. It is comprised of indicators for the protection of property rights and the predictability of the judiciary. GE measures the capacity of the government to formulate and enforce policies, and it measures the quality of the civil service and bureaucratic efficiency. The main focus of this index is on measuring inputs that are deemed necessary for the efficient provision of public services.¹⁰ Table 8 reports the set of countries used in the various regression analyses.

Following Isham *et al.* we distinguish between point and diffuse resources. Accordingly, we disaggregate export data into two classes: (i) Fuels, Ores, and Minerals, which we regard as point resources, and (ii) Agricultural products and Food, which are deemed diffuse resources.¹¹ While widely used, the data by the World Development Indicators omit precious stones and gold as mineral (point) resources, which implies that a word of caution is in order

before interpreting the results. Failure to capture rents arising from gold and gems is clearly inappropriate (but not readily remedied). Finally, in keeping with virtually all of the resource curse empirical literature, we use resource exports as a share of total exports to indicate resource abundance and use 1970 as a reference point (for initial GDP/cap and resource abundance).¹² Summary statistics are reported in Table 7.

4. RESULTS OF REGRESSION ANALYSES

We estimate three equations: an institutional quality equation (Eqn. (2) above) and two "development" equations (Eqns. (1) and (3) above). We examine alternative measures of NR, IQ, and DI; hence, the total number of regression equations estimated is considerable. Because observations are scarce, our empirical approach is conservative in the number of conditioning variables included. For each model, we estimate and report a baseline specification that includes relatively few conditioning variables. We then describe how the coefficients of interest were affected by altering the specification, either to add additional determinants or to remove variables that appear in the baseline.¹³ Table 1 summarizes the results of the first development regression, Eqn. (1), where we explore the correlation between resource abundance (point and diffuse resources) and development indicators, while *not* controlling for institutional quality.

The outcomes are consistent with earlier empirical work on the resource curse. Initial GDP/cap unsurprisingly positively impacts subsequent development. Once we control for initial per capita GDP, point resources always have a negative and significant impact on all the development variables in these "baseline" models. That is, given any initial level of per capita GDP, countries with a greater reliance on point resources perform worse than others. *Ceteris paribus* they have lower HDI scores and life expectancy, and higher percentages of the population that suffer from undernourishment or lack of access to safe water—and the results are significant in three out of four cases. The same does not apply for diffuse resources. While only one of the four coefficients for diffuse resource intensity is significant (at the 10% level), they suggest a reverse effect: diffuse resources are associated with positive

Table 1. *Explaining development: the impact of resources and income*

	HDI	Undernourished population	No Water	Life expectancy
<i>Point resources</i>				
Constant	-0.54* (-5.72)	136.05* (5.03)	99.3* (3.33)	-8.82 (-1.01)
GDP/cap 1970	0.16* (14.87)	-16.31* (-4.79)	-10.46* (-2.59)	9.28* (9.36)
Investment price 1970	-0.13* (-6.03)	14.43* (3.92)	11.28* (3.09)	-8.18* (-4.06)
Point resources	-0.001* (-2.38)	0.14* (1.98)	0.14* (1.96)	-0.05 (-1.58)
% European language	0.03 (1.33)	12.01** (3.00)	-4.16 (-0.67)	3.35 (3.19)
% English	-0.02 (-91)	-4.87 (-1.21)	-8.66 (-1.89)	-3.86 (-1.91)
$R^2 = 0.84, N = 90 \quad R^2 = 0.46, N = 66 \quad R^2 = 0.41, N = 66 \quad R^2 = 0.73, N = 90$				
<i>Diffuse resources</i>				
Constant	-0.67* (-5.17)	140.62* (4.86)	93.32* (2.70)	-23.35** (-1.88)
GDP/cap 1970	0.17* (12.39)	-15.46* (-4.72)	-8.67* (-2.02)	10.56* (8.33)
Investment price 1970	-0.12* (-5.44)	13.42* (3.66)	9.69* (2.74)	-7.47* (-3.91)
Diffuse resources	0.0005 (1.17)	-0.11** (-1.65)	-0.026 (-0.33)	0.05 (1.50)
% European language	0.03 (1.22)	10.32* (2.40)	-9.43 (-1.44)	3.05** (1.94)
% English	-0.03 (-1.20)	-4.68 (-1.07)	-4.34 (-0.96)	-4.26* (-2.06)
$R^2 = 0.82, N = 100 \quad R^2 = 0.44, N = 74 \quad R^2 = 0.38, N = 75 \quad R^2 = 0.73, N = 100$				

* Significant at the 5% level.

** Significant at the 10% level.

development outcomes.¹⁴ The resource curse therefore appears to spill over from just economic growth to a broader set of development indicators.

Next, we turn to the institutional quality regression, Eqn. (2). Table 2 reports results. In this table, the columns correspond to two different indicators of institutional quality in 1998, the dependent variables in the regression equations. Our primary interest is in the relationship between 1970 measures of point and diffuse resources, and 1998 values of institutional quality.

Table 2 suggests that, all else equal, countries with abundant point resources end up with worse institutions, and governments that perform poorly along several dimensions.¹⁵ Countries with abundant diffuse resources show no tendency to follow this pattern. This is consis-

tent with results reported by LW-IWPB-SS. Another interpretation consistent with Table 2 might be that institutions determine the production and output mix of countries—countries with bad institutions fail to develop a competitive base and may therefore remain exporters of primary products. While such reverse causality cannot be ruled out, we argue that this interpretation is less apt given that we use a historic measure of abundance (and 1970 GDP/cap—not GDP/cap growth between 1970 and the present) and a current measure of institutions. This lends some support for our interpretation. Nevertheless, it is understood that the debate about causality in the literature on institutions and growth is ongoing (e.g., see Glaeser, La Porta, Lopez-de-Silanes, & Shleifer, 2004, and the references contained therein) and cannot be settled here. To analyze causality in greater

Table 2. *Natural resource abundance and the quality of institutions*

	RL	RL	GE	GE
GDP/cap 1970	0.41* (2.66)	0.52* (3.21)	0.35* (2.26)	0.49* (3.20)
Enrollment	0.03* (4.94)	0.02* (2.94)	0.03* (4.96)	0.02* (2.80)
Investment price	-0.25 (-2.04)	-0.36* (-2.72)	-0.20 (-1.34)	-0.27 (-1.72)
% English	-0.07 (-0.22)	0.19 (0.54)	-0.20 (-0.54)	0.05 (0.13)
% European language	-0.15 (-0.68)	-0.30 (-1.28)	0.02 (0.10)	-0.12 (-0.49)
Constant	-3.86* (3.27)	-4.26* (-3.62)	-3.45* (-2.86)	-4.02* (-3.64)
Diffuse resources	-0.002 (0.90)		0.03 (1.00)	
Point resources		-0.007* (-2.02)		-0.009* (-2.20)
	$R^2 = 0.70, N = 97$	$R^2 = 0.73, N = 87$	$R^2 = .60, N = 97$	$R^2 = 0.65, N = 87$

RL = rule of law, GE = government effectiveness.

* Significant at the 5% level.

detail, one might resort to considering changes rather than levels of development indicators. Unfortunately, our data on institutional quality do not go back further in time than 1996.

We tested the sensitivity of these results to alternative specifications and found the coefficients of primary interest to be robust to different measures of school enrollment, adding trade openness as an additional explanatory variable, adding a measure of initial income inequality, and deleting individual conditioning variables from the models reported in the table.¹⁶

The absolute magnitude of point resources on institutional quality is readily assessed. The standard deviation of the variable "Point/Export" is 30.4 (see Table 7). A country whose Point/Export index falls by one standard deviation would increase the RL and GE variables by 0.21 and 0.27, respectively. This may be contrasted with the standard deviation of these variables, which are 1.12 and 1.14 (see Table 7).

The magnitudes involved are further detailed in Table 3, where we report beta coefficients of key explanatory variables. Beta coefficients are computed by multiplying a regression coefficient by the standard deviation of its variable, and then dividing the product by the standard deviation of the dependent variable. They indicate the magnitudes of associations between variables in terms of their standard deviations; for example, the -0.21 coefficient relating Rule

Table 3. *Relative magnitudes of natural resource effects on institutions*

Variables	Rule of law	Government effectiveness
Point resources	-0.21	-0.27
% English	0.04	0.01
% European language	-0.11	-0.01
GDP/cap 1970	0.41	0.38
Enrollment	0.39	0.39
Investment price	-0.18	-0.10

of Law to Point resources indicates that a 1 standard deviation change in the point resource variable is associated with a 0.21 standard deviation change in a country's RL index. The magnitudes of the effects of point resource abundance are smaller than those of education and initial income, but larger than those of the other explanatory variables.

Next, we turn to results of the development equation, identified as (3') earlier. The initial expectation is that each indicator of development is enhanced by better institutions and by higher GDP/cap, and GDP/cap in turn is also enhanced by better institutions (which now replace the language shares as explanatory variables). Accordingly, we hypothesize two ways in which better institutions can enhance development outcomes. Our IQ variable will capture both of these if we include the noninstitutional

determinants of current GDP per capita, rather than including GDP/cap directly. Table 2 established that, controlling for other factors, point NR abundance is negatively associated with IQ. Thus, a finding that IQ variables are in turn significantly related to development indicators would imply that the resource curse applies to development outcomes indirectly, through the governance channel. We also include NR as a separate regressor in DI models, to determine whether resource abundance also has a *direct* effect, after accounting for other channels. In Table 4A and B, we summarize key results for the two institutional measures introduced earlier: RL and GE.

A fairly consistent story emerges from Table 4A and B. First, a higher initial GDP per worker is consistently associated with better development outcomes. Note that a negative coefficient on certain indicators, such as the percentage of the population that is undernourished, corresponds to a positive effect on development.

Second, conditional on initial GDP/cap and noninstitutional factors determining its subsequent growth, better institutions are associated with improved development. The signs of the coefficients consistently support this conclusion and the effect is significant in 12 out of 16 cases and marginally significant in one additional case. It is interesting to note that some indicators appear more responsive to institutional quality than others—compare the robust impact of institutions on the HDI indicator versus the more ambiguous impact on lack of access to safe water. As we note in the concluding section, formal theories of the resource curse are not sufficiently well developed at this point to shed light on why these results occur.

Third, the effect of natural resources on development indicators is generally weakened when controlling for institutional quality.¹⁷ Holding GDP/cap and institutions constant, point resource abundance has *no significant association* with development indicators in six of the eight cases examined, and is only significant at the 10% level in the remaining two cases. For only one development indicator, access to safe water, does resource intensity remain significant and of approximately the same magnitude after institutional quality is included. For the other three development indicators, HDI, percentage of population undernourished, and life expectancy, including institutions either causes the association with point resources to become diminished, statisti-

cally insignificant, or both. This general observation suggests that institutional quality is the main causal channel through which point resources affect development outcomes.¹⁸ Once again, we cannot rule out reverse causality: countries at higher levels of development may simply have greater resources to create better institutions, which in turn generate even higher levels of development. In the absence of good instruments for institutional quality, this issue cannot be satisfactorily resolved here.¹⁹

How important is the impact of institutional quality and natural resources for the various development and welfare indices in a quantitative sense? In the first two rows of Table 5 we show beta coefficients for IQ; i.e., we report how lowering the RL and GE variables by 1 standard deviation affects development. It appears that, in general, the RL variable has a larger effect on development indicators than the GE variable.

From these estimates, we glean that the effect of better institutions on development and human welfare is sizeable. For HDI, population without access to safe water, and life expectancy, a 1 standard deviation improvement in the RL or GE moves a country's development outcome upward by about one-fourth of a standard deviation. Such an improvement amounts to a 4% reduction in the population lacking access to safe water and a 3.3-year increase in life expectancy.

The total effect of point resources, including effects that operate through institutions and through other channels, may be obtained by computing beta coefficients from the estimates in Table 1. (Because they do not hold constant either institutional quality or current GDP/cap, the reduced form estimates in Table 1 reflect the overall association between resources and development.) These beta coefficients are shown in rows 3 and 4 of Table 5. A 1 standard deviation decrease in point resource intensity is associated with improvements in undernourished populations and access to safe water of about 0.25 standard deviation. The estimated effects of point resource intensity on the HDI and life expectancy are roughly one-half as large. These general magnitudes can be compared to existing evidence on the adverse effects of (point) resource intensity on economic growth. For example, IWPB report that a decrease of 1 standard deviation in the resource index yields an increase in the annual per capita growth rate of about 0.5. Since the standard deviation of the growth variable is about 2.4,

Table 4. *Explaining development*

	HDI	Undernourished population	No Water	Life expectancy
Panel A: Rule of law				
<i>Point resources</i>				
Constant	-0.31* (-2.65)	75.24* (3.03)	88.26* (3.98)	2.35 (0.20)
GDP/cap 1970	0.12* (8.97)	-8.07* (-2.66)	-9.37* (-3.31)	7.92* (5.63)
Investment price	-0.11* (-5.32)	7.68* (2.30)	9.91* (2.97)	-7.61* (-3.76)
Point resources	-0.0005 (-1.53)	0.04 (0.68)	0.14** (1.86)	-0.04 (-1.15)
Rule of law	0.04* (3.40)	-11.38* (-4.35)	-6.00* (-1.95)	1.98** (1.82)
	$R^2 = 0.86, N = 90$	$R^2 = 0.57, N = 66$	$R^2 = 0.43, N = 66$	$R^2 = 0.74, N = 90$
<i>Diffuse resources</i>				
Constant	-0.38* (-2.68)	78.20* (3.07)	85.82* (3.33)	-7.99 (-0.0)
GDP/cap 1970	0.13* (8.47)	-7.94* (-2.87)	-8.11* (-2.76)	8.63* (6.04)
Investment price	-0.10* (-4.76)	7.42* (2.27)	8.81* (2.98)	-6.61* (-3.51)
Diffuse resource	-0.0005 (-1.43)	-0.05 (-0.81)	-0.04 (-0.59)	0.06* (1.74)
Rule of law	0.05* (4.78)	-11.61* (-4.84)	-7.50* (-2.70)	2.75** (2.88)
	$R^2 = 0.85, N = 100$	$R^2 = 0.57, N = 74$	$R^2 = 0.41, N = 75$	$R^2 = 0.73, N = 100$
Panel B: Government effectiveness				
<i>Point resources</i>				
Constant	-0.36* (-3.32)	84.94* (3.67)	102.54* (4.57)	-1.54 (-0.14)
GDP/cap 1970	0.13* (10.37)	-9.28* (-3.25)	-11.12* (-3.93)	8.42* (6.51)
Investment price	-0.12* (5.69)	9.54* (2.68)	11.43* (3.38)	-8.04* (-4.01)
Point resources	-0.0005 (-1.59)	0.04 (0.54)	0.14** (1.89)	-0.04 (-1.20)
Government effectiveness	0.03* (3.36)	-9.83* (-3.62)	-2.36 (-0.90)	1.38 (1.50)
	$R^2 = 0.86, N = 90$	$R^2 = 0.56, N = 66$	$R^2 = 0.40, N = 66$	$R^2 = 0.73, N = 90$
<i>Diffuse resources</i>				
Constant	-0.47* (-3.37)	88.52* (3.62)	102.20* (3.85)	-15.44 (-1.19)
GDP/cap 1970	0.14* (9.45)	-9.29* (-3.52)	-10.12* (-3.35)	9.58* (7.03)
Investment price	-0.11* (-5.00)	9.22* (2.65)	10.23* (3.23)	-7.20* (-3.73)
Diffuse resource	0.0005 (1.31)	-0.04 (-0.79)	-0.04 (-0.55)	0.06** (1.680)
Government effectiveness	0.035* (3.99)	-10.22* (-4.09)	-3.69 (-1.45)	1.61* (2.02)
	$R^2 = 0.84, N = 100$	$R^2 = 0.57, N = 74$	$R^2 = 0.37, N = 75$	$R^2 = 0.73, N = 100$

* Significant at the 5% level.

** Significant at the 10% level.

Table 5. *The quantitative impacts of institutional quality and natural resources on welfare*

	HDI	Undernourished population	No safe water	Life expectancy
Rule of law	0.25	-0.71	-0.34	0.17
Government effectiveness	0.19	-0.62	-0.13	0.12
Point resources	-0.12	0.22	0.27	-0.11
Diffuse resources	0.07	-0.19	-0.05	0.12

the relative effect amounts to about 0.20 of a standard deviation in the growth rate. This is similar to the responsiveness we estimate for undernourished populations and safe water; they are roughly twice as large as our estimates for life expectancy and the HDI.

As noted in an earlier comparison of Tables 1 and 4, our results indicate that, with one exception, the association between resource intensity and development operates to a large extent through the channel of institutional quality. That is, when one controls for the effect of institutions, the association between resources and development generally becomes small and/or insignificant. The exception is access to safe water, which exhibits a strong, significant association with point resource intensity even after the effect of institutional quality is controlled.²⁰

It is perhaps tempting to interpret these findings as an argument against exploiting (point) resources, but that would be misconstruing our results. Extraction of point resources is typically characterized by a “boom-and-bust” pattern. We show that the boom (the early windfall gain, captured by the initial income variable GDP/cap1970 in our analysis) contributes positively to later development, and therefore works in an opposite direction than the institutional results highlighted in Tables 2–4. One correct interpretation of our main results is as follows. All else equal, increasing GDP is good for both development indicators and institutional quality. However, for a *given* level of income, having that GDP derived from extraction of point resources adversely affects subsequent institutional quality and development outcomes. The net effect of a greater resource endowment is thus unclear. It raises initial GDP, which is “good,” but it shifts the mix of GDP toward point resources, which is “bad”. To analyze the net effect of point resource extraction on development one should follow another methodological avenue. For example, one could compare the development trajectories of a set of countries with comparable income levels *before* resource stocks were discovered in some of these countries (as op-

posed to controlling for income *after* the discovery). This is left for future work.

5. CONCLUSIONS AND DISCUSSION

We have examined whether the paradoxical result that resource-rich countries tend to grow slower than their resource-poor counterparts also applies to the relationship between resource wealth and several measures of human development. In other words, we extend the literature on the resource curse by considering a broader set of welfare and development criteria.

Our main findings are consistent with the consensus that appears to be emerging in the resource curse and growth literature. After examining several alternative models and measures of institutional quality and human development, we find that *point resources* (as reported by the WDI, omitting certain high-rent resources such as gems and gold) are typically associated with less productive social institutions (lower GE and RL scores).²¹ Interestingly, point resources are assets that can be easily controlled by relatively small groups in society, often resulting in a highly skewed distribution of income. Isham *et al.* discuss why point resources might trigger bad scores on such governance indicators. One potential explanation is that elites in control of point resources resist industrialization, which would dilute their power base. The result is delayed modernization and lower levels of development. Another explanation is that export composition affects social structure—think of horizontal relationships between agents based on equality and cooperation versus systems geared by clientelism and distrust (see also Ross, 1999). We conclude that formal modeling of the linkages between resource endowments and institutional structure should be a high priority for those who seek to understand how the resource curse works.

Our second result is that countries with unproductive institutions tend to score lower on various development indicators. This im-

plies that the resource curse is a phenomenon that occurs at a broader scale than just economic growth—countries that rely on point resources tend to perform worse across a spectrum of criteria. This reinforces a conclusion that others have reached: institutional reform may well be a necessary condition for countries to develop. Finally, if the effects of GDP/cap and governance are accounted for, both point and diffuse resource abundance typically have no significant impact (or only a weakened impact) on development. The exception to this general result is the variable Access to Safe Water, whose coefficient is unaffected by including institutional proxies. In any event, it appears that the impact of resources on development is mainly indirect, occurring through channels of institutional quality.

Our analysis indicates a significant association between development and resource intensity. Whether the magnitudes of these overall effects, and the portions that operate through institutional quality, are large or small is a matter of individual judgment. They are quite possibly small enough to be mitigated or reversed by the adoption of enlightened social and economic policy, perhaps at the prompting of an international development agency. There is, however, a large empirical literature which indicates that pro-development policy improvements and aid require a sound institutional framework to be effective. Our finding that re-

sources have a large, robust, negative impact on institutions suggests that resource rich countries, with poorer institutions, are more likely to be trapped in conditions that render such policy improvements ineffective. If so, the indirect consequences of resource richness could be more enduring and far reaching than our estimates indicate.

Future research arguably should be based on other measures of resource abundance. Following [Sachs and Warner \(1997\)](#), most studies measure resource abundance by the share of natural resource exports in GDP (or total exports). This is of course a direct measure of a country's resource export dependence, and as a flow measure it is at best only an imperfect proxy for a country's actual resource stock. Export shares will not be an accurate measure of resource abundance unless there is a consistent and invariant mapping between *in situ* resource stocks and annual exports of these stocks.²² A skeptic could argue that the generic SW regression merely demonstrates that primary export intensity hampers growth, and dismiss the more far-reaching proposition that resource abundance impedes growth. To demonstrate convincingly that resource abundance is indeed a curse, and that the results now so prominent in the literature are not spurious, future empirical analysis needs to be based on measures of resource stocks (see [Stijns, 2002](#)).

NOTES

1. While the focus of the resource curse literature is to explain *income growth* over a given period, empirical models nearly always include the initial income level as a regressor. Accordingly, the resulting specification can be regarded as a model that explains the link between the historic level of resource abundance and current income (conditional on a past income level). The human development models we estimate in Section 3 follow a parallel specification. We estimate the relationship between historic resource abundance and current human development, conditional on past income.

2. [Ross \(1999\)](#) provides a discussion and critique of the political explanations—closely linked to our third category of economic explanations. In addition to these explanations there exists a rather disparate set of alternative theories and findings that might fit in the puzzle as well. For example, [Collier and Hoeffler \(1998\)](#) demonstrate that increased endowments of natural

resources raise the probability of civil war, with detrimental growth impacts. This occurs up to the point where primary commodity exports to GDP equals 27%; thereafter, the impact is negative. This includes most of the countries in the sample used by [Collier and Hoeffler](#).

3. Some commentators argue that there is little evidence to suggest that a dependence on natural resources is intrinsically growth retarding. Mining may be as technically advanced and knowledge intensive an industry with as much capacity to generate positive spillovers as, say, manufacturing. Similarly, productivity gains in agriculture and forestry have been fuelled by high-tech innovations with both forward and backward linkages to other sectors in the economy (an example being the Green Revolution).

4. For a critical assessment of this idea, see [Davis \(1998\)](#) who emphasizes the heterogeneity of mineral

exporting countries and argues that “ethnic fractionalization” may be responsible for poor economic performance.

5. For more work on the relationship between natural endowments and institutions, please refer to [Acemoglu, Johnson, and Robinson \(2001a\)](#), [Bourguignon and Verdier \(2000\)](#), [Easterly and Levine \(2003\)](#), [Ross \(2001a\)](#), and [Sokoloff and Engerman \(2000\)](#).

6. [Isham et al. \(2003\)](#) have shown that the resource curse result spills over to some agricultural products, or more correctly, modes of agricultural production associated with certain crops, but not to others. Countries that heavily depend on plantation crops like coffee, cocoa, and bananas, appear to suffer from effects similar to those dependent on minerals and fuels.

7. This should not be misconstrued as an argument against the extraction of (point) resources. Mineral and oil exports are often of a boom-and-bust nature, and therefore it is possible that such exports give an impetus to income in early periods (possibly with favorable consequences for development in later periods). Therefore, even if we can ascertain that point resources adversely impact on institutions and that institutions are important for development, it is not possible to claim that the *net effect* of resource intensity or abundance on development is negative. To make such a claim would involve controlling for the impact of resource exports on initial income (but there are insufficient data to do this). We thank an anonymous referee for highlighting this interpretation, and we return to this issue in Section 4.

8. SS find that “average price volatility in the country’s terms of trade” and “average overvaluation of the exchange rate” are insignificant variables in explaining GDP/cap, and these will therefore not be included. We excluded “the prevalence of malaria in 1,800” because it is only available for a relatively small sample of countries, and the relatively unimportant variable measuring “coastal population density in 1970” as we did not have ready access to it.

9. The Human Development Indicator conflates three variables (GDP/capita, life expectancy, educational attainment) that tend to be correlated. In countries where correlations are low, it may be for the same sort of institutional reasons highlighted in this paper. We thank an anonymous referee for pointing this out.

10. Another proxy of IQ would be the Voice and Accountability (VA) variable that is constructed from various indicators capturing the extent to which citizens participate in the selection of government and the freedom of the press. We have also included this variable

in various regressions, but found it yielded disappointing results. While VA is significant and of the expected sign in Eqn. (1) and significantly affected by NR in Eqn. (2), it did not perform well as an explanatory variable in Eqn. (3'). Therefore we do not report the VA results in the various tables below, but they are available upon request. It is important, however, to highlight that different measures of IQ apparently have different effects on the performance of welfare or development indicators.

11. Since some agricultural output will be produced on plantations, the “diffuse resource” class is broad and possibly not homogeneous. However, we are mainly interested in the impact of point resources. In our sample the two resource measures are highly correlated, and including both in one regression results in large standard errors for each. Consequently, we have inserted them separately in the various models. However, because the resource types are correlated, we cannot precisely separate their individual contributions to development outcomes.

12. Our results may be sensitive to the base year chosen to measure resource abundance. For example, as mentioned by one referee, according to that choice, Botswana is classified as a nonresource exporter, which is clearly not appropriate in light of developments in Botswana’s mining sector since then. However, 1970 has become very common, indeed nearly the default year, in empirical work on the resource curse. In addition, [Davis \(1995\)](#), p. 1772 argues that “mineral endowment related comparative advantages are very slow to change”. During the period 1970–91, only one country left the set of mineral dependent economies in 1970 and 1991 (Tunisia). In contrast, Davis identified 10 newly mineral based countries during this period (among which Botswana). However, to avoid problems with causality, we have chosen not to explore the implications of a more recent base year. We argue that historic resource abundance shapes current institutions; by considering more recent base years, this interpretation would become more debatable, with institutions also coshaping export patterns, for example. However, we did explore the robustness of our results to omitting the newly mineral based countries identified by Davis (Botswana, Angola, Niger, Papua New Guinea, Syrian Arab Republic, South Africa, Cameroon, Togo, and Ecuador). Our main results are robust with respect to excluding these countries (details available from the authors upon request).

13. We tested for heteroscedasticity (specifically, that error terms are not independent of predicted values of the dependent variable) and found evidence of it in several of the models estimated. While the regression

coefficients retain desirable properties under heteroscedasticity, their estimated standard deviations do not. For this reason, we used White's method for estimating a heteroscedasticity consistent covariance matrix.

14. This result is robust to the exclusion of conditioning variables. As an additional sensitivity test, we examined the impact of including school enrollment, population growth, and Gini coefficients. They are significant in some instances but not in others, and while the signs of resource coefficients are robust to these changes, including these new variables sometimes diminishes the resource intensity coefficients (but not always).

15. As mentioned in footnote 9, we also found—but do not report—that point resource intensity tends to be associated with low scores for the Voice and Accountability variable, which is a measure of democratic outcomes.

16. Adding the Gini coefficient for the period 1970–75, led to a substantial decline in the sample size. The finding that diffuse resources have no impact on the IQ measures was unaffected. However, adding the Gini coefficient caused the coefficient of point resources to fall in the Rule of Law (RL) and Government Effectiveness (GE) equations. It is possible that this volatility in magnitudes is a consequence of the sharp decline in sample size, from 85 to 46 observations. However, it is useful to note that the general qualitative conclusion continues to hold—point resources have a deleterious impact on IQ measure, but diffuse resources do not.

17. We have done an extensive sensitivity analysis to examine the robustness of this result. We have included 1960 school enrollment rates, population growth, and Gini coefficients and find that the qualitative findings with respect to resource intensity and institutional quality are unaffected.

18. This general conclusion is robust to the inclusion of additional explanatory variables, such as schooling, population growth, and inequality. The one contrary finding, that point resource abundance exhibits a significant association with access to safe water after institu-

tions are included, is not similarly robust. Adding either population growth or school enrollments to this model renders the coefficient on the resource term insignificant.

19. We experimented with the Hall and Jones instruments for IQ (European and English language fractions). While the results were broadly supportive of our conclusions they were not robust. We attribute this to the weakness of these instruments as proxies for IQ. We are unaware of any stronger instruments for IQ for our sample of countries.

20. The indirect resource-development association that operates through the institution channel could be estimated by combining results on the resource-institutions association with results on the institution-development association. This cannot be done by simply combining coefficient estimates from Tables 2 and 4 because these coefficients may well be correlated with one another. If so, simply multiplying the two together would yield a biased estimate of their product. An unbiased estimate could be obtained by estimating the two sets of models as a system, but this exercise is beyond the scope of this paper.

21. As emphasized above, we obtain our results by controlling for income in 1970. To the extent that resource abundance affected GDP in 1970 (say due to windfall gains) there is an additional effect to consider, and the net effect of point resource abundance (or intensity) on development is unclear from our analysis.

22. The Sachs–Warner proxy may even be inaccurate as a measure of export intensity. For instance, when using the share of natural resource exports in GDP, Singapore, with its very high proportion of processed re-exports of natural resources, is classified as highly resource abundant. To correct for this anomaly, Sachs and Warner adjust Singapore's resource endowments by using net resource exports as a proportion of GDP as a proxy for Singapore's resource endowments. But it is evident that the gross measure of exports used for all other countries will overestimate the true level of resource exports for any country involved in the re-export of primary products.

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APPENDIX A. DATA SOURCES AND SUMMARY STATISTICS

See Tables 6–8.

Table 6. *Data sources and definitions*

Variable	Source	Definition
Undernourished population	FAO	Percentage of population that is undernourished, 1998–2000
HDI	HDR	Human Development Index in 2001
No water	HDR	% people without access to safe water 2000
Life expectancy	HDR	Life expectancy 2001
GE	KKM	Government effectiveness in 1998
RL	KKM	Rule of law in 1998
Diffuse resources	WDI	Diffuse resource exports (food and agricultural exports) as a share of total exports, 1970
Point resources	WDI	Point resource exports (fuels and minerals) as a share of total exports, 1970
English fraction	H&J	Fraction of the population speaking English as first language
European fraction	H&J	Fraction of the population speaking a major European language as first language (English, German, French, Spanish, or Portuguese)
GDP/cap 1970	S&W	Log of GDP per member of economically active population (ages 15–64) in 1970 in PPP US\$
Enrollment	S&W	Enrollment rate in secondary education in 1960
Investment pr.	S&W	Investment price

Sources:

FAO, UN Food and Agriculture Organization;

HDR, UN Development Programme, *Human Development Report* online;

WDI, World Bank, *World Development Indicators* online;

KKM, Kaufmann, Daniel, Aart Kraay, and Mastruzzi, 2003 (cited in references);

Polity, Marshall, Monty G., and Keith Jagers, 2000 (cited in references);

H&J, Hall and Jones, 1999 (cited in references);

S&W, Sachs and Warner, 1997 (cited in references).

Table 7. *Summary statistics*

Variable	Obs.	Mean	Std. dev.	Min	Max
Undernourished population	62	20.919	18.555	0	73
HDI	84	0.699	0.200	0.275	0.944
No water	61	22.25	16.35	0	62
Life expectancy	84	65.521	13.462	33.4	81.3
GE	94	0.184	1.144	−2.14	2.59
RL	94	0.141	1.121	−1.97	2.36
Diffuse resources	100	54.595	31.729	0.110	99.95
Point resources	94	24.495	30.385	0.0003	99.79
English fraction	94	0.086	0.257	0	0.974
European fraction	94	0.288	0.409	0	1.0
GDP/cap 1970	94	8.333	0.898	6.43	9.95
Enrollment	87	21.643	21.725	1	86
Investment price	87	0.392	0.5402	−0.27	2.21

Note: These summary statistics were used to form beta coefficients reported in Table 3. They were computed for the samples of countries used in estimation of models reported in Table 2 and therefore exclude an observation whenever one or more of the variables used for estimating the corresponding regression equation was missing.

Table 8. *Countries included in the regression work**Countries in HDI and Life Expectancy equations (Table 1)*

Algeria, Angola, Argentina, Australia, Austria, Belgium, Benin, Bolivia, Brazil, Burkina Faso, Burundi, Cameroon, Canada, Central African Republic, Chad, Chile, Colombia, Comoros, Congo, Democratic Republic of the Congo, Rep., Costa Rica, Cote d'Ivoire, Cyprus, Denmark, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Fiji, Finland, France, Gabon, Ghana, Greece, Guatemala, Guyana, Honduras, Hungary, India, Indonesia, Iran, Islamic Republic of Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Rep., Madagascar, Malawi, Malaysia, Mali, Mauritania, Mexico, Morocco, Mozambique, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Peru, Philippines, Portugal, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, Spain, Sudan, Sweden, Switzerland, Syrian Arab Republic, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, United Kingdom, United States, Uruguay, Venezuela, RB, Zambia

Countries in undernourished population and No Water equations (Table 1)

Algeria, Angola, Benin, Bolivia, Brazil, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Chile, Colombia, Comoros, Congo, Democratic Republic of the Congo, Rep., Costa Rica, Cote d'Ivoire, Cyprus, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Fiji, Gabon, Ghana, Guatemala, Guyana, Honduras, India, Indonesia, Iran, Islamic Republic of Iran, Jamaica, Jordan, Kenya, Korea, Rep., Madagascar, Malawi, Mali, Mauritania, Mexico, Morocco, Mozambique, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Peru, Philippines, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, Sudan, Syrian Arab Republic, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uruguay, Venezuela, RB, Zambia

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