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In Search of the Missing Resource Curse

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Abstract

The debate over the curse of natural resources has haunted developing countries for decades if not centuries. A review of existing empirical evidence suggests that the curse remains elusive. The fragile negative effect of natural resources on economic growth might be due to international heterogeneity in the effects of natural resources on economic growth, to the use of weak indicators of natural resources that might be unrelated to relative natural-resource endowments, or to the inability of econometric analysis based on international data to capture historical processes. This paper defends an empirical proxy for relative abundance of natural resources, which is based on standard growth theory. In turn, various econometric estimations are hopelessly deployed in the search for the missing resource curse. Some evidence suggests that natural resources might have large positive effects whose true magnitude remains unknown due to unresolved econometric issues.

This paper—a product of the Trade Team, Development Research Group, and the Office of the Chief Economist for Latin America and the Caribbean Region of The World Bank—is part of a larger effort in both departments to understand the potential effects of the structure and quality of trade on development. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at dlederman@worldbank.org and wmaloney@worldbank.org.

In Search of the Missing Resource Curse*

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I. Introduction

Like Dracula, the notion of a natural resource curse remerges periodically, haunting the development debate, striking fear into the hearts of policy makers, and causing quantities of ink to be spilled on the various ways in which being blessed with mineral, agricultural or other natural wealth, will lead to anemic growth performance. Adam Smith (1776) was perhaps first to articulate a concern that mining was a bad use of labor and capital and should be discouraged.[1] The idea reappeared in the mid 1950s in Latin America when Raúl Prebisch (1959), observing slowing regional growth, argued that natural resource industries had fewer possibilities for technological progress and were condemned to decreasing relative prices on their exports. These stylized facts helped justify the Import-Substitution experiment in modifying national productive structures. Subsequently, disenchantment with the inefficiencies of protectionism and the consequences of populist macroeconomic policies led to more open trade regimes and less intrusive micro economic policies, partly with the example of East Asia's rapid export-led growth in mind.

However, over the interim, two stylized facts have emerged to convert a new generation of analysts to believers in the curse. First, the liberalizing economies, with some notable exceptions, did not become manufacturing dynamos, or major participants in what is loosely called the new "knowledge economy." Further, growth results were not impressive and, in the case of Africa, dramatic falls in commodity prices contributed to negative growth rates. With the increased popularity of cross country growth regressions in the 1990s, numerous authors offered proof that, in fact, natural resources appeared to curse countries with slower growth: Auty (1993), Davis (1995), Gylfason et al (1999), Neumayer (2004), Mehlum Moene and Torvik (2006), and arguably most influentially, with several authors drawing on their data and approach, Sachs and Warner (1995, 2001), have argued empirically that since the 1960s the resource-rich developing countries across the world have grown slower than other developing countries. Last year Macartan Humphey, Jeffrey Sachs, and Nobel Prize winner Joseph Stiglitz published *Escaping the Resource Curse*, which adds further credence to the myth. Consequently, we find ourselves again in a time when the conventional wisdom postulates that natural resources are a drag on development, which contradicts the common-sense view that natural riches are riches nonetheless.

Yet there has always been a countervailing current that suggests that common sense was not, in this case, misleading. Most recently, evidence supportive of a more positive view was brought together in Lederman and Maloney (2007) in *Natural Resources, Neither Curse nor Destiny,* although, far earlier notable observers such as Douglass North and Jacob Viner had dissented on the inherent inferiority of, for instance, agriculture relative to manufacturing. Even as Adam Smith was writing the *Wealth of Nations*, the American colonies were declaring their independence on their way to being one of the richest nations in the history of humanity, based for a long period, largely on natural resources (see, for example, Findlay and Lundahl 1994). Other success stories – Australia, Canada, Finland,

[1] "Projects of mining, instead of replacing capital employed in them, together with ordinary profits of stock, commonly absorb both capital and stock. They are the projects, therefore, to which of all others a prudent law-giver, who desired to increase the capital of his nation, would least choose to give any extraordinary encouragement …"

and Sweden – remain, to date, net exporters of natural resources.[2] Latin America's and Africa's disappointing experiences clearly offer a counterbalance to these success stories, but they do not negate them.

The acknowledgment of the important heterogeneity of experiences has led tentatively to a greater circumspection about the impact of resources, although not necessarily less enchantment with the term "curse." Humphreys, Sachs and Stiglitz begin their book noting that resource countries *often* perform worse than their resource poor comparators, and Dunning (2005) talks of "conditional resource curse" – that is, under certain conditions, there is a negative growth impact. This is without a doubt a more careful way to frame the issue that moves explaining the heterogeneity to center stage. Yet, the notion of a resource "curse" suggests more than the existence of a negative tail in the distribution of impact. Dracula's sinister reputation arises not from the occasional involuntary transfusion when in Transylvania, but rather that a bloody parasitism is the central tendency of character. (Disclaimer: the authors have not reviewed carefully any of the relevant empirical literature on this topic.)[3]

This article builds on our earlier work to argue that such a negative central tendency does not characterize natural resource abundance, and we would do well to exorcise the curse from the economic discourse. The next section reviews the various channels through which the curse is thought to operate, and we argue that, in many cases, the channel is either not convincingly present, or in fact, applies to many other factors of production. We then review some of the existing literature, arguing that the existing stylized fact of a curse is tentative at best and certainly not robust enough to impugn an entire category of production. We then examine with more care the appropriate proxy for measuring resource curse effects and, in the process, suggest what may be driving some other findings of a negative impact. Finally, using our preferred proxy, we deploy various estimations methods in search of the missing curse, including an aspect of the resource curse we left relatively unexplored in *Neither Curse nor Destiny*, the voracious political economy channel. Though our results in this dimension are, to some degree, rudimentary, they are suggestive

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[2] Across time, notable thinkers have also been less credulous about the existence of a curse. In Prebisch's era, future Nobel Prize winner Douglass North (1955 p.252) argued that "the contention that regions must industrialize in order to continue to grow ... [is] based on some fundamental misconceptions;" and the pioneer trade economist Jacob Viner argued that "There are no inherent advantages of manufacturing over agriculture" (Viner, 1952 p. 72). The literature is clear that these development successes based their growth on natural resources and several still do (see figure 1). See Irwin (2000) for the US; Innis (1933) and Watkins (1963) for Canada; Wright (2001), Czelusta (2001) for Australia; Blomström and Kokko (2001) and Blomström and Meller (1987) for Scandinavia. Latin America also offers its success stories: Monterrey in Mexico, Medellin in Colombia, and São Paolo in Brazil all grew to become dynamic industrial centers based on mining and in the latter two cases, coffee. Copper-rich Chile has been the region's model economy since the late 1980s.

[3] We don't for example, talk about a "venture capital" curse because 19 out of 20 VC financed firms go bankrupt. If the central tendency is that NR have a positive effect, then they remain a blessing, albeit conditional, and we need to understand the complementary factors necessary to maximize it. This is not different than understanding why Taiwan did better with its electronics industry than Mexico; or that Italy did better with its fashion industry than Korea did with "Project Milan."

that this element of the curse, too, merits closer scrutiny and might be a figment of our statistical imagination.

II. The Mechanics of the Curse

Numerous channels through which the curse might operate have been offered. Here we discuss only a few.

First, Prebisch (1959), among others, popularized the idea that terms of trade of natural resource exporters would experience a secular decline over time relative to those of exporters of manufactures. However, Cuddington, Ludema and Jayasuriya (2007) find that they cannot reject that relative commodity prices follow a random walk across the 20th century with a single break in 1929. That is, there is no intrinsic force driving the observed decline and prices could as easily rise tomorrow as fall further. While commodity by commodity important mean reverting components are evident and are, in fact, necessary for stabilization funds to be viable, the notion that long run prices have a strong unpredictable and permanent component appears more relevant today than at any time across the last half century. Paul Krugman (2008), taking exactly the opposite position from Prebisch, argues that continued growth by China and India, combined with simply "running out of planet" will lead to continued strong excess demand such that "rich countries will face steady pressure on their economies from rising resource prices, making it harder to raise their standard of living."[4]

Second, beginning with Smith, observers have argued that natural resources are associated with lower human and physical capital accumulation, productivity growth, and spillovers. This case is far from proven, however. Consistent with Viner's (1952) early assertion, Martin and Mitra (2001) find total factor productivity growth to be higher in agriculture than in manufactures in a large sample of advanced and developing countries. Wright and Czelusta (2006) and Irwin (2000) have argued that, contrary to Smith's prejudice, mining is a dynamic and knowledge intensive industry in many countries and was critical to US development. Blomstrom and Kokko (2006) have argued the same for forestry in Scandinavia.

Several authors stress the complementarity of essential factors, particularly human capital (see Gylfason and Bravo Ortega and de Gregorio 2007). Relatedly, Maloney (2002, 2007) argues that Latin America missed opportunities for rapid resource-based growth due to deficient technological adoption driven by two factors. First, deficient national "learning" or "innovative" capacity, arising from low investment in human capital and scientific infrastructure, led to weak capacity to innovate or even take advantage of technological advances abroad. Second, the period of inward-looking industrialization discouraged innovation and created a sector whose growth depended on artificial monopoly rents rather than the quasi-rents arising from technological adoption, and at the same time undermined natural-resource-intensive sectors that had the potential for dynamic growth. Røed Larsen (2004) argues that Norway's surge from Scandanavian laggard in the 1960s to regional leader in per capita income was based largely on the opposite strategy and

[4] Krugman, Paul, "Running Out of Planet to Exploit," *The New York Times*, March 21, 2008.

concludes that “Norwegian oil is a high technology sector which we may assume has much the same positive spillover effects as manufacturing is supposed to have” (p 17).

These arguments are central to the discussion surrounding the “Dutch Disease” aspect of the curse emphasized by, among others, Gylfason et al (1999), Sachs and Warner (2001) where perhaps through an appreciated exchange rate or classic Rybczinski effects, resource booms depress manufacturing activity. If the natural resource sector is not inferior in terms of its growth potential, then this sectoral shift would be of similar import to the canonical displacement of agriculture by manufacturing, or the finance-driven exchange rate effects arising from the City of London on manufacturing in the United Kingdom.

Third, either for reasons of history or Dutch disease, natural resource abundance may result in high levels of export concentration, which may lead to higher export price volatility and hence greater macro volatility.[5] However this is a more general concern. Dependence on any one export, be it copper in Chile or potentially micro-chips in Costa Rica, can leave a country vulnerable to sharp and sudden declines in terms of trade with attendant channels of influence through volatility.

Fourth, another important literature suggests that natural riches produce institutional weaknesses (see, among others, Auty 2001, 2005, Ross 1999, Gelb 1988 Easterly, and Levine 2002). Tornell and Lane (1999) described the phenomenon where various social groups attempt to capture the economic rents derived from the exploitation of natural resources as the “voracity effect.” Subsequent refinements have focused on how “point source” natural resources -those extracted from a narrow geographic or economic base, such as oil or minerals- and plantation crops have more detrimental effects than those that are diffuse such as livestock or agricultural produce from small family farms (Murshed 2004, Isham et al 2006). But again, this concern is not specific to natural resources, but to any source of rents. Autey, for instance, points to a similar impact of foreign aid. “Natural” monopolies, such as telecom have given rise to precisely the same effects in Mexico, and the rent-seeking literature generated by Krueger (1974)often focused on the adverse political economy effects arising from trade restrictions. Rajan and Zingales (2004) in *Saving Capitalism from the Capitalists* examine *rentie*r attitudes among the corporate, including manufacturing and financial elite, and the need for financial markets to ensure the pressure of new entry.

That said, there is clearly an important agenda to understand the interaction between political institutions and the emergence of resource sectors. Mehlum, Moene and Torvik (2006) have argued the importance of strong institutions to minimize rent seeking activity, and Rodríguez and Gomolin (2008) stress the pre-existing centralized state and professionalized military as essential to Venezuela’s stellar growth performance during 1920-1970 after the oil exploitation began in 1920. Dunning (2005) offers a model of how differences in the world structure of resources, the degree of societal opposition to elites, and the prior development of the non-resource private sector help predict the incentives to diversification and political stability.

[5] Sachs and Warner (1995b) argue that Dutch disease leads to concentration in resource exports, which they assume to have fewer possibilities for productivity growth.

III. The Elusive Curse

Without question, many of the channels discussed above may have important implications for growth. However, the question is whether taking all these impacts together, resource abundance has, as a central tendency, curse-like qualities. The literature has used a variety of proxies for resource abundance but has not been able to demonstrate this.

By far, the best known empirical tests for the resource curse are found in the work of Sachs and Warner (1995a, 1997a, 1997b, 1999, 2001a,b) who employ natural resource exports as a share of GDP as their proxy. Using cross sectional data employed previously by Barro (1991); Mankiw, Romer and Weil (1992); and DeLong and Summers (1991) across the period 1970-1990, they persistently find a negative correlation with growth, much to the alarm of many resource abundant developing countries.[6] Yet, this proxy leads to some counterintuitive results as a measure of resource abundance. Singapore, for example, due to its substantial re-exports of raw materials, appears very resource abundant and given its high growth rates, even seems to impart a positive relationship between resource abundance and growth. Because this gross measure is clearly not capturing the country's true factor endowments, Sachs and Warner replaced the values of Singapore and Trinidad and Tobago with net resource exports as a share of GDP (see data appendix in Sachs and Warner 1997a). It is not clear why net values should only be used for these two cases. Numerous countries in Asia and Latin America have a large presence of export processing zones that would, using the gross measure, overstate their true abundance in manufacturing related factors.[7] The issue turns out to be central to the findings of a curse. When Lederman and Maloney (2007) replicate the Sachs-Warner results using either a net measure of resource exports, or using the gross export measure without the adjustments for the two countries, they find that the negative impact of natural-resource abundance on growth disappears.

In fact, the interpretation of the Sachs Warner results is not clear even using their modified data. Sala-i-Martin et al (2004) in their search for robust regressors across millions of growth regressions find a persistent negative sign when the proxy enters, but it is not robust enough to be considered a core explanatory variable for growth as other variables appear to absorb its influence. In a similar vein, Lederman and Maloney (2007) show that, controlling for fixed effects in a panel context, the negative impact of resources also goes away suggesting that it is not their particular proxy, but its correlation with unobserved country characteristics that are driving the result. Manzano and Rigobón (2007) concur, and argue that the cross sectional result arises from the accumulation of foreign debt during periods when commodity prices were high, especially during the 1970s, that lead to a stifling debt overhang when prices fell. These results, and the analogy to

[6] The other papers by Sachs and Warner (1995b, 1997b, 1999, 2001a, 2001b) contain the basic results of 1997a, at times using a slightly longer time span (1965-1990 instead of 1970-1989), and often including additional time-invariant explanatory variables such as dummies identifying tropical and landlocked countries, plus some additional social variables.

[7] The variable also shows substantial volatility over time reflecting terms of trade movements and hence the average for the period is probably a better measure than the initial period value that was used by Sachs and Warner in several of their papers.

other bubbles, are important, not only because they further dispel the alleged curse of natural resources, but especially because the policy implication is that the right levers to deal with the lackluster performance of resource-rich developing countries in recent decades lies in the realm of macroeconomic policy instead of trade or industrial policies.

Bravo-Ortega and de Gregorio (2007) using the same proxy (as well as natural resource exports over total merchandise exports), also find a negative cross sectional impact but trace its origin to a Dutch disease effect working through human capital. Adding an interactive human capital term suggests that as the stock of human capital rises, the marginal effect of the stock of natural resources on income growth rises and becomes positive. This is broadly consistent with Gylfason et al's argument that a national effort in education is especially necessary in resource-rich countries, although without their hypothesis that resource-rich sectors intrinsically require, and hence induce, less education. However, Bravo-Ortega and Gregorio find that the point at which resources begin to contribute positively to growth occurs at around 3 years of education, a level achieved by all but the poorest countries.

Sachs and Vial (2002), Sachs and Warner (1995) confirm a negative and robust relationship using a second, related proxy- the share of natural resources exports in total exports, and this proved somewhat more robust. However, it, again, does not make Sala-i-Martin et al's core of robust regressors. Further, when Lederman and Maloney include a generic measure of concentration, the Herfindahl index, using export data disaggregated at 4-digit SITC, the resource curse disappears. The curse is one of concentration, not resources. This finding is consistent with Auty's (2000) concern about a resource drag on growth arising from the limited possibilities of diversification within commodities. However, Lederman and Xu (2007) argue that diversification into non-resource sectors from a strong resource base is feasible.

Leamer (1984) argues that standard Heckscher-Ohlin trade theory dictates that the appropriate measure is net exports of resources per worker. This measure has been the basis for extensive research on the determinants of trade patterns (e.g., Trefler 1995, Antweiler and Trefler 2002, Estevadeordal and Taylor 2002).[8] This was Lederman and Maloney's (2007) preferred measure because it obviated the Singapore issue by netting out resource exports from the beginning.[9] In cross section and in panel context across the Sachs-Warner period, it yielded either insignificant or positive results. Using Maddison's (1994) growth data from 1820-1989, Maloney (2002, 2007) finds suggestive evidence of a *positive* growth impact of resources from 1820-1950, but then a negative impact thereafter, driven by Latin America's underperformance.

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[8] Assuming identical preferences, a country will show positive net exports of resource intensive goods if its share of productivity-adjusted world endowments exceeds its share of world consumption. Usually, the net exports are then measured with respect to the quantity of other factors of production, such as the labor force.

[9] It is worth mentioning that the cited references show that the HO model of factor endowments performs relatively well for natural resources net exports, but it performs less well for manufactures. The current debate in the trade literature revolves around the question of how the HO model might be amended (by considering, for example, technological differences across countries, or economies of scale) to help predict better the observed patterns of net exports across countries. But there is not debate about the use of net exports as a proxy for revealed comparative advantage in this literature.

Finally, a set of papers explore the impact of more direct measures of mining production or reserves. Stijns (2005) finds no correlation of fuel and mineral reserves on growth during 1970-1989. This confirms earlier work by Davis (1995) that mineral dependent economies, defined by high share of minerals in exports and GDP, did well relative to other countries across the 1970s and 1980s. Across their several million regressions, Sala-i-Martin et al (2004) find the mining share in GDP to be consistently positive and in the core of explanatory variables. Nunn (2008) finds a positive partial correlation between the per capita production of gold, oil, and diamonds and GDP per capita, in an analysis of long-term fundamental determinants of development, with a special focus on the role of the slave trade and its concomitant economic consequences for African economies. Most recently, Brunnschweiler (2008) finds that per capita mineral and fuel production in 1970 have direct positive effects on economic growth during 1970-2000.

Clearly the resource curse remains elusive. The cross-country econometric evidence remains weak, with results changing depending on the empirical proxies used to represent relative endowments. Moreover, there have been surprisingly few efforts to understand the theoretical content of trade-data proxies. The following section puts the literature in theoretical context, which in turn helps motivate our empirical strategy.

IV. Clarifying the Curse

Some simple algebra helps clarify some dimensions of the curse and possible approaches and pitfalls to measuring it. Start with a two-factor and two-goods economy, where labor is initially immobile across sectors, and endowments of natural resources can only be used to produce natural-resource-intensive commodities. Denoting the natural-resource sector by subscript "nr" and rest of the economy by subscript "1," domestic equilibrium in the labor market entails all labor, L, is fully employed:

(3) $L=L_1 + L_{nr}$

National income is simply the sum of the income produced by each sector:

(4) $Y=Y_1 + Y_{nr}$.

Let K denote the endowment (stock) of natural resources, which are used only in the production of related commodities.[10] Each sector has a production function determined by sector-specific technologies with constant returns to scale:

(5) $Y_1=a_{1L}L_1$, and

(6) $Y_{nr} = a_{nr} K^b L_{nr}^{1-b}$, and therefore, national income is:

[10] The modeling approach with a stock of productive resources is standard in the growth literature, and it also appears in recent studies of natural resource production functions (Peretto 2008).

(7) $$Y = a_{1L}(L - L_{nr}) + a_{nr} K^{b} L_{nr}^{1-b}.$$

The a's are technologically determined productivity parameters. In the case of sector 1, a_{1L} is output per worker, which is always positive. In the case of the natural-resource sector, a_{nr} is the output per complementary units of K and L. Parameter "b" is the natural-resource share in output of that sector, and it is bounded by zero and one.

By fully differentiating (7), it is easy to show that the marginal effect of natural resource endowments on national income has three components under the assumptions that the marginal effect on the total labor force is zero (i.e., $\partial L / \partial K = 0$) and the marginal effect on K's share in natural-resource output is also unaffected:

(8)

$$\partial Y / \partial K = \left(\partial a_{1L} / \partial K \right)(L - L_{nr}) + \left(\frac{\partial a_{nr}}{\partial K} \right) K^{b} L_{nr}^{1-b} + \left(\partial L_{nr} / \partial K \right)\left((1-b) a_{nr} - a_{1L} \right)\left(\frac{K}{L_{nr}} \right)^{b} + b a_{nr} \left(\frac{K}{L_{nr}} \right)^{b-1}$$

The first two elements in (8) are the effects of marginal changes or differences in K on factor productivities. The literature on the voracity effect, for example, can be interpreted as negative first derivatives of productivity with respect to K. As pointed out by Rodríguez (2007), the empirical endogenous growth literature has revolved around the issue of the multiplicity of variables that could affect an economy's efficiency of factor use, and institutions have been part of that debate. The third element is the marginal effect of K on Y through the reallocation of labor, the Dutch disease effect. If labor in the natural-resource sector increases, then income from the rest of the economy falls as it loses labor, but output rises in the natural-resource sector. The net effect of the reallocation effect will depend on the difference in the effective labor productivities across the two sectors. This issue is usually framed as the alternative sector, perhaps manufactures, exhibiting some externality or that it implies that the private optimization that leads to the reallocation of labor implies a social loss somehow. The fourth term is the marginal effect on the output of the natural-resource sector, which is equal to the marginal productivity of K's share in natural-resource output.

In a nutshell, various strands of the curse literature argue that, with greater or lesser weight put on particular arguments:

$\left(\partial a_{1L} / \partial K \right) < 0$, $\left(\partial a_{nr} / \partial K \right) < 0$, and/or $\left(\partial L_{nr} / \partial K \right)\left((1-b) a_{nr} - a_{1L} \right)\left(\frac{K}{L_{nr}} \right)^{b} < 0$, such that

$$\left(\partial a_{1L} / \partial K \right)(L - L_{nr}) + \left(\frac{\partial a_{nr}}{\partial K} \right) K^{b} L_{nr}^{1-b} + \left(\partial L_{nr} / \partial K \right)\left((1-b) a_{nr} - a_{1L} \right)\left(\frac{K}{L_{nr}} \right)^{b} < -b a_{nr} \left(\frac{K}{L_{nr}} \right)^{b-1}$$

in the long-run.

Unfortunately for empirical work, K is unobserved. Even data on known mining reserves is inadequate as endogenous investments in exploration lead to new discoveries. As discussed, some studies use output of oil or mining as a share of GDP (e.g., Nunn 2008, Sala-i-Martin et al. 2004), which appear positively correlated with GDP per capita or subsequent economic growth. Other studies use gross export receipts as a share of total merchandise exports or as a share of GDP (e.g., Sachs and Warner 1997, 2001; Bravo-Ortega and De Gregorio 2007, Gylfason 2004). These proxies of natural resource dependence are found to be positively correlated with GDP per capita (Bravo-Ortega and De Gregorio 2007) but are often found to be negatively correlated with subsequent growth.[11]

V. Empirical Strategy

The discussion above suggests that empirically the resource curse, like Dracula, is hard to nail down. More specifically, getting the right proxy for resource abundance, and understanding its properties, is critical to establishing the credibility of any empirical finding. The mining reserve measures are closest to measuring true abundance, but capture only a narrow range of products and hence do not obviate the need for a trade based proxy.

In taking up the search for the curse again, we follow the vast literature on growth empirics but with a couple of innovations that help us identify a floor of the effect natural resource endowments. A key innovation is the inclusion of the trade-data indicator of relative endowments, which has the desirable property of an expected positive correlation between natural-resource endowments per worker, which is not the case for the preferred proxies used by resource-curse believers. We also choose an institutional variable that is commonplace in the institutions and growth literature concerning the powers of the executive branch of government, which has been absent in the voracity effects empirical literature.

V. A. Empirical strategy: static and dynamic growth models

If relative endowments were observed, an empirical income function consistent with the economic growth literature can be written as:

(9) $y_i = a + h(\ln(K/L)_i) + f'X_i + e_i$,

where the subscripts represent countries, a is the intercept, y is the natural logarithm of GDP per capita adjusted for purchasing power parity, X is matrix of other determinants of cross-country income differences, and e is assumed to be white noise error. The corresponding literature includes Frankel and Romer (1999), Acemoglu, Johnson and

[11] Isham et al. (2005) used dummy variables to identify countries according to export structures by looking only at the top two merchandise exports (according to the three-digit SITC trade classification), which further confounds the notion of natural resource dependence. It is also noteworthy, as mentioned earlier in this paper, that papers that have relied on the Sachs and Warner data are actually using a observations that use the gross exports of natural resources as a share of merchandise exports where a couple of observations, Singapore and Trinidad & Tobago, were actually net exports of natural resources.

Robinson (2001), Glaeser et al. (2004), Acemoglu and Robinson (2005), and Nunn (2008). We call this the “static” growth model.

The general form of the dynamic empirical growth model found in the literature since Barro (1991) is:

(10) $y_{i,t} - y_{i,t-1} = a + g(y_{i,t-1}) + h(\ln(K/L)_{i,t}) + f'X_{i,t} + e_{i,t}$.

The obvious difference between equations (9) and (10) is the inclusion of the lagged dependent variable as a regressor. Parameter g is the so-called convergence coefficient, which is interpreted as the conditional rate of convergence between poor and rich countries when $g<0$. This model is the dynamic version of (9), and g-1 is equal to the autoregressive coefficient of y, because the lagged value of y also appears with a negative sign in the left-hand side. We present estimates of the static and dynamic growth models, but with K/L replaced with a proxy discussed below.

V.B. A proxy of relative endowments with desirable properties: Net exports per worker

A good proxy has to be positively correlated with the relevant endowments, so that we can interpret a growth-regression coefficient as truly capturing the effect of these endowments. Our preferred indicator is net exports per worker. Net exports are simply the difference between what is produced and what is consumed in the domestic market:

(11) $$NX/L = (Y_{nr} - C_{nr})/L = (1-c_{nr})a_{nr}(K/L_{nr})^{b} - c_{nr}a_{1L}(1-l_{nr}),$$

where $0 \leq l_{nr}=(L_{nr}/L) \leq 1$ and $0 \leq c_{nr} \leq 1$. The selling point of this indicator is that it strictly rises with K/L, because the consumption of natural resources is a fraction of total income, $0< c_{nr} <1$, and, following Rybcynski, labor is attracted to the resource sector as the endowment expands:

(12) $$\frac{\partial\left(NX/L\right)}{\partial\left(K/L\right)} = b(1-c_{nr})a_{nr}(L_{nr})^{-b}K^{b-1}L\frac{\partial l_{nr}}{\partial(\frac{K}{L})} + c_{nr}\alpha_{1L}\frac{\partial l_{nr}}{\partial(\frac{K}{L})} \geq 0 .$$

It is, however, not without flaws. When used as a proxy for K/L in the estimation of income or growth models, it results in two distinct problems, which are both related to the consumption of natural resources, which rises as income grows and as the endowments grow.

The fact that income growth also increases consumption introduces a biased estimate of the partial correlation between NX/L and y.. This issue strikes us as non-trivial. Figures 1 and 2 show the relationship between the log of the absolute value of average net exports per worker during 1980-2005 and the log of GDP per capita for exporters and importers of natural resources. There is a strong positive correlation for both sub-samples, and the bi-variate elasticity is close to one in both cases. While the positive correlation of the net exporters with income suggests that there is no resource curse in levels, the strong negative correlation of net importers of natural resources strikes us as most plausibly evidence of increased consumption of NR with development, with potentially symmetrical effects on imports and exports. This issue is even more extreme where a rise in income from non-resource related sectors leads to an increase in consumption of resources, giving rise to a negative correlation of growth and NX/L. If this is the case, and the technical annex suggests it is algebraically likely, then the negative bias of the coefficient of net exports is substantial.

The second problem created by the use of our preferred proxy, which is related to a consumption effect of increases in K/L, affects the inferences that can be drawn even from unbiased estimates of the (causal) partial correlation between Y and NX/L. It is clear from equation (12) that a rise in endowments also gives rise to increased imports and, symmetrically, decreased exports of NR that mutes the degree to which movements in NX/L reflect movements in K/L.

Operationally, to moderate the bias in the estimate of the coefficient of NX/L in income and growth functions, we include imports of natural resources per worker as an additional regressor in the empirical models. Under the assumption that there is also a symmetrical effect on exports, then the sum of the coefficients on NX/L and M/L is a good approximation to the effect of NX/L on y. After this adjustment, we still need to be careful about drawing inferences about the effect of K/L on y based on this unbiased estimate, because it is still potentially a magnified effect of K/L on y – see the technical annex.

Still, we think this proxy is preferable to other popular indicators of natural-resource dependence used in the curse literature simply because these are not strictly positively correlated with K/L. The ratio of gross natural resource exports over GDP, in addition to the entrepot (Singapore) problem discussed earlier, potentially can be negatively correlated with K since a rise in K leads to a rise in exports which may be less than any induced rise in Y.[12] Gross exports (which is an unknown fraction of national production) of natural resources as a share of total merchandise exports can be negatively correlated with K/L when the share of consumption of natural resources in national income, such as agricultural products and food, is larger than the consumption share of other goods. Though it may be interesting as a measure of NR exports per se, and perhaps more generally as the concentration of exports, it is not an especially good if the goal is to show that resource endowments themselves are pernicious.

V. D. Executive constraints as key institutional variable and other controls

As Levine and Renelt (1992) first pointed out in the growth context, cross-country growth regressions are sensitive to the control variables included in the specification. A substantial portion of the empirical growth literature focuses on the neoclassical growth model, where the basic conditioning variables are related to capital accumulation and

[12] It is straightforward calculus to derive these conditions. They are available from the authors upon request.

growth of the labor force per unit of capital. In this regard, we follow the classic paper by Mankiw, Romer, and Weil (1992) in our most fully specified models.

Regarding institutions, the literature on the resource curse recently put emphasis on the role of so-called “point-source” resources. Isham et al. (2005, 143) define point source natural resources as “… those extracted from a narrow geographic or economic base, such as oil, minerals (such as copper and diamonds), and plantation crops (such as sugar and bananas)….” They argue that “Where extractive institutions were initially laid down, they soon consolidated themselves in ways that reduced the likelihood that over time they would have an interest in generating – or in being subjected to countervailing pressures to generate – either more diverse revenue (export) streams or more open political structures” (Isham et al. 2005, 145-6). These statements consequently imply that natural resources should be positively correlated with political characteristics that entail weak checks and balances, which would otherwise limit the capacity of the *rentier* elites to control these resources and public policies that might hamper economic diversification. In turn, the literature suggests that such institutional characteristics are negatively correlated with long-term GDP per capita.

It is possible, however, that under certain institutional arrangements, the resource curse might come alive. That is, natural resources might not produce poor institutions as in Isham et al. (2005), but when they interact with certain types of political institutions, natural resources might hamper development. For example, as the voracity effect is a problem of governing the commons, political institutions that yield fragmented and multiple coalitions might be associated with a natural resource curse. This is the argument by Sala-i-Martin and Subramanian (2003). But it should be noted that this is a different argument about heterogeneity of the effects of natural resources, similar to the concerns raised by Dunning (2005). Hence it is entirely consistent with the idea that natural resources might not necessarily produce institutional outcomes that in turn interact with natural resources to produce a curse. Our empirical exercises focus on testing this latter hypothesis, and we leave it for future research to test for interactions between institutions and natural resources as the source of the curse.

V.C.1. Estimation

In light of the discussion above, we include four interactive terms in the estimation of 9 above: dummy variables for net exporters and net importers are multiplied with the natural logarithm of the absolute value of net exports of natural resources per worker. In addition, the (log of) imports of natural resources per worker are also interacted with the relevant dummies.

To assess the possibility of heterogenous effects of resources due to interactions with other non-observables, such as institutional quality, As mentioned, coefficient heterogeneity is a concern in growth regressions we estimate Quantile Regressions of our basic model with only two conditioning variables (the Sachs-Warner reform index and the growth of terms of trade) followed by a more fully specified model that includes macroeconomic volatility, and the Mankiw, Romer, and Weil (1992, MRW henceforth) neo-classical growth variables. While recent literature has taken other approaches to dealing with heterogeneity in growth regressions (see, also, Durlauf, Kourtellos, and Minkin 2001), Quantile Regressions provide estimates of the coefficients across the conditional distribution of the sample, for example, by allowing the bottom 25% of observations to be below the predicted values, while at the same time estimating the coefficients conditional on having 50% percent of the sample above and below the predictions, as well as the top 75% of the sample. If the coefficients are sufficiently different, then we can conclude that resources have distinct effects in different country contexts. The regression errors from each quantile are allowed to be correlated and they are bootstrapped (with 100 interactions of random sub-samples), because they are unknown a priori.

The discussion of the Quantile Regressions is followed by the presentation of 3SLS estimations of the basic and the fuller specifications of (9), but adding the Acemoglu-Robinson institutional variable. We explore the role of institutions, namely constraints on the executive branch, which could be affected by the relative abundance of natural resources according to the resource curse hypothesis. We follow the relevant literature on institutions and growth by complementing the static GDP per capita function with the population densities of countries circa 1500 as the identifying instrumental variable of the 3SLS estimator, which is the approach of Acemoglu and Robinson (2002, 2005) and Glaeser et al. (2004).[13] 3SLS allows for the simultaneous estimation of the growth and institutional equation, with different explanatory variables in each structural equation. For example, imports of natural resources per worker appear in the growth equation, but not as a determinant of executive constraints.

VI. Data and Bi-variate Correlations

Standard publicly available sources offer all the necessary data to implement our empirical strategy. The relevant variables are averaged over the 1980-2005 period. Table A1 in the Appendix lists the variable definitions and sources.

VI. A. Variable definitions and data sources

The dependent variables are the real GDP per capita, its average annual growth rate between 1980 and 2005, and the average annual growth rate in each five year period. The data come from the latest version of the Penn World Tables, which has data until 2004. The year 2005 is derived by applying the real growth rate of GDP per capita in local currency and constant domestic prices between 2004 and 2005.

[13] There are numerous potential pitfalls in the estimation of the GDP per capita in levels model with 2SLS even when we can conclude that the IV is correlated with the endogenous explanatory variable but not with the dependent variable. One is that the chosen instrument could be weak in the sense of explaining a very low share of the variance of the endogenous variable (executive constraints in this application); see Dollar and Kraay (2003) for a similar application. Another related pitfall is that the variance of the endogenous variable that explains the variance of the dependent variable should be related to the variance of the instrumental variable – see Dunning (2008). As discussed in the results section, these issues became unimportant since we did not find much evidence that executive constraint affects the underlying relationship between our proxy for relative natural-resource endowments and development.

The main explanatory variable of interest, as mentioned, is the natural logarithm of the absolute value of net exports of natural resources per worker. The trade data come from UNCOMTRADE, as downloaded from the World Bank's data server. The commodity groups of products classified as being intensive in the use of natural resources are Leamer's (1984, 1995) non-manufacturing commodities – see Table A1.

Regarding the conditioning variables, we follow the strategy in Lederman and Maloney (2007) by examining how changes in the specification of the model affect the coefficient on the natural-resource variables. The initial multi-variate regression model specification includes two variables in addition to the natural-resource proxies: (a) the share of years during 1980-1999 when the dummy variable for policy reform was observed, as per the data in Wacziarg and Welch (2002) and Sachs and Warner (1995);[14] (b) and the average annual growth of the terms of trade during 1980-2005, which comes from the World Bank's World Development Indicators data, as downloaded in early 2008.

The augmented model includes the executive constraints variable, which is the institutional variable used in Acemoglu and Robinson (2002, 2005) and Glaeser et al. (2004). The data come from the Polity IV database, and has a value that ranges between 1 and 7, with higher values representing less executive-branch discretion. The econometric models include the natural logarithm of this variable, which makes it easier to interpret coefficient estimates as elasticities. The literature argues that constraints on the Executive should be negatively partially correlated, in the first stage of 2SLS estimations, with historical population density.[15] Due to the limited coverage of the historical population density variable, we present two sets of 3SLS estimations of the static and dynamic models; one with the limited sample and another with a sample that incorporates observations with imputed values for population density circa 1500. This allows for a discussion about how the limited sample affects the estimated coefficients.[16]

[14] The policy reform index is one if import tariffs are below 40%, if there are not significant non-tariff barriers, if governments have privatized a significant share of public enterprises, and if the foreign-exchange black market premium is below a certain threshold – see the Data Appendix for details.

[15] High population densities circa 1500 are presumably associated with the localization of extractive activities and slave trade rather than with permanent settlement. Acemoglu and Robinson (2005, 960) state: "The second determinant of European colonization strategy was initial indigenous population density. Where this was high, Europeans were more likely to "capture" the local population and put it to work in some form of forced labor system. Where initial population density was low, Europeans were more likely to settle themselves and less likely to develop extractive institutions even when they did not settle. Acemoglu et al (2002) provide evidence that for countries colonized by European powers there is a strong negative relationship between population density in 1500 and income per capita today. This relationship is driven by the fact that former colonies with greater population density in 1500 had, and still have, worse property rights institutions. The density of indigenous population per square kilometer in 1500 is therefore an appealing alternative instrument. Because settler mortality and population density in 1500 correspond to different sources of variation in practice (the correlation between the two measures is 0.4), but should have similar effects on property rights, using these two instruments separately is a good check on our results." If the curse-via-politics hypothesis is correct, then we also expect a negative partial correlation in the first-stage equation between our proxy for relative natural-resource abundance and the executive constraints index. It is noteworthy that Glaeser and coauthors (2004) argue that education trumps institutions. This issue will be important in the interpretation of our results, since we also control for capital accumulation and human capital.

[16] The imputed values are estimated using all the other explanatory variables in the equation of the determinants of executive constraints, namely (log of the absolute value of) net exports of natural resources,

Macroeconomic volatility can also affect economic performance, especially private investment. To the extent that natural resources have higher price volatilities than other goods, it is possible that this might be a channel through which they affect growth performance. Following Servén (2003), our measure of macroeconomic uncertainty is the standard deviation of the monthly variation of the log of the Real Effective Exchange Rate from the IMF's *International Financial Statistics*.

The empirical neoclassical growth model of MRW includes, in addition to the level of education of the population and the investment rate, the growth of "effective units of labor," which is the observed growth of labor for each country minus a global capital-depreciation rate plus an estimate of the global rate of technological progress. MRW assume that the rate of technological progress minus the rate of capital depreciation is equal to 0.05 per year. If the neoclassical growth model is correct, the expected coefficient on the log of the growth of the effective labor force should be around -0.5. MRW found this to be within the confidence intervals of the relevant coefficient only for growth regressions with a sample of OECD high-income countries, but not for samples with developing countries. For the sake of consistency, we include the MRW variable in the levels as wells as the growth regressions.

Lastly, in light of evidence from the Quantile Regressions (see below) suggesting that there is substantial heterogeneity in the intercepts, we also include regional dummy variables in the 3SLS cross-sectional estimations of the static and dynamic models. The regions are classified according to the World Bank's regional groups into seven groups as described in the Appendix table.

VI. B. Descriptive statistics of net exports of natural resources and performance

Table 1 shows the average annual variation in the terms of trade, the average annual growth of GDP per capita, the average value of the executive constraints index, and the average growth of exports and imports of natural resources in current U.S. dollars. The data show the average of each indicator for countries that were net exporters in all five-year periods during 1980-2005, net importers in all periods, and two groups of switchers. The lower panel of the table contains the corresponding information for the sample of Latin American and Caribbean (LAC) economies with available data. It is notable that the vast majority of countries in the data were either net exporters or importers, and the number of switchers is small. In the case of LAC, the switchers were four small economies, including El Salvador (became a net exporter on average only during 1985-1989), Guatemala, Nicaragua, and Paraguay (net importer only in 1995-1999).

Interestingly, the net exporters of natural resources experienced terms of trade deteriorations on average, while net importers experienced slight improvements. In the sample period, the Prebisch-Singer hypothesis on the deterioration of the terms of trade could be present. But variations in these relative prices would need to affect either the level

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growth of the terms of trade, and regional dummies.

of GDP per capita or economic growth in the long-run for the curse to operate through this channel. Relevant econometric evidence is discussed in the next section.

With respect to executive constraints, table 1 shows that for the global sample, net exporters of natural resources do tend to have lower scores than net exporters. But this is not true for the sample of LAC economies, where net exporters actually have higher constraints on the executive branch, and in fact both net exporters and importers of natural resources in LAC had higher average scores than the rest of the global averages during this time period.

The growth performance of the net importers was superior to the average of the net exporters. Surprisingly, however, the net importers of natural resources experienced significantly higher growth rates of the value of natural-resource exports than the net exporters, in the global sample. Hence even in this cursory look at the data, it is not clear that growth of natural resource exports per se is in any systematic way related to low growth.

VII. Results

The results are reported in tables 2-5. Table 2 shows the results from the Quantile Regressions applied to the static model with both sets of control variables (but without regional dummies). Table 3 reports the corresponding estimations of the dynamic model. Tables 4 and 5 contain the 3SLS estimations of both models, including the results with the larger samples that use the imputed values of historical population densities. All tables report the probability values of the null hypothesis that the sum of the coefficient on net exports and imports per worker are zero.[17] For ease of exposition, the coefficients on most of the other explanatory variables and the tests for equivalence of coefficients across quantiles are not reported in the tables, but they are briefly discussed in the text below.

VII. A. Quantile regressions

In Table 2, the basic model is reported under column 1. Although the only the coefficients on imports per worker are statistically significant across all quantiles, the F-tests suggest that the effect of NX/L on GDP per capita is statistically significant for all quantiles. The implied elasticities are about 0.75 for the first quantile, 0.66 for net exporters and 0.46 for net importers in the second quantile, and 0.58 and 0.51 respectively in the third quantile. This evidence implies that natural resources are a blessing for growth, but there is notable heterogeneity across quantiles in this basic specification of the static model. It is noteworthy that even if the average share of consumption of natural resources in national income were 50%, the effect of K/L on GDP per capita would be quite large, ranging between 0.23 and 0.38. Interestingly, the significantly highest elasticities are those of the lower quantile, which also have the lower intercepts and are thus the low-income countries.

[17] For the sub-samples of net importers, the sum is the negative of the coefficient on the log of the absolute value of net exports per worker plus the corresponding coefficient on imports per workers.

The fully specified static model reported under column 2 provides more mixed evidence of a blessing effect. First, the implied effect is significant only among net exporters in the three quantiles – see the F-tests reported at the bottom of the table. These blessing effects have implied elasticities in the range of 0.30-0.36, and there is no evidence of cross-quantile heterogeneity. Contrary to the curse hypothesis, it seems that the heterogenous blessing effect is associated with the macro volatility and/or the MRW factor accumulation.

Among the other explanatory variables, only educational attainment is significant in the second specification. The range of its coefficient is 0.75 in the lowest quantile to 0.49 in the highest quantile. But they are statistically different across quantiles.

The results in Table 3 correspond to the dynamic growth model. The sums of the relevant coefficients in the basic model are statistically significant at the 5% level only for net importers in the second quantile and for net exporters and importers in the third quantile. Although all point estimates are positive, those for the highest quantile are the largest in magnitude, implying that a one percent increase in NX/L is associated with 1.1-1.9 percentage points rise in the average annual growth rate of GDP per capita during 1980-2005. Hence it seems that the inter-quantile heterogeneity in growth rates is different from the heterogeneity observed in the static model results reported in Table 2. As in the static model, however, the results under column 2 of Table 3 suggest that these blessing effects disappear after controlling for macro volatility and factor accumulation.

Regarding other control variables in the dynamic growth models, we found significant cross-quantile heterogeneity in the convergence rate and in the coefficient of M/L in both specifications. Convergence is stronger among the second and third quantiles, but not in the first. Although not statistically different across quantiles, the Sachs-Warner reform index is positive and significant in the first two quantiles. Furthermore, the investment rate is positive and significant in the upper two quantiles.

Overall the Quantile-Regressions evidence suggests that it is important to control for heterogeneity in intercepts regardless of the model or sample. Also, there is significant heterogeneity in the in the effect of natural resources, although it appears strongly only in the static model. But the latter are not particularly strong when compared to the intercept heterogeneity. Also, the existing studies that argue that there might be heterogeneity in the effects of proxies of natural resource abundance, such as Bravo-Ortega and De Gregorio (2007) might be confounding heterogeneity in other potential determinants of growth with heterogeneity of the effects of natural resources. We leave this issue for future research.

More importantly, any estimation of these models without some heterogeneity of intercepts is likely to confound the effects of the explanatory variables with differences in the intercepts of the levels and growth rates of GDP per capita. The 3SLS estimations of the static and dynamic models discussed below therefore include regional dummies. Future research, however, could use panel-data estimators to assess the effect of natural resources on growth while also controlling for heterogeneity.

VII. B. 3SLS estimates of the static and dynamic models with endogenous institutions

Tables 4 and 5 contain the relevant results. The first two columns in both tables present the results of the basic model, columns 3 and 4 the fully specified model, and columns 5-8 contain the corresponding results with the augmented samples utilizing the imputed values of historical population densities.

In Table 4, the blessing effects appear strongly, although admittedly magnified, as discussed earlier. Indeed, the elasticity of one for the sub-sample of net importers is impossibly large. Moreover, there is no evidence that there is an indirect curse effect via institutional constraints on the Executive branch of government, after controlling for regional dummies. It is worth noting that historical population density remains a good instrument, although only significant at the 10% in the basic model under column 1.

In the fully specified static model presented in columns 3 and 4, the blessing effect remains significant only for the sample of net exporters of natural resources. This elasticity is close to 0.25. The elasticity for the sub-sample of net importers declined from a bit over one in the basic specification to about 0.19, and it is not statistically significant. Again, there is no evidence of a statistically significant average effect of NX/L on executive constraints. Furthermore, among the control variables, only the Sachs-Warner reform index is statistically significant and positive, and the MRW variable capturing the accumulation of effective labor units is negative and significant with coefficient estimate of approximately -1.3.

The comparable results with the expanded samples are strikingly similar. In the basic model, there are significant blessing effects among net exporters and importers, with the respective elasticities of 0.49 and 0.38. Indeed, the latter estimate for net importers is much more reasonable than the estimate of close to one that appeared in the restricted sample. In the fully specified model under columns 7 and 8, the blessing effect remains significant, but only at the 10% level. Interestingly, there might be a blessing effect via institutions, because net exports per worker appear with a positive and significant coefficient in column 8. But the point estimates are not significantly different from those reported in the columns 1-4, thus suggesting that the results might not be driven by the small sample.

Table 5 also suggests that natural resources could be a blessing, even for growth during 1980-2005. In the restricted samples and in the basic specification, this blessing effect is significant only among net importers. In contrast, in the fully specified model, but with the smaller corresponding sample, the blessing effect is significant only among net exporters. In both specifications, there is no evidence of an indirect curse effect via institutions.

With the expanded samples, the blessing effect appears significant for both net exporters and net importers in the basic specification. In the full specification, neither is significant, again suggesting that if there is a blessing, it might operate through factor accumulation and/or macro volatility. Perhaps more importantly, the changes in the point estimates and their levels of significance due to the change of samples also suggest that there is probably significant heterogeneity of effects across sub-samples of countries.

Among the control variables, the Sachs and Warner reform index appears positive and significant in the estimation of models 1 and 3, but not in 5 or 7. The MRW variable of the growth of effective units of labor is significant at approximately -0.04 in both the restricted and expanded samples in models 3 and 7. This is about one tenth of the magnitude predicted by neoclassical growth theory without controlling for the effects of the other determinants of growth included in our specifications.

VIII. Summary and Conclusions

The review of the literature on the resource curse indicated that the evidence in support of the curse is weak at best. There are important issues of measurement of relative endowments, of potential heterogeneity in the effects of such endowments on development and growth, and some of the international econometric evidence that appears to support the curse hypothesis has been based on the use of weak proxies, and even on nonstandard manipulations of influential data points.

This mixed evidence in favor of the resource curse also needs to face up to some obvious historical facts, ranging from the successful development of now rich countries, to the success of numerous developing economies, ranging from Rwanda to Chile. Moreover, the idea that natural resources inevitably worsen political or other institutions that might be important for development also seems to have ignored historical facts related to the evolution of such institutions, and there are examples where "good" institutional characteristics had emerged prior to the discovery of natural resources, for example, in the case of Venezuela, which may explain the strong economic growth of this economy for almost 50 years.

In the process of reviewing the existing literature and linking it to current data, we have highlighted an important weakness in the empirical literature that uses trade-based proxies for relative endowments. That is, the variables of choice of the propagators of the curse are weak proxies for relative endowments. Our own previous work had ignored the analytical contents of these empirical proxies, which might explain why we had been able to so easily drive a stake of doubt into the heart of the resource demons.

Our preferred proxy, net exports per worker, while flawed, can help push the literature forward, because in certain circumstances, the simultaneous estimation of coefficients for the samples of net exporters and net importers can provide a magnified effect of natural resources on development.

With new data, new econometric analyses provided definitive evidence that there is no curse, not even indirectly by affecting the political institutions that would be most likely to be affected by the curse-via-politics effects, which has been central in the literature on the "point-source" nature of natural resources. In fact, the direct positive effect of natural resources can be substantial, although we cannot be sure about its exact magnitude due to the imperfect correlation between relative endowments and our trade-data proxy variable. Furthermore, we found heterogeneity in the potential blessing effects of natural resource endowments. More specifically, in the static model, the poorest countries benefit the most, whereas in the dynamic model, the richest seem to have benefitted the most. But in both cases, these blessing effects tend to disappear after controlling for macro volatility and factor accumulation.

In the process, we are convinced that we know less than what we thought we knew, especially from reading the existing literature. It remains a topic for future research to study potential interactions between natural resources and human capital or innovation. But we do know that there might be substantial international heterogeneity in the effects of other determinants of growth, and there is certainly cross-country heterogeneity intercept. Hence any cross-sectional estimation with cross-country data needs to control for mean shifters, such as regional dummies. Preferably, panel-data estimators should be applied, because they allow for controlling for fixed effects.

Similarly, much remains to be learned from historical case studies and perhaps from cross-country statistical analysis of the interaction between natural resources and institutions, in spite of the unreliable existing evidence concerning the curse-through-politics hypothesis. From a policy viewpoint, institutional arrangements to smooth out the economic consequences of natural-resource windfalls makes as much sense as more general discussions about counter-cyclical fiscal policies. That is, in spite of the elusive resource curse, we do not argue against common sense policies that in some countries might be inextricable from natural riches.

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Figure 1. Net *Exporters* of Natural Resources during 1980-2005 and Real GDP per Capita in 2005

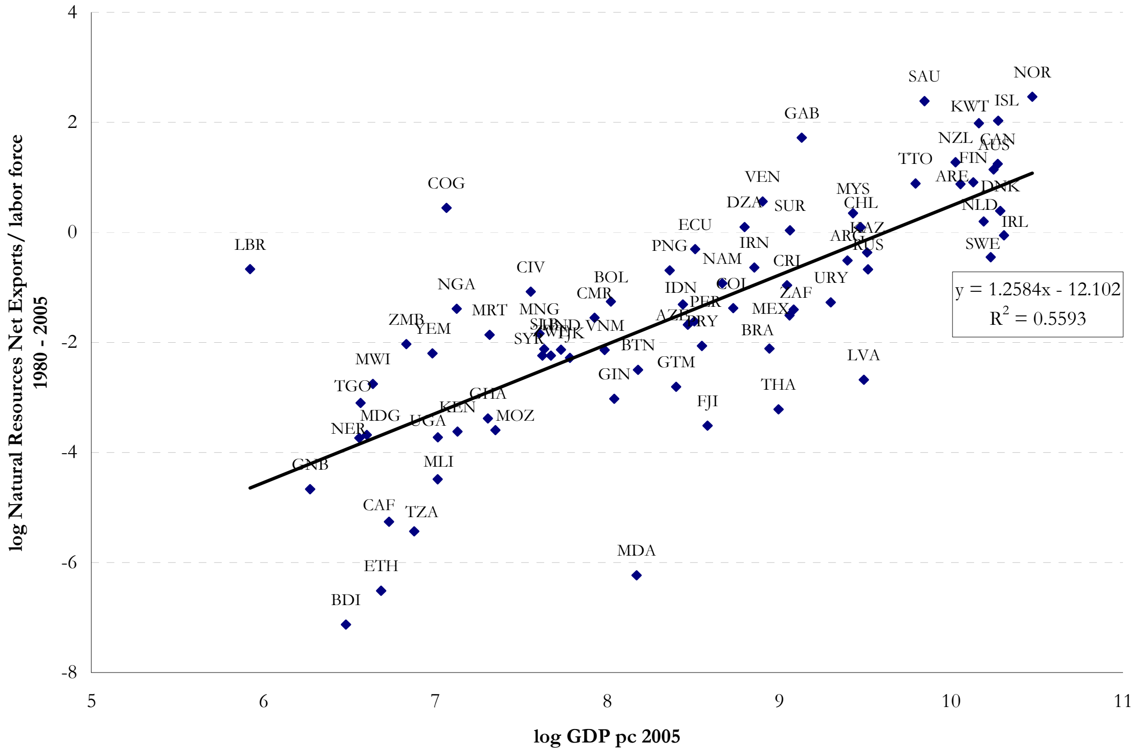

Figure 2. Net *Importers* of Natural Resources during 1980-2005 and Real GDP per Capita in 2005

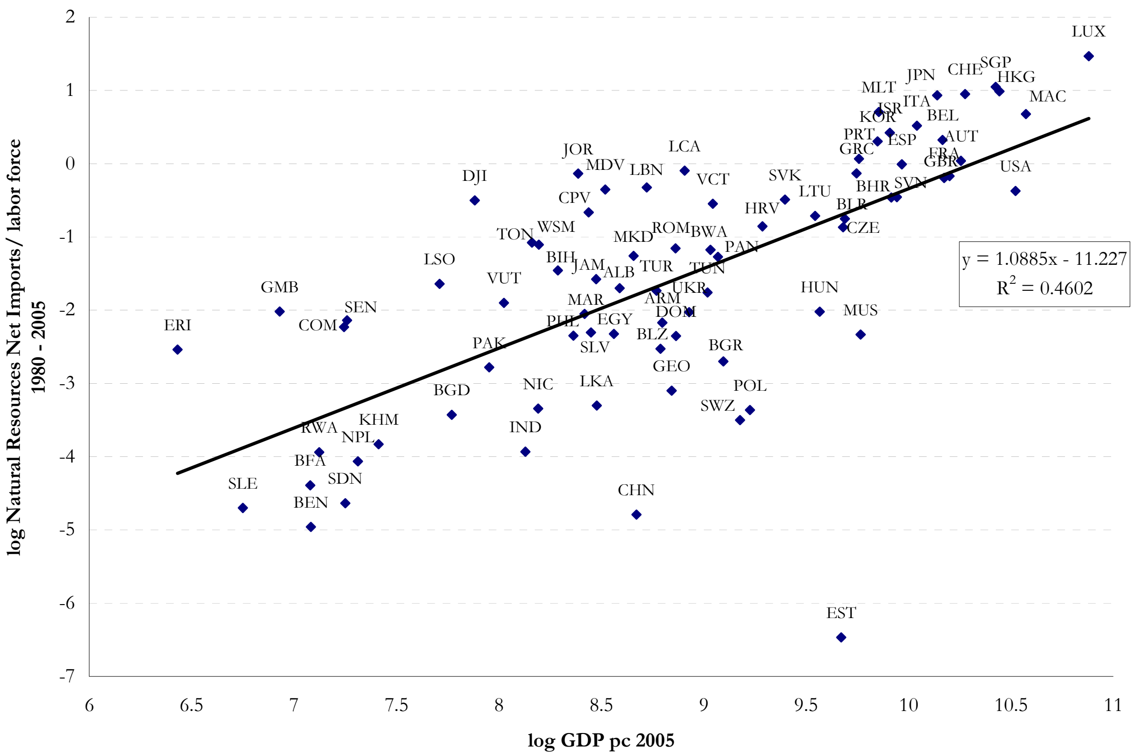

Table 1. Net Exporters, Net Importers, and Switchers: Selected Indicators

1980 -2005	**Terms of Trade growth**	**GDP pc growth**	**Executive Constraint**	**NR imports growth**	**NR exports growth**
Sample: All Countries, observations with data					
Net Natural Resource **Exporters** in all periods	-0.41%	0.61%	3.97	2.22%	1.41%
	(53)	(59)	(58)	(54)	(54)
Net Natural Resource **Importers** in all periods	0.11%	2.18%	4.88	3.31%	3.55%
	(63)	(72)	(57)	(69)	(69)
Net **Exporters** that became Net **Importers** in any period after 1985	0.83%	-0.33%	3.60	-2.47%	-0.64%
	(7)	(11)	(10)	(10)	(10)
Net **Importers** that became Net **Exporters** in any period after 1985	0.21%	1.29%	4.05	3.35%	7.40%
	(12)	(14)	(14)	(13)	(13)
Sample: LAC Countries					
Net Natural Resource **Exporters** in all periods	-0.42%	0.34%	5.48	2.56%	2.64%
	(15)	(14)	(13)	(15)	(15)
Net Natural Resource **Importers** in all periods	0.01%	1.56%	4.99	-0.68%	-2.07%
	(6)	(9)	(4)	(8)	(9)
Net **Exporters** that became Net **Importers** in any period after 1985	0.42%	-0.63%	4.34	3.94%	4.53%
	(3)	(3)	(3)	(3)	(3)
Net **Importers** that became Net **Exporters** in any period after 1985	-0.49%	0.88%	5.00	6.00%	2.66%
	(1)	(1)	(1)	(1)	(1)
Notes: The numbers inside parentheses are the countries in each group.					

Table 2. Quantile Regression Results of the Static Model without Regional Dummies

Dependent Variable:	Log GDP per capita in 2005 (PPP$)	
	q25	
Positive_ln(NX/L)	0.205	0.120
	(1.93)	(1.17)
Negative_ln_abs(NX/L)	-0.015	0.028
	(0.20)	(0.25)
Positive_ln(M/L)	0.541	0.184
	(4.56)**	(1.61)
Negative_ln_(M/L)	0.730	0.304
	(5.69)**	(0.92)
	q50	
Positive_ln(NX/L)	0.087	0.098
	(1.21)	(1.96)
Negative_ln_abs(NX/L)	0.068	0.084
	(1.28)	(0.98)
Positive_ln(M/L)	0.569	0.261
	(6.60)**	(2.08)*
Negative_ln_(M/L)	0.528	0.164
	(8.07)**	(1.73)
	q75	
Positive_ln(NX/L)	0.122	0.088
	(2.57)*	(1.32)
Negative_ln_abs(NX/L)	0.026	0.086
	(0.52)	(0.82)
Positive_ln(M/L)	0.460	0.240
	(6.83)**	(1.31)
Negative_ln_(M/L)	0.533	0.311
	(9.20)**	(1.84)
Constant q25	9.088	5.215
	(40.37)**	(3.94)**
Constant q50	9.486	6.294
	(52.07)**	(3.54)**
Constant q75	9.537	6.732
	(65.12)**	(2.74)**
	Sum of Coefficients (F-Tests, P-values)	
q25: Postive_ln(NX/L)+Positive_ln(M/L)=0	0.746 [0.00]	0.304 [0.00]
q25: - Negative_ln_abs(NX/L)+Negative_ln(M/L)=0	0.745 [0.00]	0.276 [0.32]
q50: Postive_ln(NX/L)+Positive_ln(M/L)=0	0.656 [0.00]	0.359 [0.00]
q50: - Negative_ln_abs(NX/L)+Negative_ln(M/L)=0	0.460 [0.00]	0.080 [0.44]
q75: Postive_ln(NX/L)+Positive_ln(M/L)=0	0.582 [0.00]	0.328 [0.04]
q75: - Negative_ln_abs(NX/L)+Negative_ln(M/L)=0	0.507 [0.00]	0.225 [0.47]
Observations	103	74

Absolute value of t statistics in parentheses

* significant at 5%; ** significant at 1%

Other control variables included (see text) but not reported.

Model 1 includes: Sachs-Warner reform index (average during 1980-2005), average annual growth of terms of trade.

Model 2 includes: Variables in model (1) plus real-exchange rate volatility, log of average investment rate, log average years of education, and MRW.

Table 3. Quantile Regression Results of the Dynamic Model without Regional Dummies

	(1)	(2)
Dependent variable:	Average annual GDP per capita growth, 1980-2005	
	q25	
Positive_ln(NX/L)	0.000	0.001
	(0.18)	(0.07)
Negative_ln_abs(NX/L)	-0.002	-0.003
	(0.81)	(0.33)
Positive_ln(M/L)	0.004	0.000
	(1.21)	(1.03)
Negative_ln_(M/L)	0.003	0.000
	(0.74)	(1.52)
	q50	
Positive_ln(NX/L)	0.002	0.000
	(0.85)	(0.33)
Negative_ln_abs(NX/L)	-0.002	-0.007
	(0.68)	(1.53)
Positive_ln(M/L)	0.004	-0.001
	(1.01)	(0.16)
Negative_ln_(M/L)	0.008	0.009
	(1.80)	(0.01)
	q75	
Positive_ln(NX/L)	0.003	0.000
	(1.25)	(0.17)
Negative_ln_abs(NX/L)	-0.004	-0.001
	(1.05)	(0.77)
Positive_ln(M/L)	0.008	0.004
	(2.11)*	(0.11)
Negative_ln_(M/L)	0.015	0.000
	(2.24)*	(0.05)
q25: Constant	0.003	-0.037
	(0.05)	(0.89)
q50: Constant	0.078	0.148
	(1.61)	(0.55)
q75: Constant	0.19	0.057
	(3.61)**	(2.46)*
	F-tests, P-values	
q25: Postive_ln(NX/L)+Positive_ln(M/L)=0	0.004 [0.30]	0.001 [0.91]
q25: - Negative_ln_abs(NX/L)+Negative_ln(M/L)=0	0.005 [0.14]	0.003 [0.96]
q50: Postive_ln(NX/L)+Positive_ln(M/L)=0	0.006 [0.06]	-0.001 [0.75]
q50: - Negative_ln_abs(NX/L)+Negative_ln(M/L)=0	0.010 [0.16]	0.016 [0.61]
q75: Postive_ln(NX/L)+Positive_ln(M/L)=0	0.011 [0.00]	0.004 [0.28]
q75: - Negative_ln_abs(NX/L)+Negative_ln(M/L)=0	0.019 [0.02]	0.001 [0.12]
Observations	84	74

Absolute value of t statistics in parentheses

* significant at 5%; ** significant at 1%

Other control variables included (see text) but not reported.

Model 1 includes: Log GDP per capita in 1980 (PPP$), Sachs-Warner reform index (average during 1980-2005), average annual growth of terms of trade.

Model 2 includes: Variables in model (1) plus real-exchange rate volatility, log of average investment rate, log average years of education, and MRW.

Table 4. 3SLS Estimates of the Static Model with Endogenous Institutions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variables:	Log GDP per capita in 2005 (PPP$)	Log Executive Constraints	Log GDP per capita in 2005 (PPP$)	Log Executive Constraints	Log GDP per capita in 2005 (PPP $)	Log Executive Constraints	Log GDP per capita in 2005 (PPP$)	Log Executive Constraints
Positive_ln(NX/L)	0.156	-0.02	0.015	0.045	0.14	-0.013	0.055	0.059
	(2.29)*	(0.65)	(0.20)	(1.28)	(1.96)	(0.54)	(0.95)	(2.09)*
Negative_ln_abs(NX/L)	-0.105	-0.027	0.149	-0.061	0.069	-0.046	0.045	-0.031
	(0.91)	(0.69)	(1.24)	(1.51)	(1.03)	(1.64)	(0.72)	(0.95)
Positive_ln(M/L)	0.351		0.233		0.35		0.131	
	(3.47)**		(2.16)*		(2.77)**		(1.38)	
Negative_ln_abs(M/L)	0.932		0.334		0.448		0.178	
	(4.50)**		(1.65)		(5.01)**		(1.57)	
Log Executive Constraints	1.416		1.427		1.972		1.148	
	(2.72)**		(2.28)*		(1.60)		(1.85)	
Log population density 1500		-0.079		-0.105				
		(1.96)		(3.12)**				
Imputed Log Population Density 1500						-0.084		-0.102
						(2.14)*		(3.09)**
	Sum of Coefficients [F-Tests, P-values]				Sum of Coefficients [F-Tests, P-values]			
Postive_ln(NX/L)+Positive_ln(M/L)=0	0.507 [0.000]	n.a.	0.248 [0.0369]	n.a.	0.490 [0.00]	n.a.	0.19 [0.09]	n.a.
- Negative_ln_abs(NX/L)+ Negative_ln(M/L)=0	1.040 [0.0012]	n.a.	0.0190 [0.5459]	n.a.	0.38 [0.00]	n.a.	0.13 [0.39]	n.a.
Observations	51	51	43	43	98	98	71	71
R-squared	0.77	0.63	0.89	0.73	0.65	0.62	0.92	0.75

Absolute value of t statistics in parentheses
* significant at 5%; ** significant at 1%
Other control variables included (see text) but not reported.

Models 1 and 5 include Log GDP per capita in 1980, Sachs-Warner reform index (average during 1980-2005), average annual growth of terms of trade, regional dummies.
Models 2 and 6 include average annual growth of the terms of trade (1980-2005), regional dummies.
Models 3 and 7 include variables in model (1) plus real-exchange rate volatility, log of average investment rate, log average years of education, and MRW.
Models 4 and 8 include the same variables as in model (2).

Table 5. 3SLS Estimates of the Dynamic Model with Endogenous Institutions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variables:	Avg. GDP per Capita Growth, 1980-2005	Log Executive Constraints	Avg. GDP per Capita Growth, 1980-2005	Log Executive Constraints	Avg. GDP per Capita Growth, 1980-2005	Log Executive Constraints	Avg. GDP per Capita Growth, 1980-2005	Log Executive Constraints
Positive_ln(NX/L)	-0.0021	-0.0205	-0.0012	0.0450	-0.0003	0.0001	-0.0007	0.0590
	(1.18)	(0.65)	(0.76)	(1.28)	(0.17)	(0.00)	(0.37)	(2.09)*
Negative_ln_abs(NX/L)	-0.0028	-0.0270	0.0007	-0.0610	-0.0047	-0.0181	-0.0029	-0.0310
	(1.10)	(0.69)	(0.26)	(1.51)	(2.32)*	(0.56)	(1.17)	(0.95)
Positive_ln(M/L)	0.0060		0.0026		0.0056		0.0030	
	(2.18)*		(1.12)		(2.15)*		(1.01)	
Negative_ln_abs(M/L)	0.0126		0.0062		0.0104		0.0044	
	(2.40)*		(1.37)		(2.64)**		(1.21)	
Log Executive Constraints	0.0212		0.0020		0.2732		0.0211	
	(1.99)		(1.58)		(1.29)		(0.86)	
Log population density 1500		-0.0790		-0.1050				
		(1.96)		(3.12)**				
Imputed log population density 1500						-0.1022		-0.102
						(3.09)**		(3.09)**
	F-Tests, P-values				F-Tests, P-values			
Postive_ln(NX/L)+Positive_ln(M/L)=0	0.004 [0.144]	n.a.	0.001 [0.037]	n.a.	0.005 [0.0478]	n.a.	0.002 [0.4679]	n.a.
:- Negative_ln_abs(NX/L)+Negative_ln(M/L)=0	0.02 [0.0368]	n.a.	0.01 [0.5459]	n.a.	0.02 [0.0043]	n.a.	0.01 [0.1668]	n.a.
Observations	51	51	43	43	79	79	71	71
R-squared	0.77	0.63	0.82	0.73	0.51	0.68	0.92	0.75

Absolute value of t statistics in parentheses

* significant at 5%; ** significant at 1%

Other control variables included (see text) but not reported.

Models 1 and 5 include Log GDP per capita in 1980, Sachs-Warner reform index (average during 1980-2005), average annual growth of terms of trade, regional dummies.

Models 2 and 6 include average annual growth of the terms of trade (1980-2005), regional dummies.

Models 3 and 7 include variables in model (1) plus real-exchange rate volatility, log of average investment rate, log average years of education, and MRW.

Models 4 and 8 include the same variables as in model (2).

Data Appendix

Table A1. Data, Variable Definitions and Sources

Variable	*Definition*	*Source*
Natural Resources/labor force	Natural resources net exports divided by the labor force. Natural resources net exports is defined as exports minus imports of natural resources related goods based on Leamer (1995)[a] commodity clusters. Labor force is the population between 15-64 years.	WDI and UN COMTRADE
GDP per capita growth 1980-2005	Average yearly growth of real GDP per capita (Constant Prices: Chain series) in the period 1980-2005.	Authors' construction using Penn World Tables
log GDP per capita	Real GDP per capita (Constant Prices: Chain series). Ratio of total GDP to total population in 2005.	Penn World Tables
Openness	Percentage of years with open economic regime. A country has a closed trade policy if it has at least one of the following characteristics: 1. Nontariff barriers (NTBs) covering 40 percent or more of trade. 2. Average tariff rates of 40 percent or more. 3. A black market exchange rate that is depreciated by 20 percent or more relative to the official exchange rate, on average, during the 1970s or 1980s. 4. A socialist economic system 5. A state monopoly on major exports.	Sachs and Warner (1995a) updated by Wacziarg and Welch (2003)
Terms of Trade growth	Growth of the external terms of trade, defined as the ratio of an export price index to an import price index of goods and services	WDI
Std. Dev. Real Effective Exchange Rate	Standard deviation of monthly interannual changes in real effective exchange rates	Authors' construction using IMF data
Executive Constraints	Institutionalized constraints on the decision making powers of chief executives, weather individuals or collectivities. It is a 1-7 category scale, higher score means more constraint on the executive. Equals one if country is not independent.	Polity IV 2004
log Investment	Natural log of the share of investment over GDP	Penn World Tables
log School Attainment	Natural log of years of schooling of the adult population	Barro and Lee (2000)
MRW	Based on Mankiw, Romer and Weil (1992), the variable is the natural log of the average growth of the labor force plus 0.05. The constant 0.05 is assumed to be the sum of depreciation rate and technological growth.	WDI
Population density in 1500	Total population divided by total arable land in 1500 A.D.	McEvedy and Jones (1978) as cited in Acemoglu, et al. (2002).
Regions dummies	8 Dummies for world regions as defined by the World Bank: East Asia & Pacific, Europe & Central Asia, High income: OECD, High income: non OECD, Latin America & Caribbean, Middle East & North Africa, South Asia, Sub-Saharian Africa	The World Bank
a. SITC sections 0-9, 11, 12, 21-29, 32-35, 41-43, 63, 64, 68, 94		

Table A2. Summary Statistics

Cross-Section; All Variables in 2005

Variable	Obs	Mean	Std. Dev.
GDP per capita growth 1980-2005	138	0.01359	0.02048
log GDP pc in 1980	152	8.30638	1.10774
Executive Constraints	155	1.23111	0.61816
Natural Resources/labor force > 0	133	0.67116	2.48421
Natural Resources/labor force < 0	133	0.15405	0.57328
Openness	141	0.55319	0.41906
Std. Dev. Real Effective Exchange Rate	175	0.06932	0.0793
log Investment	184	2.47441	0.57929
log School Attainment	97	1.58728	0.62581
MRW	185	-2.6602	0.20589
Terms of Trade growth	145	0.00302	0.04458
log Population density in 1500	97	0.48645	1.5247

Periods Data

Variable	Obs	Mean	Std. Dev.
GDP per capita growth 1980-2005	1180	1.65291	3.38209
log GDP pc	1180	8.25806	1.11805
Natural Resources/labor force > 0	1133	7.10709	6.80923
Natural Resources/labor force < 0	1133	6.0296	6.76471
Executive Constraints	1238	1.12357	0.71623
log Investment	1430	2.5931	0.68728
log School Attainment	822	1.42065	0.75464
Terms of Trade growth	914	-0.0013	0.04278
Openness	904	0.44757	0.48416
log Population density in 1500	882	0.50312	1.51883

Appendix A3 Details on Sources of Bias in NX/L Proxy

In the context of our two-sector growth model, an exogenous labor-productivity shock associated with sector 1 and, for simplicity, assuming that the shock does not affect the allocation of labor (i.e., $\frac{\partial L_{nr}}{\partial a_{1L}} = 0$) or the stock of K and L or the consumption shares, the marginal change in net exports per worker associated with a marginal change in productivity:

$$(12) \qquad \partial(NX/L)\Big/\partial a_{1L} = -c_{nr} \bullet (1 - l_{nr}).$$

This consumption effect of a productivity improvement is strictly negative.[18] Hence the reverse effect of productivity growth on observed net exports of natural resources would be reflected in a decline in net exports of natural resources per worker, and any estimation of an income or growth model with NX/L as an explanatory variable will yield downward biased estimates of the effect of NX/L on Y. Allowing for a re-allocation of labor into sector 1 as a consequence of the improvement in productivity in that sector would further reduce net exports of natural resources per worker, thus further biasing estimates of the effect of NX/L on Y.

A productivity change in the natural-resource sector would affect NX/L as follows:

$$(13) \qquad \partial(NX/L)\Big/\partial a_{nr} = (1 - c_{nr}) \bullet \left(\frac{K}{L}\right)^{b}.$$

If there is a curse, $\partial a_{nr} < 0$, then NX/L would decline as exports earnings fall more than imports because $c_{nr}>0$. The fall in gross imports of natural resources would be proportional to the share of income spent in the consumption of natural resources: $\partial a_{nr} \bullet c_{nr} \bullet \left(\frac{K}{L}\right)^{b} < 0$ when $\partial a_{nr} < 0$. Under a curse, the negative effect of NX/L would be attenuated by the *fall* of imports. If natural resources are a blessing in terms of improvements in labor productivity in either sector, then imports would rise with income (which is the reason why the coefficient on NX/L is biased downward in income functions). Hence reverse causality under a blessing effect would bias the estimated coefficient of NX/L downwards due to the *rise* of imports of natural resources. However tempting it is to estimate (8) and (9) with NX/L as a proxy for unobserved K/L, this discussion highlights biases due to the consumption effect that will contaminate estimates of the effect of NX/L on Y.

To address the endogeneity biases, we estimate augmented versions of the static and dynamic models, which include the natural logarithm of imports of natural resources per

[18] Please note that a productivity shock affecting the natural-resource sector would correspond to a positive (a "blessing") shock on output. The earlier version of this paper had erroneously confounded this positive effect with an endogenous decline in NX/L due to a positive productivity shock in sector 1.

worker (M/L) as an additional regressor. Table 1 summarizes the expected coefficients under three scenarios. If there is a resource curse, then the coefficients on NX/L and M/L would be negative – see discussion on equation (11) above. If natural resources are a blessing, then the coefficient on NX/L and M/L should be positive. The attenuation effect of the reverse causality effect would be captured by the coefficient on imports.

More formally, the estimated model can be re-written to account explicitly for the reverse causality effect:

(14) $y_i = a + \left(\overleftarrow{d} - \overrightarrow{d_x} - \overrightarrow{d}_M\right)(\ln(NX/L)_i) + f'X_i + e_i$,

where coefficient b in (9) equals $\overleftarrow{d} - \overrightarrow{d}_X - \overrightarrow{d_M}$, which is the sum of the direct effect minus the reverse-causality effect. In the context of our two-sector growth model and assuming that the relevant effects operate only through changes in productivities in either sector, the direct effect can be derived from equation (8): $\overleftarrow{d} = \left[\left(\frac{\partial a_{1L}}{\partial(NX/L)}\right)(L - L_{nr}) + \left(\frac{\partial a_{nr}}{\partial(NX/L)}\right)K^b L^{1-b}\right] \bullet \frac{(NX/L)}{y}$. The reverse causality effect can be derived from equations (12) and (13): $\overrightarrow{d}_X + \overrightarrow{d}_M = \left[\partial a_{iL} \bullet c_{nr}(1 - l_{nr}) + \partial a_{nr} \bullet c_{nr}\left(\frac{K}{L}\right)^b\right] \bullet \frac{(NX/L)}{y}$, which is a composite consumption effect coming from increases in factor productivity in each sector and will equal the effect of y on gross imports (exports) of natural resources per worker. By including M/L in the estimation equation we can get an estimate of $\overrightarrow{d}_M$.[19] Thus the empirical income function becomes:

(15) $y_i = a + \overleftarrow{d} - \overrightarrow{d_x}\ (\ln(NX/L)_i) + \overrightarrow{d}_M\ (\ln(M/L)_i) + c'X_i + e_i$.

We assume that consumption effect on exports is equal to the consumption effect on imports. Thus the sum of $\overleftarrow{d} - \overrightarrow{d_x}$ plus $\overrightarrow{d}_M$ approximates an unbiased estimate of the elasticity of y with respect to NX/L.

A remaining weakness of (15) is that we are interested in estimates of $\frac{\partial y}{\partial(K/L)} \bullet \frac{(K/L)}{y}$ whereas $\overleftarrow{d} = \frac{\partial y}{\partial\left(\frac{NX}{L}\right)} \bullet \frac{(NX/L)}{y}$. The function linking K/L with NX/L was presented above in the discussion of equation (11):

[19] Alternatively, we could include X/L, but the resulting estimate could be contaminated by a supply-side effect on exports.

$\frac{\partial\left(NX/L\right)}{\partial\left(K/L\right)} = b(1-c_{nr})a_{nr}\left(L_{nr}\right)^{-b}K^{b-1} \geq 0$. The supply and consumption components in our proxy are separable. Let $z = \frac{\partial\left(NX/L\right)}{\partial\left(K/L\right)} \bullet \frac{(K)}{(NX)} = z_S - z_C$, where $z_S = ba_{nr}\left(\frac{K}{L_{nr}}\right)^b \Big/ NX$ is the un-attenuated supply-driven elasticity, and $z_C = c_{nr}ba_{nr}\left(\frac{K}{L_{nr}}\right)^b \Big/ NX$ is the consumption-driven attenuation of the corresponding elasticity.

It is trivial to show that the marginal effect of K/L on y is the product of the marginal of effect of NX/L on y times the marginal effect of K/L on NX/L. After stripping out $\vec{d}$ with the inclusion of M/L as a regressor in (15), the estimate of the effect of K/L on y, based on our proxy, is still biased:

$$\text{(16)} \qquad \frac{\partial y}{\partial(K/L)} \bullet \frac{(K/L)}{y} = \left(\overleftarrow{d} - \vec{d}_X + \vec{d}_M\right)(z_S - z_C) = (1-c_{nr})\left(\overleftarrow{d} - \vec{d}_X + \vec{d}_M\right).$$

That is, the downward bias in z produces a multiplicatively positive bias for the inference about the effect of K/L on y based on estimates of the effect of NX/L on y. In other words, because the supply elasticity of NX/L with respect to K/L is under-estimated due to the consumption effect, any blessing or curse effect apparent in the approximated elasticity of y with respect to NX/L will be an exaggerated measure of the underlying effect of K/L on y. Multiplying $\left(\overleftarrow{d} - \vec{d}_X + \vec{d}_M\right)$ by one plus the share of income spent in the consumption of natural resources would yield an estimate closer to an unbiased estimate of the elasticity of y with respect to K/L.