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European Economic Review 45 (2001) 827–838

EUROPEAN ECONOMIC REVIEW

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Natural Resources and Economic Development

The curse of natural resources

Jeffrey D. Sachs, Andrew M. Warner*

Center for International Development, Harvard University, 79 JFK Street, Cambridge, MA 02138, USA

Abstract

This paper summarizes and extends previous research that has shown evidence of a "curse of natural resources" – countries with great natural resource wealth tend nevertheless to grow more slowly than resource-poor countries. This result is not easily explained by other variables, or by alternative ways to measure resource abundance. This paper shows that there is little direct evidence that omitted geographical or climate variables explain the curse, or that there is a bias resulting from some other unobserved growth deterrent. Resource-abundant countries tended to be high-price economies and, perhaps as a consequence, these countries tended to miss-out on export-led growth.

JEL classification: O1; O4; O5; Q0

Keywords: Growth; Natural resources; Exports

0. Introduction

The curse of natural resources – the observation that countries rich in natural resources tend to perform badly – has been shown empirically and analyzed in a number of recent studies. These studies, which include Auty (1990), Gelb (1988), Sachs and Warner (1995, 1999), and Gylfason et al. (1999), among others, have emerged late in the 20th century, as evidence accumulated on the poor

* Corresponding author. Tel.: + 1-617-495-3628; fax: + 1-617-4950712.
E-mail address: andrew.warner@harvard.edu (A. M. Warner).

0014-2921/01/$ - see front matter
PII: S0014-2921(01)00125-8

growth experience of resource-rich countries in the post-world-war II period. On an intellectual level, this issue first emerged as an important international issue during the inter-war period in Latin America, after many Latin American economies suffered from the global slump in commodity prices. However during this time and in the immediate post-war period, the skepticism about natural resource-led development was rooted in forecasts of declining global demand and prices. What the studies based on the post-war experience have argued is that the curse of natural resources is a demonstrable empirical fact, *even after controlling for trends in commodity prices*. Since so many poorer countries still have abundant natural resources, it is important to better understand the roots of failure in natural resource-led development.

There have always been two important questions raised by the curse of natural resources. Is it true? If so, why? Section 1 discusses the evidence on the first question, Section 2 the second.

1. Does the curse really exist?

Empirical support for the curse of natural resources is not bulletproof, but it is quite strong. First, casual observation suggests that there is virtually no overlap in the set of countries that have large natural resource endowments – and the set of countries that have high levels of GDP. Many resource-rich countries have been resource rich for a long time. If natural resources really do help development, why do not we see a positive correlation today between natural wealth and other kinds of economic wealth? Second, casual observation also confirms that extremely resource-abundant countries such as the Oil States in the Gulf, or Nigeria, or Mexico and Venezuela, have not experienced sustained rapid economic growth. In addition, empirical growth studies tend to confirm this casual evidence. The finding in repeated regressions using growth data from the post-war period is that high resource intensity tends to correlate with slow growth. This finding is not easily explained by other variables, since this empirical result survives the introduction of a long list of control variables. It is also not easily explained as an accident from the special experience of the Persian Gulf states, since most of these states drop out of regression samples for lack of data on other control variables. In addition the finding survives statistical procedures for eliminating unusual observations. For some examples of the evidence, Sachs and Warner (1997) show regression evidence of the curse of natural resources with as many as nine additional regressors, and Sachs and Warner (1995) show regression evidence for the curse after controlling for popular variables favored by four other empirical growth studies. In more recent work, Sala-i-Martin (1997) and Doppelhofer et al. (2000) classify natural resources as one of the ten most robust variables in empirical studies on economic growth.

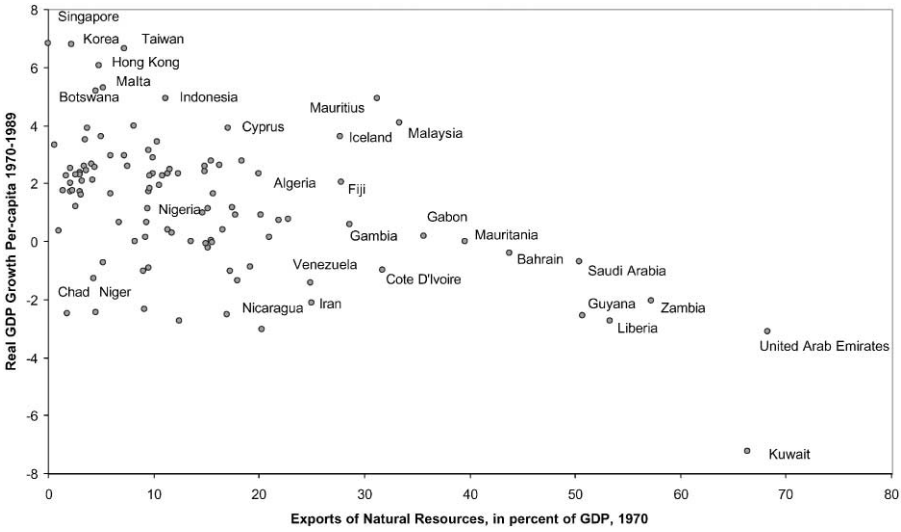

Fig. 1. Growth and natural resource abundance 1970–1989.

Fig. 1 shows why regression studies such as Doppelhofer et al. (2000) tend to find robust results. The figure shows that none of the countries with extremely abundant natural resources in 1970 grew rapidly for the next 20 years. This fact holds up using a variety of measures of resource abundance. Moreover, most of the countries that did grow rapidly during this period started as resource poor, not resource rich. The exceptions to this general tendency were Malaysia, Mauritius and Iceland. However, these were the only exceptions and, as one can see from Fig. 1, they were not strong exceptions.

Although the empirical evidence mentioned above is strong by conventional standards, we will now discuss a possible way that these results are misleading. It is possible that the negative association is a by-product of a subtle bias. To see this, suppose that there was an alternative variable, constant through time, that affected growth. We will call it a country's geography for the purposes of argument. Suppose also that countries were randomly endowed with natural resources in a way that was not correlated with their geography. If we let time pass in such a world, eventually the countries with favorable geographic conditions would have high income, since they would have been growing for a while. Because of their high income, they would appear to have low shares of natural resources in the economy – not because they were inherently poor in natural resources, but because the rest of the economy would have been growing. On the other hand, the poor-geography countries would still appear to be high-natural resource economies, since the rest of the economy would not have been growing. Now suppose we were to measure growth and natural resource as a share of

GDP after this process had been unfolding for a while. We would tend to find a negative association between growth and natural resources as a share of the economy. But in our special example, this negative association would be driven by geography which we do not observe, and not by any inherent penalty from high natural resources.

There are at least two ways to test for this possibility. If it is hard to observe the omitted variable affecting growth, one solution is simply to control for previous growth rates in the regressions. Under the story above, previous growth would be correlated with the left-out geography variables and thus serve as a proxy for them. The relevant question then is whether the natural resource variable stays in the regression even after controlling for previous growth. If instead it is not hard to observe the omitted geography variables, the second solution is simply to control for them in the regression.[1]

Sachs and Warner (1997) looked at the first of these tests and found no evidence that controlling for the previous decade's growth rate altered the negative natural resource effect. The regression that contained this result is reproduced in Table 1. Previous growth in this case is growth in the 1960s which is listed as the last regressor.

Table 2 shows additional evidence on the second of the tests: controlling for geography variables directly. The dependent variable is real growth per person between 1970 and 1990. The regressors include the log of GDP in 1970, and then a list of variables we have used in previous studies. These are: a variable measuring the outward orientation of economic policy from Sachs and Warner (1995); an interaction variable between this openness variable and initial income (to allow for faster convergence of open economies); and natural resource intensity measured by natural resource exports as a share of GDP (measured in 1970, before the growth period). The list of geography variables includes the percent of land area within 100 kilometers of the sea, kilometers to the closest major port, the fraction of land area in the geographic tropics and a falciparam malaria index from 1966. These four geography and climate variables are taken from Gallup et al. (1999).

The impact of geographical conditions on growth is studied in much more detail elsewhere (see Gallup et al., 1999). The main point for our purpose is simply to establish that the geography variables generally do not eliminate the evidence for the curse of natural resources. There is no clear evidence from the

[1] A third possible solution is to calculate natural resources per-capita so that GDP is not in the denominator. However, this is not a good solution because we want to measure the importance of natural resources in the economy, not just per-capita. For example, Canada has higher natural resources per-capita than Zambia, yet in Zambia natural resource production is more than 50 percent of the economy while in Canada it is less than ten percent. Natural resources have much more potential to crowd out other economic activities in Zambia than in Canada. To test crowding-out theories, the better measure is percent of GDP.

Table 1
Regression of economic growth on natural resource abundance, 1970–1990, controlling for growth in the 1960s[a]

Log GDP 1970	− 1.8
	(8.87)
Natural resource abundance	− 9.9
	(6.50)
OPEN	1.3
	(3.2)
Log investment	0.8
	(2.4)
Rule of law	0.4
	(3.8)
Terms of trade change	0.1
	(2.1)
Growth 1960–1969	0.02
	(0.2)
R^2	76%
N	69

[a]*Source*: Sachs and Warner (1997).

regressions in Tables 1 and 2 that there was an omitted variable in our previous growth regressions that can account for the curse of natural resources.

This concludes the section on whether the "curse of natural resources" is a statistical mirage from natural resources being the only surviving sector in slow-growth countries. To summarize, the evidence is not supportive for two reasons. Controlling for previous growth rates does not eliminate the natural resource variable from the regression. And direct controls for geography and climate variables do not eliminate the natural resource variable.

We also wish to mention two other empirical points that are sometimes raised about the resource curse finding. Sometimes it is argued that the natural resource effect should be linked to the magnitude of economic rents from the natural resource, and thus we should distinguish minerals (which generally have high rents) from agriculture (which generally has low rents). In the same vein, perhaps processed agriculture should be distinguished from primary agriculture. The main response to these objections is practical. The variation in mineral exports across countries is responsible for a large fraction of the overall variation in the natural resource variable, so that the inclusion or exclusion of agriculture does not much alter the basic empirical results. The countries, which do have significant natural resource exports other than minerals, include Iceland (fisheries), Fiji, Cote d'Ivoire, and Mauritania. For most country's, however, changes in the definition of natural resources is not as quantitatively important as one might think.

Table 2
Growth regressions with the natural resource variable and the geography and climate variables. Dependent variable: growth per-capita 1970–1989

	(1)	(2)	(3)	(4)	(5)[a]
Log GDP per pop '70	− 0.31	− 0.20	− 0.37	− 0.69	− 0.86
	(1.00)[b]	(0.67)	(1.19)	(2.12)[c]	(2.51)[c]
GDP70 × OPEN 1[d]	− 1.52	− 1.68	− 1.82	− 1.13	− 1.11
	(3.34)[c]	(3.72)[c]	(4.08)[c]	(2.58)[c]	(2.33)[c]
Share of years open (OPEN)	16.21	17.63	18.77	12.75	12.45
	(4.19)[c]	(4.64)[c]	(4.98)[c]	(3.44)[c]	(3.11)[c]
Natural resource abundance	− 0.05	− 0.05	− 0.04	− 0.04	− 0.03
(N.R. exports/GDP in 1970)	(4.91)[c]	(4.29)[c]	(3.44)[c]	(3.72)[c]	(2.57)[c]
% Land w/in 100 km coast	0.63				0.60
	(1.27)				(1.20)
Km to closest major port		0.00			0.00
		(0.28)			(0.14)
% Land in geographical tropics			− 0.87		− 0.64
			(1.77)		(1.23)
Falciparam malaria index, 1966				− 1.41	− 1.22
				(2.86)[c]	(2.16)[c]
Constant	3.40	2.79	4.52	7.17	8.48
	(1.42)	(1.17)	(1.79)	(2.66)[c]	(3.06)[c]
Observations	97	97	97	94	93
R^2	0.57	0.57	0.58	0.58	0.59

[a]Joint significance test for Geography Variables in regression (5): $F(4,85) = 3.04$ P-value $= 0.022$.
[b]Absolute value of t-statistics in parentheses.
[c]Significant at 5% level.
[d]GDP70 × OPEN is an interaction variable where GDP70 is the log of GDP per-capita in 1970 and OPEN is the shorter name for "share of years open" from Sachs and Warner (1995).
[e]Significant at 1% level.

A final empirical issue concerns the widespread popular impression that many currently rich countries once developed with the aid of their natural resources. Many are surprised by the resource curse finding because it runs against the textbook story in history books or common discussion of growth advantages. One example is an influential work by Habakkuk (1962) who argued, among many other points, that greater natural resource endowments in the United States helped explain why it surpassed England in the 19th century. As a further example, note that the beneficial effects of natural resources are still being stressed for some developing countries. As recently as August 2000, President Clinton's speech in Nigeria stressed that "With...vast human and natural resources, a revitalized Nigeria can be the economic and political anchor of West Africa…" (Quoted on the web, August 27, 2000).

We mention two points on this. First, although the data are scarce, when one measures natural resource intensity using historical data, the ratios as a percent

of GDP are much smaller than the ratios that many countries have achieved in the mid-to-late 20th century. Sweden, Australia and the United States in earlier times never approached the level of natural resource intensity we see today in the Gulf-States. Second, Habakkuk's argument could be credible for an earlier period during which cheep power from the proximity of coal was more technologically essential. With the emergence of the petroleum-based economy and revolutions in global transportation, cheep energy can be transported today in a way that was impossible earlier.

2. What explains the curse?

Just as we lack a universally accepted theory of economic growth in general, we lack a universally accepted theory of the curse of natural resources. Most current explanations for the curse have a crowding-out logic. Natural Resources crowd-out activity x. Activity x drives growth. Therefore Natural Resources harm growth. Since there is a diversity of views regarding the second of these statements (what exactly drives growth), we have a similar diversity of views on the natural resource question. In other words, a complete answer to what is behind the curse of natural resources therefore awaits a better answer to the question about what ultimately drives growth. Nevertheless, we can review some of the leading explanations.

Sachs and Warner (1995, 1999), and Sachs (1996) identify x with traded-manufacturing activities. The mechanism is familiar. Positive wealth shocks from the natural resource sector (along with consumer preferences that translate this into higher demand for non-traded goods) creates excess demand for non-traded products and drives up non-traded prices, including particularly non-traded input costs and wages. This in turn squeezes profits in traded activities such as manufacturing that use those non-traded products as inputs yet sell their products on international markets at relatively fixed international prices. The decline in manufacturing then has ramifications that grind the growth process to a halt.

To test whether this explanation is credible, the first step is to show that natural resource abundance is indeed correlated with higher non-traded prices across countries. It is difficult to observe non-traded prices directly because national statistical offices do not divide products neatly into traded and non-traded categories. However, if the non-traded prices in resource-abundant countries are higher and the traded prices across countries are roughly equal then it follows that the general price level (which is a weighted average of the two) will be higher in resource-abundant countries. Since the general price level is observable we can use this data to test the proposition.

Many observers have noted that national price levels tend to be positively associated with levels of income across countries. There are theoretical reasons

for this which go back to Ricardo, Viner, Ballasa and Samuelson. For our purposes, and to save space, we can take this as an established empirical regularity that all countries obey, regardless of their natural resource intensity.[2] Our test of overvaluation is to see whether natural resource intensive economies had higher price levels after controlling for this universal law. In other words, we control for the systematic relationship between price levels and (non-natural resource) GDP and see whether natural resource intensive economies had higher relative prices on top of this.

We measure the relative price level across countries by taking the ratio of two measures of GDP. The numerator is GDP in US dollars measured by using local current prices and the nominal US dollar exchange rate (in symbols $Y*P/E$). The denominator is the same GDP evaluated at international prices ($Y*P\$$). These international prices are averages across many countries of prices for certain goods, and therefore do not vary by country. The ratio of these two is typically a number (a fraction) that gives the country's price level relative to a global average of prices. The number is equivalent to what is also referred to as ratio of the country's purchasing power parity exchange rate to its nominal exchange rate (explained in more detail in Summers and Heston (1991)).

The regression below shows the essential results. There is a positive relationship between the log of the relative price level during any year of the 1970s and natural resource intensity in 1970, after controlling for the income effect mentioned above. The particular regression below is for the year 1979, but the general result also holds for all years during the period 1970 to 1980.

$$\text{Log(PLEVEL79)} = 3.6 + 0.27\,\text{log(RGDP79)} + 0.69\,\text{SXPR70}$$
$$(13.6) \qquad (3.5)$$
$$N = 99,\ R^2 = 66\%$$

This equation shows that natural resource intensive economies did indeed tend to have higher price levels. This effect obtains after controlling for the average cross-country relationship between price levels and per-capita income (income in all economies is measured after excluding natural resources). This provides some evidence that one of the consequences of resource abundance in the 1970s was that other businesses in resource-abundant country's had to try to compete with higher than normal price levels. To the extent that they used domestic inputs and sold products on international markets their competitiveness suffered.

We now examine whether this lower competitiveness impeded export growth. To do so, we derive a proxy for the contribution of export growth of manufactures to GDP growth over the full 20-year period 1970–1990. Mathematically,

[2] See Kravis and Lipsey (1988) for further evidence and explanations on this subject.

the contribution of export growth of manufactures to GDP growth is given by growth in value added from manufacturing exports between 1970 and 1990 times the share of manufacturing exports in GDP in 1970, or in symbols $sx \times gx$.[3] Countries will have a small contribution from exports of manufactures if either exports grow slowly or if these exports represent a small share in the economy.

Fig. 2 shows the relation across countries between the log of the export contribution to growth during the period 1970–1990 and the log of natural resource abundance in 1970. There is a strong inverse relationship. Resource abundant countries tended to have small contributions from export growth in manufactures. The tendency shown above for natural resource intensive economies to have high price levels may be part of the reason for this, but there are probably other causes too, such as lack of active promotion of exports. Whatever the cause, it is clear that we have not seen strong export-led growth in resource abundant economies.[4]

Therefore, one explanation of the resource curse is that resource abundance tended to render the export sectors uncompetitive and that as a consequence resource-abundant countries never successfully pursued export-led growth. We continue now with a summary of other explanations.

In Gylfason et al. (1999), and Gylfason (2000) in this issue the culprit 'x' is education. Furthermore, the basic logic could be extended to other variables relevant to growth. Natural resource abundance could crowd-out entrepreneurial activity or innovation, if wages in the natural resource sector rise high enough to encourage potential innovators and entrepreneurs to work in the resource sector. In the same vein, since natural resource rents are concentrated and (in some cases) easily appropriable, government officials in such countries are tempted into rent-seeking and possible corruption rather than pro-growth activities. Natural resource countries would thus experience lower innovation, lower entrepreneurial activity, poorer governments and lower growth. Also important are Auty (2000) points about how the political process gets captured in resource-abundant economies. This is another form of crowding in which a predatory state eclipses the developmental state.

It seems fair to say that some variant of these crowding-out stories are the most likely explanations for the curse of natural resources, although further refinement is needed. Other possible explanations do not pass even a cursory look at the data. For example, Sachs and Warner (1997) found little evidence that resource abundance was associated with lower savings and investment.

[3] Our measure is a proxy because we are forced to use gross exports rather than *value added.* However, we would expect that growth in these two should be highly positively correlated.

[4] Sachs et al. (1997) show a strong simple correlation between fast growth in manufacturing exports and overall economic growth during this period.

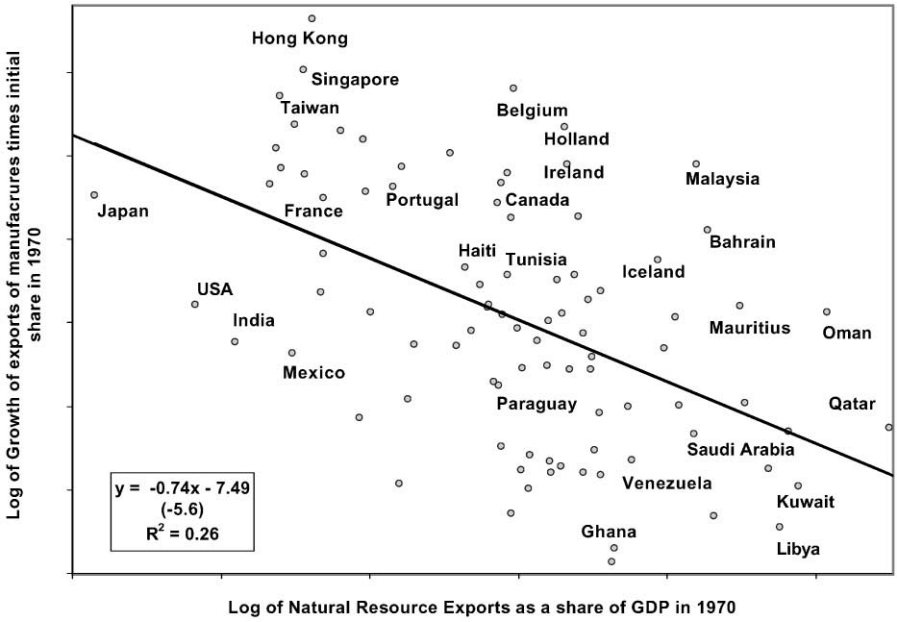

Fig. 2. Natural resource intensive economies have had *smaller* contributions from exports of manufactures to overall GDP growth.

Second, although there is evidence that resource abundance is associated with more authoritarianism, there is unfortunately only weak evidence for an association between non-authoritarian political systems and growth. The same goes for income inequality. It is also sometimes said that natural resource countries waste the natural resources on unproductive projects. Yet this by itself does not explain slow growth, it just explains a permanently lower level of GDP than the country would have enjoyed with optimal use of its natural resources.

We also wish to highlight the evidence for crowding out of entrepreneurial activity, which is less discussed in the natural resource context. If one looks at detailed wage data in resource abundant countries, one of the interesting findings is that one often sees a wage premium in natural resource sector. For example in Trinidad and Tobago, an index of average weekly earnings of production workers, which took the value 100 in 1977, was, by 1996, 1048 in the Oil Sector and only 398 in assembly-type industries (Central Statistical Office, Trinidad and Tobago, "Annual Statistical Digest", 1996, p. 101).

If these were workers of similar skills (and the data give us no reason to think otherwise since they are listed under the same classification of "production workers"), this runs counter to simple Dutch Disease notions whereby resource abundance raises wages of similarly skilled workers in all sectors. These differing

wages may indicate some selection where the petroleum workers are more productive in unobserved ways, or there may be some implicit compensation for more dangerous working conditions. A third possibility is that a labor aristocracy has developed which preserves higher wages in the petroleum sector.

If this is going on, then we cannot say that assembly manufacturing is being crowded out by the petroleum sector, through higher wages, because it does not necessarily have higher wages. However, if this kind of wage premium extends to jobs that entrepreneurs might take, the existence of the wage premium creates a big incentive for entrepreneurs and rent seekers to invest in trying to gain entry into the petroleum sector. To the extent that entrepreneurial talent is in limited supply, this will crowd out growth-promoting entrepreneurship of all kinds.

3. Conclusion

The level of natural resource intensity experienced by some countries in the mid-to-late 20th century, particularly mineral-intensive countries, seems to have been historically unprecedented, at least according to the limited data available for earlier periods. Almost without exception, the resource-abundant countries have stagnated in economic growth since the early 1970s, inspiring the term, "curse of natural resources". Empirical studies have shown that this curse is a reasonably solid fact. It is not easily explained by other variables, or by alternative ways to measure resource abundance. This paper shows that there is little direct evidence that omitted geographical or climate variables explain the curse, or that there is a bias resulting from some other unobserved growth deterrent. We also show evidence that resource-abundant countries tended to be high-price economies and that, partly as a consequence, these countries tended to miss-out on export-led growth. Except for the direct contribution of the natural resource sector itself, which, for example, explains much of the rapid growth of Botswana, natural resource abundant countries systematically failed to achieve strong export led growth or other kinds of growth.

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