

The Resource Drag

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Abstract

Between 1995 and 2001 Jeffrey Sachs and Andrew Warner published a series of influential empirical studies examining mining and energy's role in economic growth. Their principle finding was that economies heavily dependent on extractive activity in 1971 grew more slowly than comparable non-extractive economies over the next 19 years. This result has been deemed "The Resource Curse." The result is generally robust across differing country samples and across extended sample periods. Many have sought to explain the phenomenon, but without unified success. Sachs and Warner suggest that crowding out of a sector or activity with production externalities is the most likely explanation. This paper demonstrates that the relatively slower growth in mineral and energy economies may simply reflect a resource drag, whereby optimally managed per capita resource production does not grow substantially over time and hence introduces a drag on the measured growth of per capita economic output. If the resource curse is indeed only a resource drag, this has implications for trade and industrial policies implemented on the presumption that there are growth-reducing market failures associated with mineral and energy production.

Key words: Resource Curse, resource drag, Dutch disease, crowding out, mining, minerals, energy.

JEL Codes: Q33, Q43, O13, O4, O57

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Introduction

The resource curse is a phenomenon whereby economies that are heavily involved in primary resource production grow more slowly than comparable economies that are resource poor. The worry is that resource-intensive economies will fall or already have fallen short of their counterfactual growth paths, and as a result can suffer permanently lower levels of output per capita. There is much debate over the causes of the resource curse, ranging from trade effects to deindustrialization to weakened institutions.

While the resource curse implicates primary production, which includes both agriculture and mineral production, many have come to conclude that it is mineral production that is the problem (e.g., Butkiewicz and Yanikkaya 2010). The mineral resource curse has become a stylized fact in the popular press and among special interest groups (e.g., Christian Aid 2003, *Economist* 1995, Pegg 2003, Ross 2001, Surowiecki 2001). Worries about the curse are omnipresent, as indicated most recently by concerns that Afghanistan's large mineral endowment may hinder rather than help its economic development (McNeil 2010).

In this paper we revisit the original empirical work by Andrew Sachs and Jeffrey Warner (1997a) that identified the resource curse. We argue that they fail to control for the fact that a static or declining minerals sector directly causes measured growth to slow. Upon controlling for changes in mineral production we find that booming mineral and energy economies grow faster than they otherwise would, while busting mineral and energy economies grow slower than they otherwise would. There is some evidence of residual crowding out effects associated with mineral and energy production, but they are not as large as originally thought and their certainty is statistically questionable. This result requires an examination of the antidotes for the resource curse that include tariff

and non-tariff barriers, marketing boards, export controls, and exchange rate policies or sterilization efforts to offset the deindustrialization and export revenue volatility that accompanies mineral production (van Wijnbergen 1984, Sachs and Warner 1995b, Frankel 2010).

We are not the first to suggest that slow growth in mineral and energy economies may be a result of a resource drag. Alexeev and Conrad (2009), for example, suggest that while these economies do not appear to have grown more slowly in the long run, they may well grow more slowly in the short run due to static or declining mineral production. Sachs and Warner (1995b) also mention the resource drag in passing. We are the first, however, to empirically test for its significance.

The paper begins with a review of the resource curse and its empirical origins, with particular emphasis on the contributions by Jeffrey Sachs and Andrew Warner, and provides some anecdotal examples of where the curse appears to be coincident with a resource drag. It then moves on to an empirical test for the resource drag in the original Sachs and Warner data base. It ends by discussing how the resource drag explains why different empirical researchers are at odds over the resource curse effect, and what implications a resource drag has for trade and industrial policy in resource-dependent economies.

The Resource Curse

In the early to mid 1900s most economists and policy analysts assumed that mineral production and export contributed to the economic welfare of the exporting countries.¹ The “staples thesis,” largely based on observations of Canada’s favourable growth trajectory, was typical of the enthusiasm for resource-based growth (Keay 2007). In the

1980s the Dutch disease model (Corden and Neary 1982) showed that a shift in comparative advantage to a booming natural resources sector unequivocally improved national welfare, and that only in unusual circumstances could this outcome of welfare improvement be overturned (van Wijnbergen 1984).

Shortly thereafter a two-pronged attack challenged these benevolent views of minerals production. In the first, case studies by Gelb (1988), Auty (1990, 1991, 1993, 1994a, 1994b), and others, as well as initial cross-section empirical analyses by Wheeler (1984) and Auty and Evans (1994), determined that many mineral-exporting countries had had disappointing economic growth.² The second attack consisted of more comprehensive empirical analyses, of which the three working papers by Jeffrey Sachs and Andrew Warner (1995a, 1995b, 1997a) and their six spin-off publications (1997b, 1997c, 1999a, 1999b, 2000, 2001) are the best known and most influential.³ These papers confirm that agricultural and mineral-intensive economies grew more slowly than they otherwise would have between 1970 and 1990 if they had been resource poor.

The purpose of the original Sachs and Warner (1995a, 1995b) papers was to investigate what they variously call “a conceptual puzzle,” “a surprising feature of economic life,” and an “oddity:” namely, the negative association identified by Auty, Gelb, and others between the intensity of a country’s natural resource (agriculture, mining, and fuels) production and its subsequent economic growth. The third paper (Sachs and Warner 1997a) updates the growth period by one year with little impact on the results. None of these three papers has been published in a peer-reviewed journal, though portions of the 1997 paper have been published in Meier and Rauch (2000).

¹ Here and henceforth we use the term ‘mineral’ to refer to mining, oil and gas products.

² For a more extensive review of the literature see Davis (1995), Stevens (2005), and Frankel (2010).

³ According to Google Scholar, the three working papers had been cited a total of 1,776 times as of 9/7/2010.

Since the three seminal working papers are virtually identical in their empirical approach, we will discuss and revisit the results in the latest (1997a) version, for which the data set has been made available. Sachs and Warner begin by estimating for a sample of 99 developed and developing countries the intensity of natural exports in 1970 and these countries' economic growth from 1970 to 1990. The country set includes several mineral-intensive economies, but excludes most of the slow-growing Middle Eastern oil producers for fear that they would bias the results.⁴ While included in the data set, the important mining countries Botswana, Niger, and Zaire have no growth data and so are not included in the regression results. Somalia, Tanzania, Barbados, Haiti, and Myanmar, some of the poorer performing developing economies that are not mineral exporters, are also excluded from the regressions for lack of data. Sachs and Warner provide data for Chad, Gabon, Guyana, and Malaysia, but exclude them as outliers to remove the possibility that the results are being driven by these four countries, three of which are resource exporters (Chad is the exception). This leaves an 87 country sample.

Resource intensiveness is measured as the 1970 share of gross agricultural, mining, and fuel exports as a percentage of GNP (variable SXP). Economic growth is the annual change in real GDP per economically active population (variable GEA7090, which actually measures productivity growth).⁵ Sachs and Warner find that countries with a higher level of resource export intensity in 1970 grew more slowly over the subsequent two decades after controlling for convergence effects (see regression 1.1 in their paper). Of particular interest to the minerals-based version of the resource curse, when they replace primary resource exports as a share of GNP in 1970 (SXP) with the ratio of

⁴ Excluded are six poorly performing oil economies: Bahrain, Iraq, Kuwait, Qatar, Saudi Arabia, and United Arab Emirates, and one adequately performing oil economy, Oman. Included in the sample are 11 countries that did export significant amounts of crude oil or crude oil products.

⁵ In their 2001 paper Sachs and Warner report the independent variable as "real growth per person between 1970 and 1990" (p. 830). We have replicated their results in that paper, and the independent variable is in fact real growth per economically active population, as it is in the 1997a paper.

domestic mineral and energy sales to GNP in 1971 (variable SNR) the coefficient on SNR is similarly negative and highly significant. The variable SNR has the desirable property that it avoids discussions over whether gross exports or net exports are the more appropriate measure of export intensiveness (this is an issue for countries like Singapore and Trinidad and Tobago) (Lederman and Maloney 2007, p. 17). It also avoids the possibility that SXP reflects export concentration (Lederman and Maloney 2007) or level of development (Alexeev and Conrad 2009) rather than the effects of resource-intensive production.

We are able to purely replicate all of the Sachs and Warner results.⁶ When we expand the data sample to the full 99 countries by adding the four outliers and the missing growth data for Botswana, Niger, Zaire, Somalia, Tanzania, Barbados, Haiti, and Myanmar, the results remain virtually unchanged.⁷ The resource curse also persists when the sample period is extended to 1998 (Neumayer 2004) and 2003 (van der Ploeg and Poelhekke 2009), and shifted to 1980 to 1999 (Lederman and Maloney 2007).

This resource impact on growth is estimated to be quite pronounced, and as important as differences in trade policies. For example, the actual difference between annual productivity growth in mineral-poor Japan and mineral-rich Zambia over the 1970-1990 sample period was 5.5 percentage points (Japan's productivity grew by 3.3 percent per year, while Zambia's fell by 2.2 percent per year). Using the results of Sachs and Warner's regression 3.2, where the coefficient on SNR is -6.45, 2.3 percentage points of this difference are attributed to Japan's more open trade policy (1.5 percentage points)

⁶ There were, however, some errors in the 1997a paper's reporting of the results, which we log here: Table 1: independent variable is LINV7089; Table III: dependent variable is GEA7090, t-statistic on Land in regression 3.4 is -4.08; Table IV: dependent variable is GEA7090; Table VI: dependent variable is GEA7090; Table VII: dependent variable is GEA7090; Table VIII: independent variable is LGDPNR70, not LGDPEA70; Table IX: SXP80 and not SXP70 is used in the second regression, column headings should be Growth 1970 – 1980 and Growth 1980 - 1990.

⁷ We use GEA7089 in the absence of the GEA7090, taken from the same data sources used by Sachs and Warner.

and more favourable change in terms of trade (0.8 percentage points), while 2.4 percentage points are attributed to Japan's lower mineral production.^{8,9}

Crowding Out as the Cause of the Resource Curse

Finding no immediately apparent reason as to why resource production itself would cause slower growth, Sachs and Warner go on to look for indirect policy effects. Since resource exporters tend to have less trade openness than manufacturing exporters, perhaps as a response to worries about deindustrialization and the consequent protection of manufacturing during the resource boom, their slower growth may simply be due to their suboptimally closed trade policies. Sachs and Warner control for trade openness and find that resource exporters still grew more slowly than expected (SW regression 1.2). We find that the result holds when domestic minerals production (SNR) replaces resource exports (SXP) as the measure of resource intensity of the economy. Sachs and Warner find that the resource exporters still grow more slowly after controlling for terms of trade changes (variable DTT7090), investment activity (variable LINV7089), and institutional quality (variable RL). Again, we find that the same results obtain when minerals production (SNR) is the measure of resource intensiveness. We find that these results are robust to our addition of Botswana and the other omitted countries to the regressions. Resource-based economies do tend to implement economic, legal, and political policies that are traditionally thought to slow growth (Gylfason 2001, de Soysa 2002). But these indirect effects explain only a small fraction of the total growth effect (Sachs and Warner

⁸ Sachs and Warner regression 3.2 repeats regression 1.5, only with SNR replacing SXP. The coefficient on SNR is negative and highly significant. The results are not directly comparable, however, as three outliers (Gabon, Guyana, and Malaysia) omitted from the sample in regression 1.5 are added back to the sample in regression 3.2.

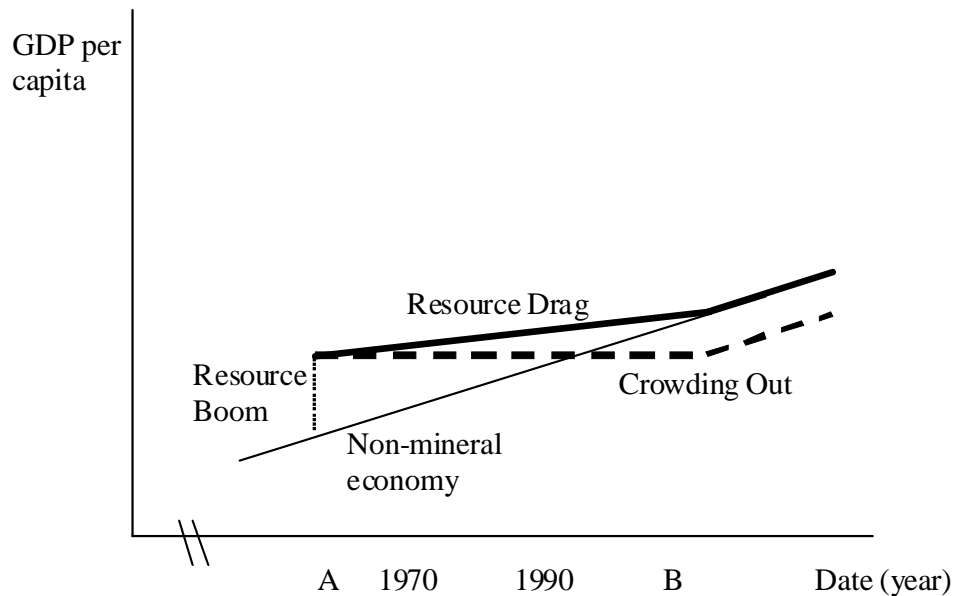
1995a, 1995b, 1997a, 1999a, 1999b, 2000). In other words, even if all the potentially negative indirect trade, political, and bureaucratic effects associated with resource abundance were corrected, there would remain a negative direct relationship between primary resource abundance broadly defined, or mineral abundance more narrowly defined, and economic growth. Geography, regional dummies, previous growth experiences, revolutions, coups, initial human capital, terms of trade volatility, income inequality, and a host of other usual determinants of economic growth also do not explain the residual (Sachs and Warner 1997a, 1997b, 2001).

With no indirect effect identified, the negative relationship between initial resource intensity and subsequently slow economic growth remains to be explained, and Sachs and Warner are left to speculate about its cause. They posit that the problem is the crowding out of manufacturing or another activity, such as entrepreneurialism, that exhibits externalities in production (Sachs and Warner 1995b, 1999a). As they put it in their final paper on the topic, “Natural Resources crowd-out activity x . Activity x drives growth. Therefore Natural Resources harm growth” (Sachs and Warner 2001, p. 833). We call this the “crowding out” model of the resource curse.

Under this model the general path for an economy during a minerals boom is depicted by the dashed line in Figure 1. The boom begins in year A, which is prior to the start of the measurement period (1970). While the crowding out model allows for either a spike or drop in GDP during the resource boom, there is ample empirical evidence to support a spike (Alexeev and Conrad 2009, Rodriguez and Sachs 1999, Sachs and Warner 1999a). Crowding out is alleged to cause subsequent growth to slow to such an

⁹ Zambia should have grown 2.5 percent faster than Japan as a result of its lower initial per capita income and 1.9 percent slower than Japan as a result of rule of law and investment differences. Adding these to the trade policy, terms of trade, and mineral intensiveness growth differences leads to an explained growth difference of 4.1%. This leaves 1.4% of the difference unexplained.

Figure 1: Slower Growth of a Mineral Economy During a Resource Boom



extent that eventually the level of GDP per capita falls to below that predicted in the absence of a mineral boom. The boom is in the end immiserizing, and a true curse.

As of 2001 the crowding out theories were thought to need further investigation and refinement (Sachs and Warner 2001, 6, Torvik 2001). More recently, Alexeev and Conrad's (2009) failure to find any degree of immiserization in mineral economies, many of which have been producing minerals for over 50 years, indicates that if there is immiserization from crowding out it has yet to show up. That is, point B in Figure 1 is at least 50 years beyond point A. Still, there is strong evidence that mineral intensive economies have experienced the resource curse of slower than normal growth since 1970, and it is of interest to determine why.

The Resource Drag

The absence of observed immiserization of mineral economies to date lends support to the possibility that the measured slower growth in the mineral economies is simply an artefact of national income accounting. At the level of the firm, the optimal mineral production profile at first rises and then falls in both competitive and uncompetitive markets (e.g., Ghoddusi 2010). It is not hard to imagine that if all mining and energy firms in a country start activity at more or less the same time as a mineral frontier opens up, an economy-wide production profile would have this same pattern. Then, given that national mineral production will at some point be static or declining, a resource drag ensues (Boyce and Emory 2011, Jones 2002, Nordhaus 1992, Rodriguez and Sachs 1999). The drag is not immiserizing, however, and simply reflects an overshooting of the steady state rate of growth (see the solid line in Figure 1).

Alexeev and Conrad (2009) give a particularly parsimonious model of growth that can reflect this type of resource drag. We modify it here to reflect per worker values.

Assume that an economy's non-mineral GDP is linear in capital, and that producing minerals does not require any capital or labour (this assumption is also used in Sachs and Warner's crowding out model). The economy's per worker output is then

$Y_t = \alpha K_t(1 + g)^t + M_t$, where K_t is capital per worker, M_t is the per worker output of the mineral sector and g is the exogenous rate of technical progress. The addition of output from the minerals sector causes a spike in GDP per worker. The economy invests a constant share, b , of its per worker output, which, assuming no growth in labour, yields $\Delta K_t = bY_t$. An expression for the economy's discrete rate of growth in output per worker is then

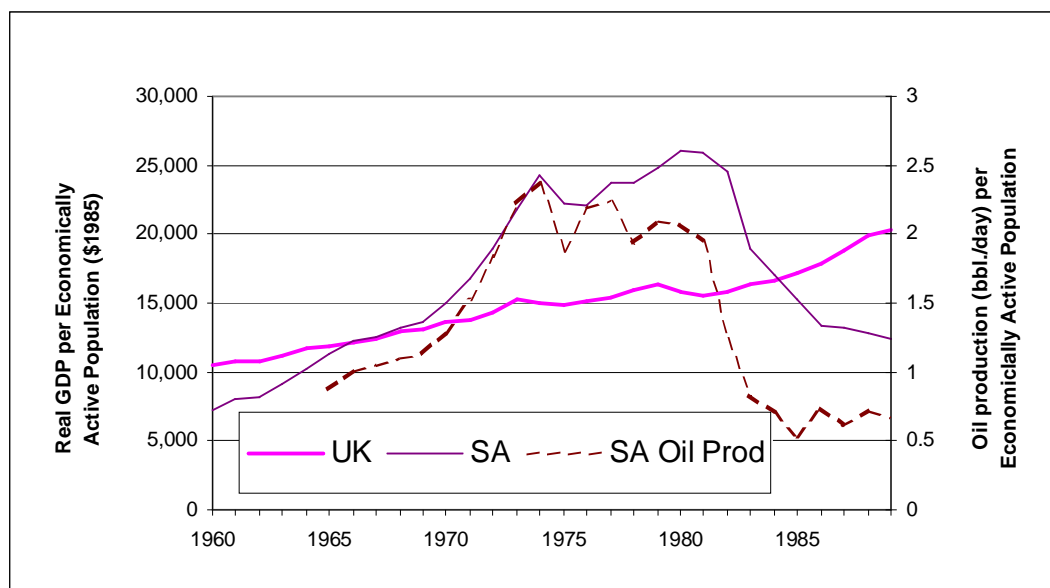
$$\frac{Y_{t+1} - Y_t}{Y_t} = \alpha b(1 + g)^{t+1} + g + \frac{M_{t+1} - (1 + g)M_t}{Y_t}. \quad (1)$$

As shown by the last term on the right-hand side of equation (1), any mineral economy whose per worker resource output is growing at less than rate g will experience a resource drag that slows measured growth.¹⁰ The influence of that resource drag is proportional to the share of minerals in the economy. Once the resource is depleted growth will return to the normal rate. Rodriguez and Sachs (1999) model this very path for Venezuela, whose negative real growth in the 1970s and 1980s, averaging -1.85% per year, can be explained using a CGE simulation that includes a resource drag effect from Venezuela's declining oil production.

Figure 2, depicting GDP per worker and oil output per worker for Saudi Arabia, shows just how severe the resource drag can be (Davis 2009). Saudi Arabia's economic collapse in the 1980s clearly coincided with the drop in per worker oil production. Economic growth for the UK, a country with the same level of GDP/capita as Saudi Arabia in 1970 and that serves as the counterfactual to Saudi Arabia in the Sachs and Warner regressions given that they control for the 1970 level of real GDP/capita, is also depicted in the figure. The UK had relatively little mineral production and hence suffered no resource drag over this period. Table 1 provides similar evidence of a resource drag for other Middle Eastern countries that have been poster children for the resource curse (e.g., Karl 1997). The Middle Eastern economies that had the slowest growth also had the highest rate of oil production per worker and the most steeply declining oil production per worker. Oman is the only country in Table 1 to have positive growth, and it had the smallest rate of reduction in per worker oil output.

¹⁰ This same result obtains when we include labour explicitly in the production of non-mineral output, though the derivation is more cumbersome.

Figure 2: Annual real GDP (1985 PPP dollars) per economically active person for Saudi Arabia (SA) and the United Kingdom (UK) from 1960 to 1989; daily oil production per economically active person for Saudi Arabia (SA Oil Prod) is shown from 1965 to 1989.



Sources: Growth data: Penn World Tables v 5.6. Oil production data: BP Statistical Review of World Energy 2004. Economically active population data: World Bank World Development Indicators.

Table 1: Rates of economic growth and changes in oil production per economically active person, selected Middle Eastern countries

Country	Real per Worker Growth Rate (%/yr., 1970-1989)	Oil Prod., 1970 (bbl/day/eapop)	Oil Prod., 1989 (bbl/day/eapop)	Oil Prod. Change (%/yr.)
Qatar	-7.70 (80-90)	3.09 (1980)	1.27 (1990)	-8.9
Kuwait	-5.39	7.41	1.11	-10.0
UAE	-4.60 (73-89)	6.18 (1973)	1.74	-7.9
Iraq	-1.88 (70-87)	0.32	0.28 (1987)	-0.8
Saudi Arabia	-0.76	1.28	0.67	-3.4
Oman	0.69	0.86	0.80	-0.4

Sources: Growth data: Sachs and Warner (1997a, Table II). Oil production data: BP Statistical Review of World Energy 2004. Economically active population data: World Bank World Development Indicators.

The Evidence

In this section we empirically test for the resource drag by adding change in per worker mineral production as a conditioning variable to the Sachs and Warner studies. Using Sachs and Warner's index of domestic mineral production, SNR, as a guide (1997a, p. 30), we first compute real mineral sales per worker for each country in their sample in 1971 and 1990 for 23 minerals using 1971 prices. We use 1971 rather than 1970 as the starting year for mineral production so that we can compare our results to Sachs and Warner's use of SNR, which is based on mineral production in 1971. The 23 minerals are coal, natural gas, natural gas liquids, petroleum, bauxite, copper, gold, iron ore, lead, manganese, nickel, platinum, silver, tin, uranium, zinc, asbestos, industrial diamonds, gem diamonds, phosphate rock, potash, salt, and elemental sulphur. We use the same data source as in Sachs and Warner's computation of SNR, the US Bureau of Mines' Minerals Yearbooks. The inclusion of gold and diamonds makes this a particularly interesting index of mineral production, as gold and diamonds have been suggested to be the worst type of minerals for creating a resource curse (e.g., Earthworks and Oxfam America 2004, Olsson 2006). The trade-based indices of resource intensity (such as SXP) omit gold and precious stones for lack of data.

We then re-estimate Sachs and Warner's (1997a) Table 1 results for their full 148 country sample, adding missing growth data for 10 countries.¹¹ Given (1), the resource drag model of the resource curse is empirically estimated as

$$\text{GEA7090} = \beta_0 + \dots + \beta_{n+1} \frac{\text{M90/EAPO90}}{\text{GDPEA70}} + \beta_{n+2} \frac{\text{M71/EAPO71}}{\text{GDPEA70}} + \dots + \varepsilon, \quad (2)$$

where M90/EAPO90 is real mineral sales per worker in 1990 (using 1971 prices), M71/EAPO71 is mineral sales per worker in 1971, and GDPEA70 is real GDP per worker in 1970, based on 1985 international prices. From (1), if the resource drag alone explains the resource curse, the joint null is $\beta_{n+1} > 0$, $\beta_{n+2} < 0$, and $\beta_{n+2} = -(1+g)\beta_{n+1}$. If the crowding out model is instead correct, the joint null is $\beta_{n+1} = 0$ and $\beta_{n+2} < 0$.¹² If a combination of crowding out and resource drag effects is in action, then both pure models should be rejected and $\beta_{n+1} > 0$, $\beta_{n+2} < 0$, and $\beta_{n+2} < -(1+g)\beta_{n+1}$, the latter inequality reflecting that the initial level of mineral production has a larger impact on growth than as reflected in the anticipated resource drag effect. Our value for g given a nineteen year observation period from 1971 to 1990 is 0.13, constant across all countries, reflecting an average 0.6% per year rate of technical growth from 1971 to 1990.¹³

We also test the restricted regression

$$\text{GEA7090} = \beta_0 + \dots + \beta_{n+1} \frac{(\text{M90/EAPO90} - (1+g)\text{M71/EAPO71})}{\text{GDPEA70}} + \beta_{n+2} \text{SNR71} + \varepsilon, \quad (3)$$

which directly tests the Sachs and Warner regressions for omitted variable bias. In this

regression the pure resource drag is supported by the joint null $\beta_{n+1} > 0$ and $\beta_{n+2} = 0$,

while the pure crowding out model is supported by the joint null $\beta_{n+1} = 0$ and $\beta_{n+2} < 0$. A

¹¹ These are Botswana, Niger, Zaire, Somalia, Tanzania, Barbados, Haiti, Myanmar, Oman, and Saudi Arabia. We use GEA7089 in the absence of the GEA7090 data.

¹² $\frac{\text{M71/EAPO71}}{\text{GDPEA70}} \cong \text{SNR71} = \frac{\text{M71}}{\text{GNPD71} * \text{POP70}}$, where GNPD71 is GNP per capita in 1971 dollars and

POP70 is population in 1970. We have more data for $\frac{\text{M71/EAPO71}}{\text{GDPEA70}}$ and $\frac{\text{M90/EAPO90}}{\text{GDPEA70}}$ than for

SNR71 due to better availability of the data that go into making up the ratio.

¹³ This is the value of g for the United States over this period (Jones 2002, Table 2.1). The average for all of the economies in our sample is probably higher than this (Jones 2002, Figure 2.15), but we stay with 1.13 to be conservative. Hall and Jones (1999) note that by 1988 productivities differed dramatically across countries. This is consistent with all countries having only small differences in the level of g , since the differing productivities are a result of compounding differences in g over perhaps 100 years.

combined effect is supported by the joint null $\beta_{n+1} > 0$ and $\beta_{n+2} < 0$.¹⁴ In a check of the primary source data used by Sachs and Warner to compute SNR we were unable to match the values for several countries.¹⁵ In this light we computed our own series for SNR using the same primary sources used by Sachs and Warner. To avoid confusion we relabel the Sachs and Warner variable SNR71 when the series is based on our computations rather than the original Sachs and Warner values.

Tables 2, 3, and 4 present the results.¹⁶ The regressions are numbered to match the regressions in Sachs and Warner, with the “a” regressions having the same conditioning variables that they use, only with SNR71 replacing SXP since we are interested in the minerals version of the resource curse. For example, regression 1.1a in Table 2 is regression 1.1 in Sachs and Warner (1997a) extended to the full country sample and with SNR71 as the index of mineral intensiveness instead of SXP. In most cases in the regressions in these tables the adjusted R-squared jumps substantially when we control for changes in mineral production either via the unrestricted specification in equation (2) or the restricted specification in equation (3). With the exception of the convergence variable in regression 1, all of the coefficient signs are as expected.

¹⁴ We are aware of the criticism that the ratio of minerals production to level of GNP, as in SNR71, suffers from an endogeneity problem in the sense that economies that are growing more slowly over the long run will tend to have a higher SNR71 value for a given level of mineral output (Alexeev and Conrad 2009). Alexeev and Conrad nevertheless concede to adding mineral output per unit of economic output to their regressions as a conditioning variable, and so do we, since the purpose of our paper is to revisit the Sachs and Warner regressions and to test the robustness of their results after taking into account the resource drag effect.

¹⁵ We are able to determine the 23 mineral products used by exactly matching Sachs and Warner’s reported total value of mineral production across these 23 minerals, and so differences are either due to reported mineral production for each country or imputed US import prices. In some cases Sachs and Warner report “0” SNR values for countries that are not included in the Minerals Yearbook database. We instead remove these countries from the sample. In other cases we are not able to find 1971 GNP per capita data for a country using the sources cited in Sachs and Warner. The end result is the addition of SNR71 data for 3 countries and the removal of SNR71 data for 11 countries. Most other SNR71 values differ only slightly from the SNR values originally computed by Sachs and Warner.

¹⁶ We determined Botswana to be an outlier using a Grubbs test since its change in mineral production during the sample period is over 10 standard deviations from the sample mean and over 9.9 standard deviations from the next value in the sample. It has been removed from the sample in all regressions. Sala-i-martin (2004) also note that Botswana is an outlier that is driving their results, but do not appear to exclude it from their regressions.

Table 2: Associations between growth (1970 – 1990) and minerals production, controlling for initial productivity and trade policy

Dependent variable: Average percentage annual growth in real GDP per economically active population, 1970 – 1990 (GEA7090).

	(1.1a)	(1.1b)	(1.1c)	(1.2a)	(1.2b)	(1.2c)
Constant, β_0	-1.33 (-0.94)	-0.75 (-0.59)	-0.76 (-0.55)	4.95 (3.35)	5.10 (3.69)	5.01 (3.43)
Initial productivity (LGDPEA70), β_1	0.31 (1.92)	0.24 (1.60)	0.24 (1.46)	-0.59 (-3.12)	-0.62 (-3.44)	-0.60 (-3.19)
Ratio of minerals to GNP (SNR71), β_2	-3.24 (-2.55)		-1.16 (-1.82)	-2.41 (-2.81)		-0.90 (-1.51)
Mineral production in 1990, β_3		29.17 (3.60)			27.56 (3.53)	
Mineral production in 1971, β_4		-40.22 (-4.70)			-33.97 (-4.49)	
Openness (SOPEN), β_5				3.03 (7.15)	2.95 (6.92)	2.86 (6.71)
Ratio of β_4 to β_3		-1.38 (-1.36)			-1.23 (-0.48)	
Resource drag, β_6			37.81 (4.04)			28.23 (3.52)
Adjusted R ²	0.07	0.12	0.15	0.39	0.43	0.43
Sample Size	105	112	105	101	106	101
Standard error	1.78	1.75	1.71	1.44	1.42	1.39

White heteroskedasticity-consistent t-statistics in parentheses. t-statistic in Ratio of β_4 to β_3 tests $H_0: \beta_4 = -1.13\beta_3$. A two-tailed test is appropriate here.

Table 3: Associations between growth (1970 – 1990) and minerals production, controlling for initial productivity, trade policy, investment, and rule of law

Dependent variable: Average percentage annual growth in real GDP per economically active population, 1970 – 1990 (GEA7090).

	(1.3a)	(1.3b)	(1.3c)	(1.4a)	(1.4b)	(1.4c)
Constant, β_0	5.21 (4.19)	5.48 (4.88)	5.26 (4.33)	7.26 (3.35)	7.52 (4.45)	7.98 (3.92)
Initial productivity (LGDPEA70), β_1	-1.01 (-5.87)	-1.07 (-6.71)	-1.00 (-5.94)	-1.26 (-4.64)	-1.30 (-5.83)	-1.34 (-5.34)
Ratio of minerals to GNP (SNR71), β_2	-2.73 (-3.46)		-1.30 (-3.29)	-3.51 (-2.23)		-0.04 (-0.03)
Mineral production in 1990, β_3		20.48 (2.74)			27.65 (2.61)	
Mineral production in 1971, β_4		-35.83 (-5.48)			-39.95 (-4.78)	
Openness (SOPEN), β_5	2.53 (6.54)	2.34 (6.42)	2.37 (6.24)	1.89 (4.71)	1.69 (4.39)	1.67 (4.46)
Log investment (LINV7089), β_6	1.29 (5.90)	1.43 (6.69)	1.26 (5.65)	1.21 (2.81)	1.20 (2.96)	1.11 (2.68)
Rule of law (RL), β_7				0.23 (1.35)	0.25 (1.87)	0.29 (1.85)
Ratio of β_4 to β_3		-1.75 (-2.61)			-1.44 (-1.16)	
Resource drag, β_8			26.63 (3.40)			35.84 (3.51)
Adjusted R ²	0.52	0.59	0.56	0.54	0.60	0.60
Sample Size	101	106	101	77	78	77
Standard error	1.27	1.19	1.22	1.24	1.13	1.15

White heteroskedasticity-consistent t-statistics in parentheses. t-statistic in Ratio of β_4 to β_3 tests $H_0: \beta_4 = -1.13\beta_3$. A two-tailed test is appropriate here.

Table 4: Associations between growth (1970 – 1990) and minerals production, controlling for initial productivity, trade policy, investment, rule of law, and changes in terms of trade

Dependent variable: Average percentage annual growth in real GDP per economically active population, 1970 – 1990 (GEA7090) in regressions 1.5a - 1.5d; average real percentage annual per capita growth in manufacturing and service sectors, 1970 – 1990 (GMR7090) in regression 8.2.

	(1.5a)	(1.5b)	(1.5c)	(1.5d)	(8.2)
Constant, β_0	9.28 (4.23)	9.23 (4.63)	9.38 (4.34)	6.58 (4.07)	7.99 (2.77)
Initial productivity (LGDPEA70), β_1	-1.37 (-5.32)	-1.42 (-5.90)	-1.40 (-5.46)		
Ratio of minerals to GNP (SNR71), β_2	-6.27 (-4.57)		-3.51 (-2.36)	-4.10 (-1.95)	1.08 (0.33)
Mineral production in 1990, β_3		21.90 (2.62)			
Mineral production in 1971, β_4		-41.66 (-5.81)			
Openness (SOPEN), β_5	1.69 (4.73)	1.59 (4.88)	1.59 (4.64)	1.40 (3.40)	2.72 (3.91)
Log investment (LINV7089), β_6	0.80 (1.99)	0.90 (2.28)	0.81 (2.07)	0.98 (2.67)	1.21 (2.01)
Rule of law (RL), β_7	0.33 (2.23)	0.35 (2.59)	0.35 (2.41)	0.07 (0.53)	0.16 (0.63)
Growth in log TOT (DTT7090), β_8	0.25 (3.53)	0.17 (2.75)	0.21 (2.94)	0.16 (2.17)	
Ratio of β_4 to β_3		-1.90 (-3.67)			
Resource drag, β_9			23.32 (3.15)	23.52 (2.43)	34.26 (1.42)
Initial productivity (LGDPNR70), β_{10}					-1.37 (-3.68)
Initial productivity (LGDPEA70FIT), β_{11}				-0.95 (-5.36)	
Growth volatility (STDRGDPL), β_{12}				-0.17 (-2.24)	
Adjusted R ²	0.63	0.65	0.66	0.58	0.53
Sample Size	77	78	77	76	51
Standard error	1.10	1.06	1.07	1.48	1.48

White heteroskedasticity-consistent t-statistics in parentheses. t-statistic in Ratio of β_4 to β_3 tests $H_0: \beta_4 = -1.13\beta_3$. A two-tailed test is appropriate here.

Table 2 lists the Sachs and Warner regressions that control for initial productivity and trade policy. The coefficient on SNR71 in regressions 1.1a and 1.2a is negative and statistically significant at the 5% level, our chosen level for confidence testing, indicating that mineral economies had slower growth. This is the result Sachs and Warner attribute to crowding out. In regression 1.1b we test for the resource drag effect via equation (2). The coefficients on the minerals production terms have the expected signs and are statistically significant, with the positive coefficient on minerals share in 1990 ruling out pure crowding out. Given that $\beta_3 > 0$, $\beta_4 < 0$, and that we fail to reject that $\beta_4/\beta_3 = -1.13$, we fail to reject the resource drag as the explanation for the slower mineral economy growth measured in equation 1.1a. Since the ratio of $\beta_4/\beta_3 < -1.13$, there may also be a crowding out effect at work, though we cannot confirm this statistically due to the failure to reject $\beta_4/\beta_3 = -1.13$ using a one-tailed test. In regression 1.1c, which tests the restricted equation (3), the coefficient on the resource drag is of the expected sign and statistically significant, again causing us to reject pure crowding out in favour of the resource drag model as the cause of the slower growth. The negative and statistically significant coefficient on SNR71 indicates that even after controlling for resource drag effects there are some residual nefarious impacts of having high mineral production at the start of the growth period. The economic importance of the effect is, however, about half of what was estimated in regression 1.1a.

Regression 1.2 repeats this exercise while controlling for trade openness. Adding trade policy increases the R-squared significantly, and the sign on initial productivity is now correct and statistically significant. The coefficient on SNR71 in regression 1.2a is again negative and significant, indicative of slower growth in mineral economies even after controlling for trade policy differences. In regression 1.2b the pure crowding out explanation of this effect is again rejected in favour of a resource drag, where we cannot

reject that $\beta_4/\beta_3 = -1.13$. That the ratio is -1.23 allows the possibility that there is some additional crowding out going on. In restricted regression 1.2c, however, the coefficient on SNR71 is not significantly different from zero in a one-tailed test, rejecting any residual crowding out effect.

Regression 1.3 in Table 3 adds as an explanatory variable the natural log of the ratio of real gross domestic investment (public and private) to real GDP averaged over the 1970-1989 period (LINV7089). In regression 1.3a the slow growth effect of SNR71 persists even after conditioning for differences in savings rates. The pure crowding out explanation is rejected in regression 1.3b due to the positive coefficient on minerals production in 1990. The pure resource drag model is also rejected, since we reject that the ratio of coefficients on mineral production is -1.13. Given that the ratio of β_4/β_3 is less than -1.13, there appears to be a combination of resource drag and crowding out in this regression. This is confirmed in the restricted regression 1.3c, where the coefficient on SNR71 is negative and statistically significant after controlling for the resource drag. Once again, though, the crowding out effect is about half of what it was before controlling for the resource drag effect.

Sachs and Warner next add variable RL to control for institutional quality. Adding that variable drastically reduces the number of countries in the sample (regression 1.4) due to missing data. The coefficient on SNR71 in regression 1.4a is still negative and significant. We reject pure crowding out in favour of a resource drag in both the unrestricted (1.4b) and restricted (1.4c) versions of the test. The insignificance of the coefficient on SNR71 in regression 1.4c rejects any residual crowding out effect. That is, subject to the caveat that this is a smaller country sample, the resource drag completely explains the slower growth in mineral economies once one controls for convergence, trade policy, investment, and rule of law differences.

To control for global commodity price shocks Sachs and Warner then add the average annual growth rate of the ratio of export to import prices between 1971 and 1990 (DTT7090). This is regression 1.5 in Table 4. Regression 1.5a shows that the coefficient on SNR71 is large and statistically significant. It is this remaining residual impact of mineral production on economic growth after controlling for several indirect channels of influence that has convinced so many that there must be a crowding out effect separate from any negative institutional and policy effects of minerals production. But in regression 1.5b we once again reject the pure crowding out model, with the signs on the resource drag terms being the right sign and statistically significant. The resource drag does not explain all of the mineral production effect on growth, since we can reject $\beta_4/\beta_3 = -1.13$. Restricted regression 1.5c confirms that there is some residual crowding out effect, with the coefficient on SNR71 being negative and statistically significant after controlling for the resource drag. Again, though, this crowding out impact is about half of what was measured in regression 1.5a.

In regression 1.5d we add two additional conditioning variables that seem particularly pertinent in teasing out the presence of a residual resource curse. If mineral economies have income levels that are temporarily high, conditioning on that income level is likely to underestimate the poor growth performance of the mineral economies given convergence effects, and therefore to underplay crowding out. To correct for this we use Alexeev and Conrad's (2009) equation (3) to estimate the log of initial sustainable income per capita for each country in our sample and use this in place of LDGPEA70. Second, van der Ploeg and Poelhekke (2009) suggest that crowding out effects in these types of regressions disappear once growth volatility is added as an independent variable. We add the standard deviation of annual real GDP per capita growth from 1970 to 1990,

STDRGDPL, as an additional conditioning variable.¹⁷ The results continue to find that both the drag effect and the crowding out effect are significant at the 5% level.

Finally, we test for crowding out directly. Regression 8.2 in Sachs and Warner looks at growth in the non-resource sectors of the economy. The coefficient on SXP in their regression is negative and statistically significant, consistent with the hypothesis that natural resource exports crowd out growth in the non-resource sectors. When we redo regression 8.2 controlling for mineral production (SNR71) instead of natural resource exports (SXP), this crowding out effect of mineral production disappears (Table 4, regression 8.2).¹⁸ The growth in the non-resource sectors is also not affected by changes in mineral production, providing support for equation (1) as a model of growth in mineral economies.¹⁹ These results suggest that Sachs and Warner are picking up export concentration effects on non-resource sector growth rather than mineral production crowding out effects (Lederman and Maloney 2007).

In each of these regressions we fail to reject that the resource drag is a component in explaining the slower growth in the mineral economies from 1970 to 1990. In regressions 1.2c and 1.4c there is no evidence of any remaining crowding out effect once we control for the resource drag. In 8.2 the crowding out effect disappears when we measure mineral production as opposed to mineral exports. In regressions 1.1c, 1.3c, 1.5c, and 1.5d the crowding out effect is still evident, but at about half the economic importance as originally estimated by Sachs and Warner.

¹⁷ Source: RGDPL, Penn World Tables v. 6.2. We lose Guyana in regression 1.5d due to absence of growth data over the sample period.

¹⁸ Neumayer (2004), in a similar cross-sectional study, replaces GDP growth with growth in genuine income adjusted for capital depreciation and mineral depletion. He finds that the resource drag slowed growth by about 0.06 percentage points per year for the most resource intensive economies and increased growth by 0.12 percentage points per year for the initially least resource intensive economies. There remains, however, a considerable and statistically significant crowding out effect even in growth in genuine income. Neumayer only adjusts GDP for the production of 13 minerals, compared with our 23. This and the fact that he controls for SXP rather than SNR is probably why he does not reject a crowding out effect.

¹⁹ The coefficient on SNR71 is insignificant whether or not we include the resource drag term. The coefficient on SXP when we exclude the resource drag term is -5.32 with a t-statistic of -2.00.

It is of interest to estimate the economic importance of the resource drag effect compared with the crowding out effect, presuming it exists. To do this we use regression 1.5c, which has the highest adjusted R-squared of all the regressions that we tested. Returning to the previously noted difference between Zambia's growth and Japan's growth from 1970 to 1990, crowding out associated with mineral production now only explains 1.3 percentage points of the difference, roughly half of the previous estimate of 2.4 percentage points. The resource drag explains 1.9 percentage points.²⁰ Differences in trade policy and terms of trade constitute an estimated 2.3 percentage points of the difference, with the remaining 0.5 percentage points unexplained. Expanding this type of accounting to our overall sample, the impact of the resource drag on economic growth from 1970 to 1990 averaged -0.3 percentage points per year in the 68 economies whose mineral production did not grow at more than g , the exogenous rate of technical progress. These same economies suffered an average crowding out effect of -0.4 percentage points per year. The 46 economies in our sample whose mineral production increased by more than g enjoyed a resource "boost" in growth averaging 0.2 percentage points per year. The remaining crowding out effect completely offsets this boost. Hence, the booming mineral economies on average experienced no detrimental effects from their minerals sectors, while the busting economies suffered 0.7 percentage points slower annual growth from both resource drag and crowding out effects.

The results for the Sub-Saharan African countries in our sample are no different, with almost all of them suffering a resource drag averaging -0.3 percentage points per year. A resource curse of roughly equal magnitude caused a total reduction of 0.7 percentage points in their annual economic growth.

²⁰ Zambia, like the oil producers, suffered from a collapse of its mineral sector from 1970 to 1990 (Davis 2009).

In sum, our reworking of Sachs and Warner's initial estimates of a resource curse indicate that their regressions suffered from omitted variable bias that resulted in an overestimate of the crowding out effect of mineral production. This omitted variable bias is likely to carry through to the subsequent literature testing for the resource curse, since none of it controls for changes in mineral production. Our finding of a resource drag is robust across the regressions, while the evidence of crowding out is not. Where we do find evidence of crowding out, the economic impact is about half of the magnitude originally estimated by Sachs and Warner.

Reconciling the Resource Drag with Prior Work on the Resource Curse

Our finding that mineral economies with static or shrinking mineral sectors suffer from a resource drag and that those with a booming minerals sector enjoy a resource boost is not unexpected. Askari *et al.* (1997) point out that in a pure oil economy, changes in real GDP are simply changes in the rate of oil production. Askari (1990), Hall and Jones (1999), and Weitzman (1990) argue that because of the unsustainability of resource production it is only reasonable to compare national products of mineral economies and non-mineral economies on a net basis, adjusting for mineral depletion. Bill and Springborg (1994) note the explicit link between Middle Eastern countries' oil revenues and changes in per capita real GDP. Wright and Czelusta (2007) find that booms are important for explaining mineral economy success stories, and Auty and Evans (1994) only find evidence of a resource curse in mature extractive economies that are probably suffering from contracting resource output. Boyce and Emery (2011) use a panel of mining employment levels to show that those US states that had more mining employment in 1970 suffered from slower growth from 1970 to 2001 (see their Table 3). But once they also control for changes in mining employment from period to period,

which proxies changing mining sector output, the negative impact of initial mining sector employment disappears (see their Table 5).

The resource drag, combined with the mean reversion of mineral production, also explains why Stijns (2005) and Brunnschweiler and Bulte (2008) find against the resource curse. In regressions similar to ours, Stijns (Table 5) includes as independent variables the stocks of various types of minerals near the end of the growth measurement period. The stocks mostly have positive coefficients and are not statistically significant. Brunnschweiler and Bulte also control for the end-of-period stock of minerals and find a positive and statistically significant coefficient, a resource blessing. “Why would the outcomes for stocks and flows be different?”, they ask (p. 261). We would suggest that since stocks and flows of minerals are almost perfectly correlated (Stijns 2005), it has nothing to do with how mineral intensity is measured, but rather with when the measurement takes place.²¹ A high end-of-period stock reflects a high end-of-period flow, and that, when combined with mean-reverting mineral production, correlates with a resource boost over the growth measurement period.

Such mean reversion is illustrated in Figure 3. Economies with a high flow of mineral production in 1971 tended to have a reduction in those flows over the next 19 years. On the other hand, economies with a low level of mineral production in 1971 tended to increase their production. The trend line has an R-squared of 0.92, indicating a remarkable regularity in this pattern. The outlier at the top of the pattern is Botswana, whose real mineral production increased from almost nothing to near \$2,000 per worker over the period. Given its rapid economic growth over this same period, Botswana has been consistently ruled as a country that defeated the resource curse, and is the only

²¹ In confirmation of our proposal, Stijns (2005, p. 112) states that his results are unaffected by whether he uses stock or flow measures of resource intensity.

Figure 3: Change in mineral production per worker as a function of initial flow of mineral production per worker for 148 countries

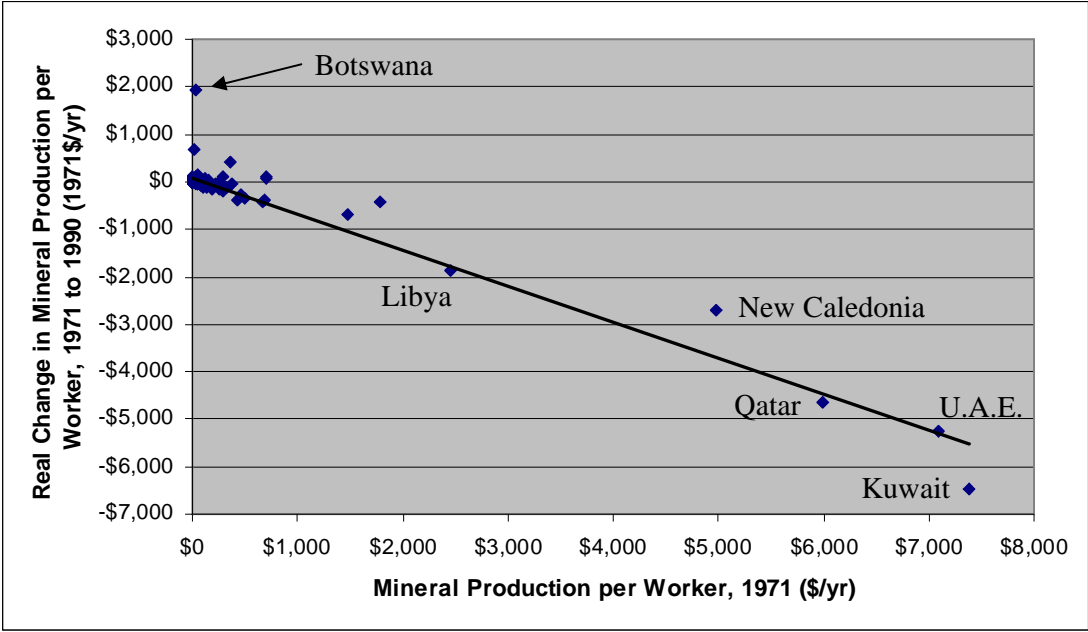
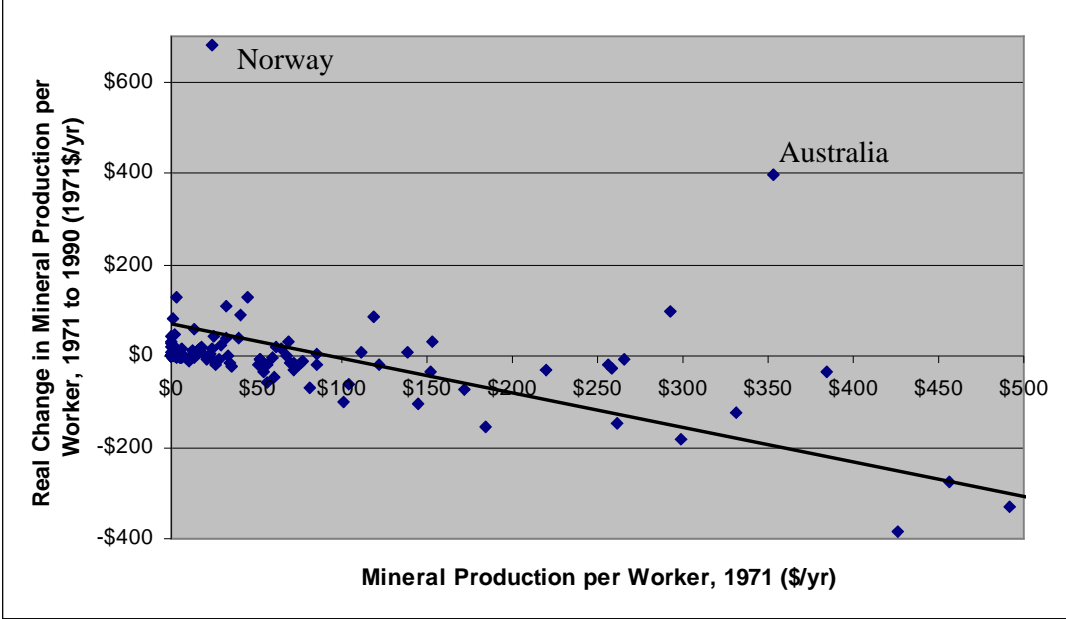


Figure 4: Detail of change in mineral production per worker as a function of initial flow of mineral production per worker



country ever to graduate from the United Nation Development Programme's list of Least Developed Countries. Our interpretation is that its rapid growth was based on its rapid increase in mineral production. The data points at the bottom right of the figure reflect the unhappy outcomes of the Middle Eastern countries that started the sample period with astonishing mineral productivity which then, along with economic output, collapsed precipitously. Some of these economies were referred to in Table 1.

Figure 4 shows the data around the origin of Figure 3, where the steady-state level of real mineral production is seen to be about \$100/worker/year. The outliers at the top of that pattern are Norway and Australia, economies that have also been suggested to have avoided the resource curse. Once again, their dramatic increase in real mineral output worker from 1971 to 1990, and the resultant boost in economic growth via the resource drag framework, cannot be overlooked as playing a role in their growth success.

In a mean-reverting process, the higher the current level of the state variable the more likely that the preceding and succeeding state variables are lower. Hence, the level of SNR71 is likely to proxy the degree to which the minerals sector shrinks in the future, while the level of end-of-sample mineral production is likely to proxy the degree to which the sector has boomed over the preceding years. The Stijns and Brunnschweiler and Bulte models, which condition minerals production by end-of-period reserve variables that are correlated with end-of-period minerals flows, are flagging the booming mineral economies as those that are minerals intensive. They naturally find that these economies have not suffered from slower growth. When van der Ploeg and Poelhekke (2010) redo the Brunnschweiler and Bulte work using a start-of-period mineral stock variable that is unlikely to be correlated with start-of-period flows, they find, not surprisingly, that resource stock has no effect on subsequent economic growth. Regressions that include both start-of-period and end-of-period mineral production, as in Sala-i-martin *et al.*

(2004), will find a negative coefficient on the beginning-of-sample variable and a positive coefficient on the end-of-sample variable, as in our regressions (b) in Tables 2 through 4. Sala-i-martin *et al.* indeed find a negative but not robust coefficient on primary exports as a fraction of total exports in 1970 (Sachs and Warner's PXI70 variable), which is near the start of their 1960 – 1996 sample period, but a positive and robust coefficient on minerals value added as a share of GDP in 1988, which is near the end of the sample period.^{22,23} Sala-i-martin *et al.* (p.827), when referring to the significant positive coefficient on 1988 mineral value added, conclude that, “While many economists expect that the large rents are associated with more political instability or rent-seeking and low growth, our study shows that economies with a larger mining sector tend to perform better.”²⁴ We would instead interpret their results as saying that economies with a larger minerals sector *near the end of the sample period* tend to have performed better in preceding periods since they are experiencing a resource boost. When Stijns (2005, Table 5 bis) adds a start-of-sample flow measure to his growth regressions, he similarly finds a negative sign on the flow measure and a positive (though statistically insignificant) sign on the end-of-period stock measure. All of these results reflect the workings of the resource drag.

Conclusions and Policy Implications

Alexeev and Conrad (2009) fail to find a long-run resource curse in current mineral economies. This, however, does not explain the currently slower growth of these economies, and nor is it assurance, given that slower growth, that immiserization will not eventually emerge. It is therefore of interest to determine what is causing the mineral economies' slower growth, and whether it may be related to a crowding out effect that

²² Minerals value added as a share of GDP in 1988 is Hall and Jones' (1999) variable “Mining.”

²³ See also Sala-i-martin (1997a, 1997b).

²⁴ While they refer to mining, the independent variable includes oil and gas extraction.

could, in the long run, result in immiserization. In this paper we find that the slower growth of the mineral economies may be entirely a resource drag effect associated with static or declining mineral production, though we cannot rule out that this drag effect is supplemented by an equally important crowding out effect.

Sachs and Warner (1997b) note that we still need to learn more about the growth experiences of the few “successful” (i.e., rapidly growing) resource rich countries like Chile and Malaysia. The resource drag provides some insights. Like Botswana, another successful country, these two countries were not mineral rich in 1971 (Botswana’s annual mineral production per worker was \$42, Chile’s was \$153, and Malaysia’s was \$61). By our estimation both increased their mineral production per worker over the next two decades at a rate sufficient to avoid a resource drag. Australia, Ireland, New Zealand, Norway, Oman,²⁵ and Thailand, other resource-abundant countries listed by various analysts as having escaped the resource curse (Matsen and Torvik 2005), also increased their real mineral production from 1971 to 1990 at a rate sufficient to avoid a resource drag.²⁶ There is no mystery to their success. On the other hand, of the ten countries that are listed by Matsen and Torvik as being suggested to be cursed, eight experienced mineral production growth that resulted in a resource drag from 1971 to 1990.

Our analysis also suggests that the countries currently avoiding the resource curse via a growing mineral sector will eventually succumb to it. From Figures 3 and 4, Botswana, Norway and Australia appear to be particularly at risk of substantial reductions in economic growth when their mineral reserves become depleted. Matsen and Torvik (2005, fn 13) suggest that Oman’s measured growth also reflects its unsustainable

²⁵ While Oman’s oil output per worker has fallen according to Table 1, its per worker output of all mineral and energy products has risen according to the US Bureau of Mines data that we use in the regressions.

running down of its oil stock. In other words, they suggest that Oman will eventually succumb to a measurable resource drag because its rate of growth of oil output will fall, just as it has in the other Middle Eastern countries. The presence of possible crowding out implies that these countries may even end up on an inferior growth path once the mineral is depleted.

On a more positive note, the growth rates of the mineral economies with declining mineral output should increase when the resource is depleted. Growth can also increase if mineral production increases due to change in policy or new investment. In a 2003 radio interview, Jeffrey Sachs was asked what needs to happen first in terms of new investment in Iraq. He replied, “The first thing that Iraq needs is to be able to pump the oil.”²⁷ This is a strange recommendation from the originator of the resource curse. It does, however, meet with the common sense of resource drag effects. With the current oil economies experiencing no immiserization to date from their long history of oil production (Alexeev and Conrad 2009), it may also be a good strategy in the long run.

In the mean time, we have no reason to suspect that mineral production decisions are any less optimal than other intertemporal output decisions in an economy. Hence, a rise or fall in mineral production, even when it leads to a boom-bust growth cycle due to resource drag effects, does not in and of itself warrant corrective trade or industrial policies aimed at changing the mineral production profile. Mineral economies may, on the other hand, want to increase trade protection for those activities being crowded out. The fact that the crowding out effect is statistically ephemeral once the resource drag is taken into account requires that such policy responses be carefully considered.

²⁶ Canada has also been said to have escaped the resource curse, which it has, in the long-run, if one looks at GDP per capita (Keay 2007). Keay (2007) estimates that Canada’s mineral production has had no perceptible resource drag effect in the short run. Using the results of regression 1.5c we estimate that the resource drag reduced Canada’s growth by an average of 0.12 percentage points per year from 1970 to 1990. Crowding out reduced it by another 0.20 percentage points per year.

²⁷ National Public Radio (United States), All Things Considered, 9/22/03.

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