Lifting the Curse: The Unsurprising Association between Natural Resources and Economic Growth

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Abstract: This paper makes two contributions to the literature estimating the relationship between natural resource exports and economic growth. First, a new source of data on primary resource exports is obtained from the Center for International Data (CID) to expand the sample of countries. Because the CID data are reported by importers rather than exporters, and importers tend to be more likely to report data than exporters, the sample size increases. Results suggest that enlarging the sample size tends to reduce the magnitude of the natural resource curse, but this difference is not statistically significant. Second, the empirical relationship between natural resource exports and economic growth is updated with recent data. Results here are surprising. The coefficient on natural resource exports steadily increases from a value that is negative and significant (for 1970) to a value that is positive and significant (for 1994). Whatever natural resource curse that may have existed in 1970 appears to have disappeared over time.

1. Introduction

The role that natural resources play in economic development has been the topic of debate in the economics literature for decades. One argument suggests that economies that specialize in natural resource extraction and export experience comparatively low rates of economic growth. Several reasons are provided to support this curse associated with natural resource production. First, natural resource extraction processes consume economic resources that otherwise could be allocated to industries that are thought to promote long term economic growth such as manufacturing or services. Second, global prices for natural resources can be volatile and thus destabilize exporting economies. Third, the concentrated nature of many natural resource supplies facilitates rent capture by non-inclusive governments whose institutions support the retention of political power rather than facilitating economic growth.

Natural resources can also benefit an economy. The revenue earned from the domestic or international sale of natural resources contributes directly to Gross Domestic Product (GDP). Over time, the rents gained from natural resource production can be invested in human or physical capital and thus promote long term economic growth. And in the very long run, if the rents from natural resources enrich a broad class of resource owners rather than a single regime, then the class of resource owners may increase demand for inclusive political and economic institutions such as democratic representation, respect for private property, and the establishment of a fair system of justice.

Perhaps because both sides of this argument can be persuasive, the debate over whether natural resource production helps or hinders economic growth has turned to the empirical data. At first, anecdotal evidence was employed. For example, resource-rich growth losers such as Nigeria, Zambia, Sierra Leone, Angola, Saudi Arabia and Venezuela are compared to resource-poor growth winners such as Japan, Korea, Taiwan, Hong Kong and Singapore to support the notion of a resource curse. But Norway, one of Europe's poorest countries in 1900, is now one of its richest. The growth may have been led by natural resources such as timber, fish and hydroelectric power and more recently oil and natural gas. Botswana is a growth leader in Africa perhaps due to diamond extraction. Many developed countries such as the United States, Canada, and Australia are resource-rich growth winners while dozens of developing countries across the world are resource-poor growth losers. Anecdotal referencing gets us no closer to the solving the dilemma.

A proper test of whether natural resources systematically improve or dampen economic growth requires data from a large cross-section of countries. Reliable GDP data for a many developing countries became available in about 1970, and economists made good use of these data. In a series of papers, Sachs and Warner (1995, 1997, 2001 – collectively referred to as S&W throughout the remainder of this paper) make first use of this data to estimate the statistical relationship between natural resource exports and economic growth. Results suggested a negative relationship – natural resources deter economic growth. Or, as Sachs and Warner suggest, "one of the surprising features of modern economic growth is that economies abundant in natural resources have tended to grow slower than economies without substantial natural resources." These seminal papers have been collectively cited over 6,000 times by 2012 (Davis, 2013). Results of the paper were also replicated by Davis (2013) who confirms the major findings.

Interestingly, a substantial number of empirical papers that followed S&W have either found conditioning factors for the S&W results, found no statistical relationship between resources and growth, or found a positive relationship. The only review of this literature (Van der Ploeg, 2011) seems to emphasize the literature that finds negative relationship between natural resources and growth. But the direction of the literature is less certain – if you take away the S&W results and those papers that use the same data, then empirical support for a negative relationship between resources and economic growth is rare. Thus, S&W largely stands alone in this empirical debate.

This paper demonstrates that the results obtained in S&W are no longer valid when confronted with recent data. Using the same econometric model and the same sample of countries as S&W but updating the time period of the study, the empirical evidence supporting a natural resource curse disappears with time and eventually becomes positive and significant.

Two issues emerge when examining the original S&W data. First, the sample of countries may not be random if resource-rich countries are more likely than resource-poor countries to report data and therefore appear in the sample. Second, the sample is dated. The S&W sample includes primary resource exports from almost 50 years ago (1970) to explain average economic growth between 47 and 27 years ago (from 1971 and 1990).

This paper considers two potential problems with the S&W results. First, an alternative source of data on primary resource exports is obtained from the Center for International Data (CID) to expand the sample of countries. Because the CID data are reported by importers rather than exporters, and importers tend to be more likely to report data than exporters, the sample size increases. Results suggest that enlarging the sample size tends to reduce the magnitude of the curse, but this difference is not statistically significant. Second, the S&W econometric model is updated year-by-year from 1970 to 1994. Results here are surprising. The coefficient on natural resource exports steadily increases from a value that is negative and significant (for 1970) to a value that is positive and significant (for 1994). Whatever natural resource curse that may have existed in 1970 appears to have disappeared over time.

But before describing these two improvements in the data, the next section summarizes the empirical literature estimating the relationship between natural resource production and economic growth. None of these papers questions the S&W data itself, instead most are critical either of the econometric specification or the variables used.

2. The Resource Curse Literature

As mentioned above, the first paper to make use of a large country data set was Sachs and Warner (2001). The data are used to estimate the following model,

$$ln\left[\frac{GDP_{it+20}}{GDP_{it}}\right] = \alpha + \beta_1\left[\frac{Resource\ Exports_{it}}{GDP_{it}}\right] + \beta_2 \ln[GDP_{it}] + \beta_K \bar{X}_{ikt} + \mu_{it}$$

which resembles a between fixed-effects estimator with some modifications. GDP_{it} denotes country *i*'s per-capita gross domestic product in period t. Thus the dependent variable is the natural log of country *i*'s average per-capita GDP growth rate between year *t* and year *t + 20*. The important independent variable is the ratio of country *i*'s exports of primary resources to its GDP in year *t* (not averaged over 20 years). This specification allows for 20 years of lagged effects of natural resource exports on per-capita GDP. Primary exports are defined to include all food and live animals (SITC code 0), all beverages and tobacco (code 1), all inedible crude materials except fuels (code 2), all mineral fuels, lubricants, and related products (code 3), all animal and vegetable oils and fats (code 4), and all non-ferrous metals (code 68). A negative β_1 implies the export of these natural resources reduces GDP growth.

Define $\bar{X}_{ikt} = \frac{\sum_t^{t+20} X_{ik}}{20}$, for k = 3, 4, and 5. These three independent variables are each country's capital investment expenditures divided by GDP, a variable that characterizes each country's reliance on international trade, and a variable that characterizes the quality of each country's institutions such as protection of private property, freedom from corruption, and equality before the law. The values of these three independent variables equals to the 20-year average following period t. The final independent variable is the level of per-capita GDP in year *t*. Controlling for the level of GDP in time t serves to not only allow for the convergence of GDP growth rates, but also holds constant the denominator under the resource exports variable as well as all unobserved variables that might be correlated with GDP.

The model, then, essentially works as follows. If all countries in the sample start year t with the same per-capita GDP and over the next 20 years average the same quantity of capital investment, the same degree of open trade borders, and the same institutional quality, then how does the observed difference in the 20-year average growth of GDP depend upon the ratio of exports of primary exports to GDP in year t. Sachs and Warner estimate that a one standard deviation change in the ratio of primary exports to GDP leads to a 1% decrease in the annual growth rate.

This econometric specification has raised several questions in the literature. Some argue that the level of per-capita GDP should replace the average growth rate as the dependent variable. Others question how to best measure natural resource dependency. Using exports may not serve if successful economies consume their natural resources leaving only non-successful countries with exports. Thus, natural resources exports have been replaced by natural resource production and especially (using World Bank data) the stock of natural resources – a measure of resource abundance. Papers have also questioned dividing any measure of natural resources by GDP when GDP is the dependent variable in the model. Dividing by the population is used as a substitute.

The literature has also questioned the assumption that institutional quality and per-capita GDP are exogenous. These papers use various methods to control for possible endogeneity. Finally, papers vary with respect to the scope of the data set. While many use data from all nations, others use data from a specific area (Africa, mid-east), certain stages of economic development (non-OECD), and limiting the data to countries with large quantities of natural resources (OPEC).

The first set of papers use the S&W data to better understand the curse. Leite and Weidmann (1999) replace S&W's "Rule of Law" with a Corruption Index and then disaggregate the resource variable into four categories and find that food exports are the only resource that generates a curse. Commodity price variation is found to reduce GDP but only for Africa. Gylfason (2001) redefines resources as share of natural capital in national wealth (World Bank) and adds several human capital variables. Gylfason finds that a 10% increase in natural capital share reduces GDP growth by 1% - partly due to its effect on education. The model does not control for institutional quality. Stinj (2005) use the S&W data, redefines resources as share of natural capital in national wealth (World Bank) to find that the curse disappears for all resources except land area.

Another set of papers focuses upon the role of political and economic institutions in determining economic growth. Institutions that promote shared governance and respect for individual property rights and equality under the law are considered important to long run growth. The political science literature (see Ross, 2015) suggests that natural resources may compromise political institutions through rent seeking. Acemoglu et al. (2001) suggests institutions are the only significant predictor of growth. Other variables including natural resources are insignificant once institutions, which may be endogenous, are controlled for. Rodrik et al. (2004) also find that only institutions matter to economic growth. Atkinson (2003) redefines resources as the share of resource rents in GDP. The natural resource curse exists only if resource rents are consumed by governments rather than invested. Bulte et al. (2005) consider forms of human welfare other than GDP and finds that the resource curse operates via its negative impact on institutional quality. Once institutional quality and initial GDP are controlled for, the natural curse disappears. Hodler (2006) finds that natural resources increase GDP unless the population of the country is ethnically fractionalized. Mehlum et al. (2006) use S&W data to estimate a positive coefficient on an interaction term comprised of institutional quality and natural resources. The negative effect of natural resources subsides as institutional quality improves. Boschini et al. (2007) uses the S&W data and also interacts resources with institutional quality and estimates a positive coefficient – essentially confirming Mehlum but with heterogeneous resource categories. Brunnschweiler (2007) also interact natural resources with institutional quality. Countries with poor institutions do not enjoy the positive effect of natural resources on GDP. Apengis and Payne (2014) use a time varying cointegration approach to estimate that institutional quality reduces the unfavorable effect of oil reserves on GDP.

A number of papers in the literature redefine natural resources as a stock variable rather than a flow variable. Ding and Field (2005) utilize S&W data but replace export share of GDP with the share of natural capital in national wealth and add human capital. Resource exports become insignificant and natural capital is estimated to be positive and significant. Cerny and Filer (2007) also redefine resources as the share of natural capital in national wealth to find that small non-resource sectors of the economy are responsible for slow growth and not a large resource sector of the economy. Once the size of the non-resource sector is controlled for, the natural resources curse dissipates. Cerny and Filer (2007) also find that replacing exports per dollar of GDP with exports per person causes the coefficient on natural resources to become insignificant (both for exports and natural capital endowment). Brunnschweiler and Bulte (2008) distinguish natural resource abundance (stock) and natural resource dependence (export flow). Both are considered endogenous to the model. Resource dependence is found to be insignificant and resource abundance is estimated to be positive and significant. Van der Ploeg and Poelhekke (2010) respond directly to Brunnschweiler and Bulte (2008) and find that natural resources have no impact (positive or negative) on GDP. Norman (2009) estimates that stocks of natural resources reduce institutional quality but not economic growth. Export flows do not affect institutions (when controlling for stocks) but do impact growth. Alexeev and Conrad (2009) develop instruments for 1970 GDP to find that oil and minerals enhance economic growth and are neutral towards institutional quality. Cavalcanti et al. (2011) utilizes a heterogeneous panel data approach and find that oil production and oil rents improve GDP while oil reserves are neutral. A simple OLS model with cross-section data estimates a resource curse when not controlling for institutional quality. Arezki and Van der Ploeg (2011) redefine resources as the share of natural capital in national wealth (using World Bank data) and uses instruments for institutional quality and openness to estimate that both resource stocks and resource exports reduce GDP growth Finally, Smith (2015) estimates major resource discoveries increase GDP by 40% in long run. This increase is greater for non OECD countries than for OECD countries.

Thus, of all of the papers reviewed above, only Arezki and Van der Ploeg (2011) find evidence of a natural resource curse for broad categories of natural resources. Yet, the JEL survey of this literature (Van der Ploeg, 2011) omits many of the papers reviewed above.

This paper will take a new approach and question the data used by S&W to estimate the relationship between natural resource exports and economic growth. The next section discusses whether the S&W data constitute a random sample. Section 4 then updates the model with recent data.

3. Random Sampling

There were 188 sovereign countries in 1970. The S&W data set includes 95 countries when the model includes no independent variables other than natural resource exports and only 40 countries when all independent variables are added. Are these samples random? Countries not included in the sample of

95 countries include Bahrain, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates - countries that are known to export large quantities of natural resources. Many African countries are also excluded. One concern is that although all wealthy countries may have the administrative institutions necessary to collect and provide data on primary exports in 1970, resource-rich income-poor countries may be more likely to report natural exports quantities to data agencies than resource-poor income-poor countries. Income-poor resource-poor countries may therefore be underrepresented in the sample.

One way to expand the sample is to rely upon a different source for primary exports. Sachs and Warner obtain primary export data from the World Bank. A second data source for exports of primary natural resources is available from the Center for International Data (CID) and housed by the economics department at the University of California, Davis. This data set also has exports and imports of each SITC category to estimate the same variable as used by S&W. But the approach used to gather this data departs from the standard United Nations data used above. Instead of relying on countries to report their exports, the CID relies on data submitted by importing countries. Importers report the category of import and the origin. Thus, exports from a non-reporting country are estimated by the culmination of all countries that import from that country. The number of the countries in the sample increases from 59 to 87 – the vast majority of this increase in from the addition of African countries. Iran, Iraq, and the United Arab Emirates are also added.

The model is first run with the small sample used by Sachs and Warner and then the larger sample based on CID data. All variables are defined in Table 1, and summary statistics are provided in Table 2. Data on GDP, population, investment, exports, and imports are obtained from the United Nations Comtrade Database. Adding exports with imports and dividing by GDP gives us a measure of trade openness. Institutional quality is obtained from the Heritage Foundation Freedom index. This index includes the protection of private property, freedom from corruption, and equality before the law. Each country's institutions are indexed each year, but unfortunately the number of countries indexed in 1970 is just 98 (see Table 3). Since preserving data points is the goal here, we run the model with and without the institutional quality variable to learn if the sample size makes any difference to the estimated coefficients.

The average per-capita growth rate in the sample over the 1970 to 1990 period is 1.8%. Capital expenditures are on average 20% of GDP, and a country's imports plus exports constitute an average of 48% of GDP. The institutional quality index, which varies between 27.4 and 88.6, averages 58.5 among the 98 countries indexed in 1970.

Table 1: Definitions of Variables

Variable Name	Definition
$pcGDP_{it}$	Output-side real GDP at chained PPPs (in mil. 2011US$) divided by population (millions) for country i in year t (United Nations)
$lgrowth_{it}$	$Ln(pcGDP_{it+20}/pcGDP_{it})$ for country i in year t
$UNsxp_{it}$	United Nations measure of primary resource exports (SITC Codes 1, 2, 3, 4, and 68) divided by pcGDP for country i in year t
$CIDsxp_{it}$	Center for International Data measure of primary resource exports (SITC Codes 1, 2, 3, 4, and 68) divided by pcGDP for country i in year t
$CapInvest_{it}$	Share of gross capital formation at current PPPs or country i averaged over years t to t + 20 (United Nations)
$Open_{it}$	Share of merchandise exports + imports at current PPPs four country i averaged over years t to t+20 (united Nations)
IQ_{it}	Heritage Foundation overall institutional quality score comprised of property rights, freedom from corruption, fiscal freedom, government spending, business freedom, labor freedom, monetary freedom, trade freedom, investment freedom, and financial freedom for country i averaged over year t to year t + 20

Table 2: Summary Statistics (t = 1970)

Variable Name	Observations	Mean	Standard Dev.	Min	Max
$pcGDP_{it}$	156	8,769	22,648	485	251,9377
$growth_{it}$	156	0.31	0.57	0.01	3.00
$UNsxp_{it}$	98	0.08	0.09	0.00	0.54
$CIDsxp_{it}$	132	0.09	0.14	0.00	1.04
$CapInvest_{it}$	157	0.22	0.12	0.02	0.68
$Open_{it}$	157	0.48	0.44	0.01	3.00
IQ_{it}	98	58.50	11.19	27.4	88.6

United Nations data on each country's exports of primary goods for each year can be downloaded directly from the United Nations Comtrade web site. One frustration emerges because, for the year

1970, the U.N. Comtrade data do not match the data used in Sachs and Warner (and available on their website). The Comtrade data report positive values in the relevant SITC codes for a few countries not in the S&W data set and report no values for a few other countries in the S&W data set. The mean quantity of natural resource exports in the Comtrade data in 1970 is 0.08 – lower than the mean reported by S&W – but the two measures have a high degree of correlation.

Even though the S&W data are not replicated, the data still support the existence of a natural resource curse for t = 1970. Results from estimating the econometric model above are reported in Table 3. Column (1) reflects the best effort to replicate the results in S&W. For this estimation, only countries in the S&W data set were used. Natural resource exports (UNsxp) are estimated to have a negative and significant effect on the average 20-year growth rate of GDP (1970-1990). A one-standard deviation increase in the rate of natural resource export is estimated to decrease economic growth by 17.48% over a 20-year period, or about 0.87% per year – a little lower than S&W's estimate of about 1%. The other control variables have the expected signs, although we note that the coefficient on Open is not statistically significant. The per-capita level of GDP decreases subsequent 20-year growth. This coefficient not only serves to hold GDP constant in the export variables but allows for convergence in growth rates and thus for low-GDP countries to catch up with high-GDP countries.

The model is then estimated with the CID data while holding constant the sample size at the same list of 59 countries used in the first estimation. These results are reported in Column (2) of Table 3. The estimated coefficient on CIDsxp is closer to zero than for UNsxp, but the difference between these estimated coefficients is not statistically significant. Thus, the null hypothesis that these two estimated coefficients are equal cannot be rejected – switching from UN data to CID data appears to make no difference.

The model is run again with the CID data and all available observations – results are reported in Column (3) of Table 3. The sample size increases to 83 observations. Natural resources are once again negative and significant even with the increase in sample size. Thus, the change in sample size made possible by the change in data does not appreciatively change results.

Table 3: The Resource Curse in 1970 (Dependent Variable is Lgrowth)

	Estimated Coefficient (Standard Error)				
	(1)	(2)	(3)	(4)	(5)
Variable	S&W Sample	S&W Sample	All Available	All Available	All Available
UNsxp	-1.79** (0.69)	-	-	-	-
CIDsxp	-	-1.03* (0.61)	-1.37** (0.54)	-1.35** (0.57)	-0.54** (0.36)
CapInvest	1.91*** (0.69)	1.93** (0.73)	1.69*** (0.58)	1.61** (0.62)	2.23*** (0.53)
Open	0.23 (0.20)	0.06 (0.18)	0.16 (0.15)	0.40*** (0.15)	0.26* (0.14)
IQ	0.026*** (0.006)	0.026*** (0.007)	0.020*** (0.006)	-	-
pcGDP	-0.27*** (0.07)	-0.24*** (0.07)	-0.22*** (0.07)	-0.11* (0.06)	-0.18*** (0.05)
Constant	0.62 (0.51)	0.43 (0.52)	0.67 (0.44)	0.91* (0.44)	1.22 (0.36)
	N = 59 $\bar{R}^2$= 0.453	N = 59 $\bar{R}^2$= 0.415	N = 87 $\bar{R}^2$= 0.283	N = 87 $\bar{R}^2$= 0.174	N = 132 $\bar{R}^2$= 0.147

Recall from Table 2 that the Heritage Foundation estimates institutional quality (IQ) for only 98 countries in 1970. Thus, including this variable constrains the sample size. To maximize the 1970 sample size, the model is estimated twice again without the IQ variable. First, in column (4), IQ is removed but the sample size is held constant to determine what bias may emerge from omitting this relevant variable. Omitting IQ will cause bias in those estimated coefficients most correlated with IQ. According to the results in column (4), the bias seems most pronounced in the estimated coefficients of Open and pcGDP. These (now biased) coefficient changes suggest IQ may be positively correlated with Open and pcGDP. The estimated coefficient on natural resource exports, however, does not change much (from -1.37 to -1.35) when dropping IQ and holding the sample size constant. Thus, perhaps any correlation between natural resource exports and the other variables in the model is small. With this in mind, the model is estimated again without the IQ variables and with all observations available in 1970. These results are reported in column (5) of Table 3. The sample size is now 132. The estimated coefficient on CIDsxp is still negative and significant, although the estimated magnitude of this variable had decreased relative to that obtained with small sample sizes.[1]

Thus, the estimated natural resource curse estimated by S&W appears robust to increases in the sample size. The magnitude of the course appears to weaken as the sample size increases, but given the size of the standard errors on the estimate coefficients, any difference in these coefficients is not statistically significant. Although this process is in no way sufficient to prove that the original sample of 59 countries used by S&W is not random, the results do suggest that sample size may matter.

4. Updating the Model Through Time

Data to estimate the model are available for each year from 1970 to 1994. Note that 1994 is the last year the model can be estimated because many variables are defined as the 20-subsequent-year average following the year that natural resource exports are observed. Note also that the Heritage Foundation estimates institutional quality for nearly all countries by 1994, thus the IQ variable can remain in all regressions without compromising the size of the sample. Estimated coefficients for the model with t = 1994 are reported in Table 4.

Four different samples are considered for the 1994 data. In the first estimation, with results reported in column (1) of Table 4, the sample size is held nearly constant to the size used in column (1) of Table 3 (a few countries did not complete data). In other words, only those countries used in the S&W sample size are included but with data that are 25 years into the future. Results suggest that for t = 1994, the estimated coefficient on natural resource exports is no longer negative and significant among these countries. A natural resource curse is no longer supported. Column (2) allows the sample size to grow to all countries in the original S&W data set that report export data in 1994. For this sample, the estimated coefficient on natural resources is positive and significant. Exporting natural resources improves growth rates when holding other variables constant. The third column considers all countries that reported export data to the U.N. in 1994. This sample also supports a positive and significant

[1] The model was also estimated with the UNsxp variable, without the IQ variable, and with all available observations (88). The estimated coefficient on UNsxp was -1.44 with an estimated standard error of 0.73.

relationship between natural resource exports and per-capita GDP growth. Finally, the UNsxp variable is replaced by the CIDsxp variable that allows the sample size to increase to 153 countries. The coefficient on natural resource exports with the full sample of 153 countries is once again positive and significant. A one standard-deviation increase (standard deviation of this variable in 1994 is 0.109) in the ration of natural resource exports to GDP increases annual per-capita GDP by 1.03%.

Table 4: The Resource Curse in 1994 (Dependent Variable is Lgrowth)

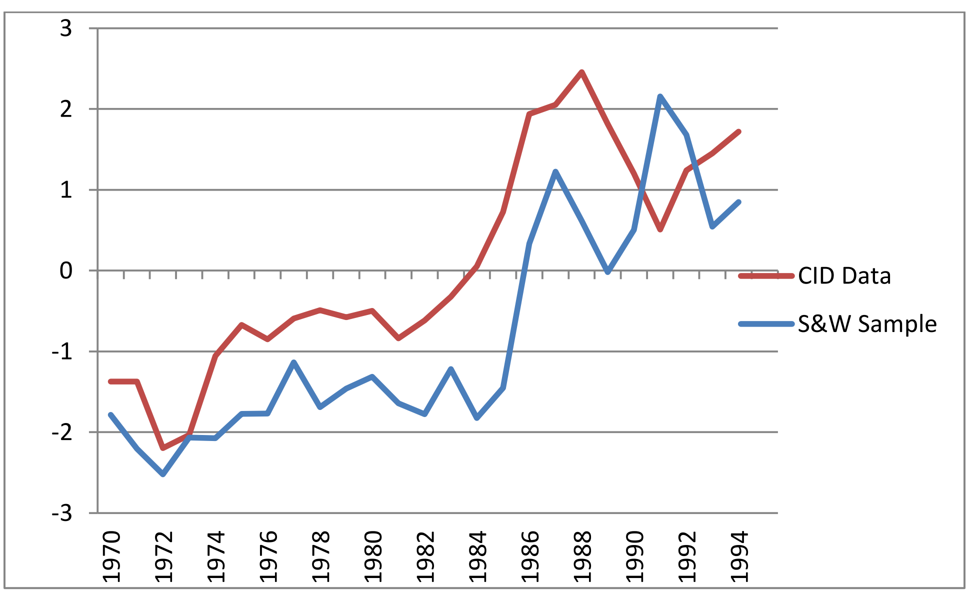
	Coefficient (Standard Error)			
	(1)	(2)	(3)	(4)
Variable	1970 S&W Data Set	1994 S&W Data Set	All Available Data	All Available Data
UNsxp	0.85 (0.77)	1.27** (0.64)	1.31** (0.52)	-
CIDsxp	-	-	-	1.72*** (0.47)
CapInvest	0.70 (1.01)	1.72* (0.88)	1.70** (0.74)	2.87*** (0.72)
Open	0.03 (0.12)	-0.07 (0.10)	-0.07 (0.10)	0.10 (0.11)
IQ	0.010 (0.008)	0.016** (0.006)	0.010* (0.006)	-0.002 (0.005)
pcGDP	-0.23*** (0.06)	-0.23*** (0.05)	-0.16*** (0.05)	-0.25*** (0.05)
Constant	1.82*** (0.47)	1.18*** (0.36)	1.02*** (0.34)	2.23*** (0.30)
	N= 52 $\overline{R^2}$ = 0.205	N = 76 $\overline{R^2}$ = 0.180	N = 104 $\overline{R^2}$ = 0.114	N = 153 $\overline{R^2}$ = 0.306

Thus, it appears that the effect of exporting natural resources on GDP changed over the time range of the full sample. Resource exports in 1970 dampened the 1970-1990 average growth of per-capita GDP for all samples considered. But by, 1994, resource exports improved 1994-2014 per-capita GDP growth rates for most samples considered – especially the large samples considered.

What happened between 1970 and 1994? The model was run 25 times on each year of data starting for t = 1970 and culminating with t = 1994. Figure 1 illustrates the value of the estimate coefficient each year for two different sample sizes. The first sample considered was held roughly constant at the 59 countries that appeared in the S&W sample in 1970 and the UNsxp variable was used to represent natural resource exports. The line labeled "S&W Data in Figure 1 illustrates these estimated coefficients. The second line in Figure 1, illustrated by the line labeled "CID Data", was estimated using the CID data. The sample size increased each year from 132 to 153 as data allowed.

Both lines in Figure 1 reveal a positive trend in the relationship between natural resources and economic growth. Regardless of which sample is considered and which definition of natural resource exports is employed, a clear upward trend appears when comparing the estimated coefficient over time.[2] Apparently whatever economic or political factors that had once resulted in a curse of natural resources in 1970 have since subsided. Using just the SW data, the last year a negative and statistically significant coefficient is estimated is 1986. For the full data set, a natural resource curse is last estimated in 1979. These results call into serious question the continued existence of any curse on GDP from the export of natural resources – estimated coefficients on natural resources are positive and significant when considering the most recent data.

Figure 1: The Estimated Effect of Natural Resources on Per-Capita GDP over Time



[2] Trend lines for coefficients estimated when holding sample sizes constant at levels considered in the other various columns of Tables 3 and 4 are similar to the two trend lines reported in Figure 1.

This trend in the evolution of the coefficient on natural resources can be formally estimated by considering all time periods in a panel-data setting and then adding a variable that represents the calendar year and a second variable that interacts the calendar year with natural resource export variable (CIDsxp). The sample size is all available countries each year – thus consistent with the far-right column of Tables 3 and 4. These results are provided in Table 5.

Table 5: Panel Data Estimations (Dependent Variable is Lgrowth)

	Coefficient (Standard Error)		
	Pooled OLS	Fixed (Within) Effects	Random Effects
CIDsxp	-1.59*** (0.16)	-0.53*** (0.08)	-0.76*** (0.09)
Year	0.01*** (0.00)	0.03*** (0.00)	0.02*** (0.00)
Year*CIDsxp	0.12*** (0.01)	0.04*** (0.01)	0.06*** (0.01)
CapInvest	2.29*** (0.14)	0.84*** (0.15)	1.50*** (0.16)
Open	0.15*** (0.03)	0.35*** (0.04)	0.40*** (0.04)
IQ	0.015*** (0.001)	0.015*** (0.001)	0.028*** (0.002)
pcGDP	-0.24*** (0.01)	-1.17*** (0.02)	-0.94*** (0.02)
Constant	0.88*** (0.08)	8.77*** (0.20)	5.95*** (0.18)
	N=2977 $\overline{R^2}$ = 0.287	N=2977 $\overline{R^2}$ = 0.02	N=2977 $\overline{R^2}$ = 0.07

Regardless of the econometric model employed, the coefficient on CIDsxp is estimated to be negative and significant. This coefficient suggests that in 1970 (when the value of year = 0), natural resources are estimated to reduce the subsequent 20-year average growth in per-capita GDP. The estimated coefficient on the interaction term (Year*CIDsxp) is positive and significant for all three econometric models. This coefficient suggests that the effect of natural resource exports on per-capita GDP increase each year from a negative value in 1970, to a number close to zero in about 1983 (when t = 13) to a positive value by 1994. These estimates essentially capture the visual relationship illustrated in Figure 1. The relationship between natural resource exports and GDP growth is not stationary but appears to change over time, and specifically, to change in a positive direction in the time interval in these data.

5. Explaining the Change

The natural resource curse seems to disappear for both data sources and sample sizes in the mid 1980's. What could be responsible for this change? One obvious explanation could originate with changes in in the global prices of natural resources. If prices increase, then each unit of exported natural resources brings additional revenue to the exporting country. Figure 2 provides a composite index of prices that includes both fuels and non-fuel price indexes obtained from the International Monetary Fund.[3] Commodity prices tended to rise in the mid-2000's after years of apparent stability. If these price increases increased per-capita GDP, then the 20-year average growth of per-capita GDP (the dependent variable in all estimations above) would slowly rise beginning in t = 1985 and continue to rise each year. This explanation appears to fit the data, but further analysis is required before formally linking natural resources effect on GDP to global commodity prices. It is interesting to note, however, that the *variance* of commodity prices does not appear to be the issue here as some theorists suggest. The *level* of prices appears to determining natural resource exports' effect on GDP. In other words, nothing odd is happening here – high prices generate wealth for suppliers regardless of whether the price is related to natural resources or any other product or service.

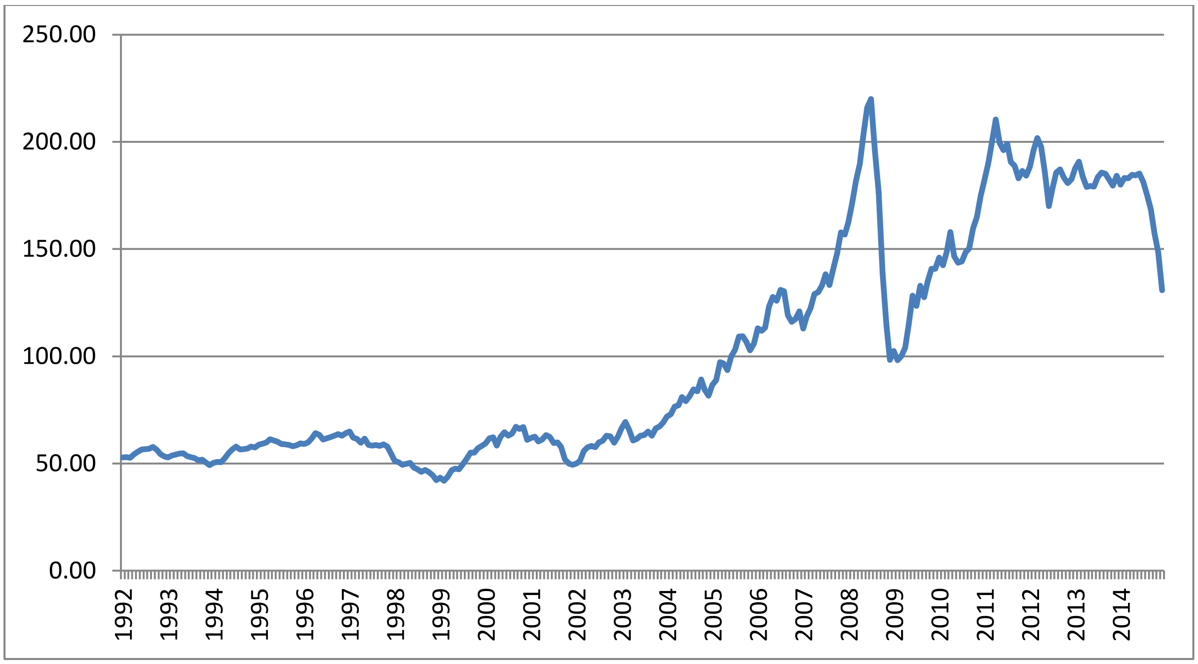
6. Conclusion:

This paper considered the sample used by the Sachs and Warner papers that estimated a negative relationship between natural resource exports and economic growth. Two previously unexplored questions arose regarding the S&W estimates. Was the sample used by S&W random, and does the negative coefficient on natural resources stand up over time? The paper finds that the S&W estimates are robust to increases in the sample size. But these estimates do not appear robust to changes over

[3] And available here: http://www.imf.org/external/np/res/commod/index.aspx

time. The curse of natural resources simply does not appear using the most recent data. In fact, the coefficient on natural resources becomes positive and significant. This change may be attributable to increases in global commodity prices that began in the mid 2000's. These results might question the ongoing public policy stance that holds that developing countries interested in long-run growth should deemphasize natural resource production and increase manufacturing or service-based activities.

Figure 2: All Commodity Price Index



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