2011

A Natural Resource Curse: Does it Exist Within the United States?

Bryce Gerard
Claremont McKenna College

I. Introduction

One of the major issues in the study of development economics today is the effect natural resources have on economic growth. It would seem intuitive that great natural resource wealth would lead to economic growth, as an abundance of natural resources would increase the overall wealth and purchasing power of a nation. Yet a cursory look at the nations of the world does not support this idea. Countries like Nigeria, while extremely rich in natural resources, are economic basket cases, while countries like Japan and South Korea, while relatively resource poor, have experienced extremely rapid growth over the past few decades. This disparity has led economists and academics of all sorts to wonder whether in fact there is an inverse causal relationship between a country's national resource wealth and its economic growth: a "natural resource curse."

Recent interest in the relationship between natural resources and growth was sparked by a widely read set of papers by Sachs and Warner. Throughout the mid 90s, they published a series of papers in which they made the case for the existence of a "natural resource curse". In these, they showed that, on aggregate, there is a negative relationship between the size of an economy's natural resource sector and its economic growth rates over the past few years.

There is a great deal of cross-country work bearing on the resource curse but very few studies have used within country variation to test the variety of hypotheses linking natural resources and growth. For example, are states that have a historic dependence on mining, such as West Virginia and Alaska, more likely to have sustained lesser growth than states such as California or Washington State, which do not have such a dependence? This is a difficult question to answer, in part because of the fact that labor mobility exists between U.S. states to a degree that it does not between separate nations. Such mobility creates a channel by which increases in wages atrract migration, increasing population and lowering estimates of GDP/Capita. This paper looks at data on natural resources and GDP/Capita over the period between 1970-1999 and shows that, when spatial equilibrium dynamics are accounted for, there is evidence that may support the existence of a natural resource curse of sorts within the United States.

II. Literature Review.

The current incarnation of the debate over the existence of a natural resource curse began with the publishing of Sachs and Warner's 1995 working paper *Natural Resource Abundance and Economic Growth.* In this paper, Sachs and Warner documented the relationship between the share of natural resources in a country's economy and its overall growth rates. Their results formed the basis for the idea of the natural resource curse as applies to development. Over the past few decades, Sachs and Warner published several papers that expanded on their thesis. In a summarization of their work, Sachs and Warner (2001) show results that expressed strong evidence for the existence of a natural resource curse. The basic methodology they adopted was to run a standard cross-country growth regression, then adding in a natural resource abundance variable to see its partial effect on economic growth. They defined this variable as the ratio of exports of primary resources divided by total exports, as well as several controlling variables that others have proposed as potential explanations of growth rates. In every regression, they found a statistically significant negative relationship between growth and natural resource abundance.

Sachs and Warner(1995) also ran many other regressions controlling for up to 14 different potential determinants of growth, such as corruption and other political factors. The results of these regressions all supported their initial hypothesis of a natural resource curse.

While this at first seems fairly convincing, upon further examination, the assumptions of Sachs and Warner raise some questions. Mainly, their measurement of natural resource dependence is defined as the total share of primary exports over total exports, or SXP as they call it in Sachs and Warner (1995.) Van der Ploeg and Poelhekke(2009) convincingly argue that a country that in a country experiencing low growth and economic dysfunction, natural resources will be the last export industry standing since it is an industry that requires less human capital and Total Factor Productivity than manufacturing. Thus, one could argue that a predominantly resource driven export sector is in fact a symptom of low growth, rather than a cause. Thus, because of their measure of natural resources abundance, Sachs and Warner's estimates may be plagued by endogeneity if causality runs the opposite way. Therefore, measuring the inherent natural resource wealth of a country and determining its effect on growth may have greater explanatory power. This would help to assuage endogeneity concerns, because the natural resource wealth of a country, unlike the size of its export sector, is randomly distributed, and unaffected by any sort of political factors.

Brunschweiller and Bulte (2008) made this argument in a 2008 paper that referred to the Natural Resource Curse, as commonly understood, as a complete red herring. They criticized Sachs and Warner's use of the share of natural resources in total exports as a poor measure of natural resource wealth, claiming that a dependence on natural resources was endogenous. They instead introduced a new measure of natural resource abundance, which was based on data from a World Bank study on the natural resource wealth of different countries (World Bank, 1997.) This study used as its explanatory variable the net present value in 2004 of an aggregate of mineral, oil, and other general types of natural resource wealth. This was a superior explanatory variable to use than Sachs and Warner's use of export share, because unlike resource dependence, which is very likely not distributed randomly and independent of other policies, the amount of natural resources a country is naturally endowed with is a function of natural geography and thus uncorrelated with any of the other determinants of growth.

This change in methodology attracted considerable attention. Up until then, according to Van der Ploeg and Poelhekke(2009) most of the literature tended to use the terms dependence and abundance interchangeably. The work of Brunschweiller and Bulte(2008) underscores the importance of distinguishing between a natural abundance of resources rather than the dependence of resources. Most recent assessments of the Resource Curse (Van der Ploeg, 2009, Bond and Malik 2009,) have taken care to distinguish between natural resource dependence vs. abundance in their methodology. Unfortunately, due to the limited nature of the World Bank data, particularly the difficulty in accurately measuring mineral deposits (Van der Ploeg, 2009) as well as lack of availability for several different countries, it is dubious whether this measure accurately represents the total natural resource endowment of a country. As a result, most of the literature still uses Natural Resource Dependence, since it is much easier to quantify, but the potential endogeneity remains a challenge to studies using such measures.

When trying to apply the logic of the natural resource curse to U.S. states, past work by Papyrakis and Gerlagh (2006), as well as this paper, will be using the Sachs and Warner estimate of Resource Dependence, rather than the Brunschweiller and Bolte measure of Resource Abundance, to assess the existence of the curse. The reason for this is twofold. One is that data for the traditional Sachs and Warner style estimate is much easier to find. The other is that, within U.S. states, specialization in natural resources is, on the face of it, less of an automatic indication of all of the other sectors having fled. After all, within a country like the U.S, with perfect capital mobility and free trade between states, specialization in a particular sector might not be as damaging a strategy as it would be for an entire country. In addition, labor mobility between state borders is much more fluid than between national borders.

There are many different channels through which natural resources themselves have the potential to impact the growth of the economy. Koren and Tenreyro (2007) established that the excessive price volatility of natural resources leads to excessive volatility of the GDP growth rate in countries dependent on natural resources. They also establish a channel by which overinvestment in natural resources crowds out other industries. Thus, when the price of whatever natural resource a country is dependent on falls, overall revenues fall and the state is unable to shift resources to other industries to make up for the shortfall. Thus, GDP/Capita would fluctuate with the price of the natural resource, which tends to be very volatile. This volatility, in turn is responsible for the drop in GDP/Capita. Ramey and Ramey (2004) show strong support for the idea that high volatility in GDP/Capita leads to a sharp decrease in growth rates for countries. They show that that volatility leads to uncertainty, which tends to depress factors like investment that lead to high growth.

Building on the work of Ramey and Ramey (2004) and Koren and Tenreyro(2007) Van der Ploeg and Poelhekke (2009) ran regressions in order to show that volatility was the key channel through which a dependence on natural resources handled economic growth. They were able to find statistically significant negative correlations between standard deviation of growth, which was their measure of volatility, and growth. This provided support for Ramey and Ramey(2004) and Koren and Tenreyro(2007). It also established a channeeld bt which dependence on natural resources for economic activity will result in high volatility of output, which will lead to higher uncertainty, which will discourage the rate of investment and lead to low growth.

This conclusion was challenged by Malik and Bond(2009), who sought to see if there was a direct connection between natural resource abundance and investment. Ultimately, they did not find such a connection, arguing, in an analysis that would support the conclusions of Lederman and Maloney(2007), that it is the specific structure of exports, i.e. how the different exports are proportioned, that determines investment, and thus has consequences for growth. However, it is worth noting that a strong emphasis of a country on a particular resource sector can increase the potential for rent seeking. One of the key findings of both Malik and Bond(2009) and Van der Ploeg and Poelhekke(2009) is that the negative effects of natural resources on growth tend to be strongest when they are associated with other potential impediments to growth. One theme that is particularly recurrent is that natural resources tend to amplify the negative effects of bad government and corruption on the growth process. The papers mentioned above have mostly found the strongest affects of natural resources on growth are found when accounting for these variables.

One of the main variables that literature on the Natural Resource Curse deals with is the effect that Natural Resources have on growth as a result of social and political institutions. Bhattacharyya and Hodler (2009) theorize that rents from natural resources tend to increase the corruption in an economy and thus depress economic growth, but with the contingency that this effect differs based on the quality of the democratic institutions in that country. Thus, a country with strong, high functioning democratic institutions will not experience corruption due to a natural resource boom. As their main explanatory variable, they use Resource Rents, defined as the difference between a commodity's world market price and its extraction costs. The use of rents avoids the problems with following the Sachs and Warner methodology described earlier. Basically, they argue that a game develops between politicians and the populace of a given country. They argue that essentially, there are good and bad politicians, good politicians basically being ones who try to look out for the welfare of the economy and bad politicians who are only self-interested. It is in the interest of a bad politician to appropriate as much profit for himself from the resource rents, but he also must stay in power, and thus to do so must restrain his greed and mimic a good politician in order to gain the support of the populace. The extent to which he can do this is based on the strength of the democratic institutions in those areas.

Others have argued that the determining factors of whether or not Natural Resources are a curse depend on the political and institutional effects of heterogeneity. Hodler(2006) describes a model by which fractionalized countries suffer from an increase in natural resources, where as more homogenized countries are able to use the natural resources as a blessing. His principal model suggests that in fractionalized countries natural resources serve as a sort of prize that the different groups will fight over. Thus, a resource bonanza such as an oil boom will lead to increased rent seeking and fighting between different groups, which will discourage investment and dampen growth. Using many different measures of fractionalization, including linguistic, ethnic, and religious measures, he regressed GDP/Capita on Natural Resource Abundance, using the World Bank measures of resource abundance rather than Sachs and Warner estimates of resource dependence, and comes up with strong results confirming his hypothesis. These results show that countries with relatively homogenous populations tend to experience income increases in response to resource booms, but that countries that heterogeneous do not. This explanation goes a long way to explaining obvious exceptions to the natural resource curse, such as Norway, which in addition to having a dominant share of their economy devoted to resource exports, has a very high standard of living. This ceases to become a mystery when fractionalization is introduced, due to Norway's high degree of homogeneity among the populace.

In addition to being contingent on democratic and demographic factors of countries, other work has argued that these factors can interact in a certain sense. Thus the question at hand, many have argued, is not whether or not a state has a strong democracy, but as to the exact nature and setup of the democracy. Recent work by Andersen and Aslaksen (2007) has looked at whether presidential or parliamentary democracies are more likely to fall prey to a natural resource curse. They also look at the dimension of whether or not a country favors a majoritarian or proportional method of voting to elect their leaders.

The logic behind this is that parliamentary forms of governments, in order to be effective, must create broad coalitions among most of the interest groups in the population in order to maintain power. According to theoretical work by Perrson and Tabellini(2004), the propensity of government to engage in equal spending amongst the general public as opposed to targeting specific special interest groups is reinforced by the ability that parliaments have to cast a vote of no confidence in their executive. Thus if a parliamentary country were to receive a resource boon, the gains in welfare would be likely to be distributed across the population, which would increase the overall welfare and growth of GDP per capita.

As far as these political factors are concerned, it is not hard to see that an analysis of the United States alone would control for most of these political factors. The United States is not a country that is famous for experiencing a great deal of ethnic sectarian violent conflict, at least not at the scale experienced by many African nations, and thus, this is not likely to be a factor. In addition, all U.S. states share more or less the same political institutions at a state level, and identical institutions at the Federal Level. Thus, the nature of the rent seeking would be very different, and factors such as, for example, the presidential vs. parliamentary makeup of the executive branch described above would not be a factor worthy of consideration. To be sure, there do exist differences in state level governing practices, but these are smaller and more nebulous than the differences that exist between countries. Nevertheless, it is possible that states with more of a natural resource sector could seek rent through congressional lobbying. However, comparing states by different levels of corruption would prove to be quite difficult, as Papyrakis and Gerlagh (2006) have found.

Work by Papyrakis and Gerlagh (2006) has focused on additional potential channels for the Natural Resource Curse to operate at the state level. One is education, the idea that states with an emphasis on Natural Resources are less likely to invest in education, due to their focus on employing laborers for primary resource extraction, which could impede their abilities to develop more knowledge based growth sectors in the future. They make a similar argument for the Research and Development sector. However, their regressions in general found that, while states that underinvested in these sectors did indeed experience negative growth as a result, these were more likely related to policy failures independent of any Natural Resource Curse. A problem with their study, however, was their lack of data, as their data only goes back as far as 1986. This study, however, will be analyzing data as far back as 1970.

The channel that we are trying to investigate for the purposes of this paper is the Dutch disease channel. The proposed channel basically works through a few channels. One is that a sudden boom in natural resources leads to an appreciation of a country's currency, leading its citizens to prefer domestic consumption. This causes an underinvestment in the export sector as well as a decrease in foreign investment, which could be detrimental to future growth. This channel is not likely to be a factor when comparing U.S. states against each other, since they all share the same currency.

The other Dutch disease channel works as follows: A discovery of natural resources in a country or state causes an overinvestment in the natural resource sector, which leads to investment in the natural resource sector instead of sectors that are conducive to long run growth. This leads to a decrease in Total Factor Productivity, or TFP, which is an important factor in the Solow growth model that is vital for continued growth. This decrease in productivity is reflected in a diminished growth rate of the GDP, and thus, the GDP/Capita. However, the initial boom of natural resources would also lead to an increase in wages, which in the context of a cross-country analysis, would lead to an increase in the wages for existing workers. In United States, there are no barriers, other than basic geography, to prevent workers from moving from states with low wages to states with high wages. Therefore, it is possible that the share of Natural Resources in GDP would actually have a negative effect on GDP/Capita due to an increase in the overall population of the state, rather than merely a decrease in productivity.

III. Data and Methodology.

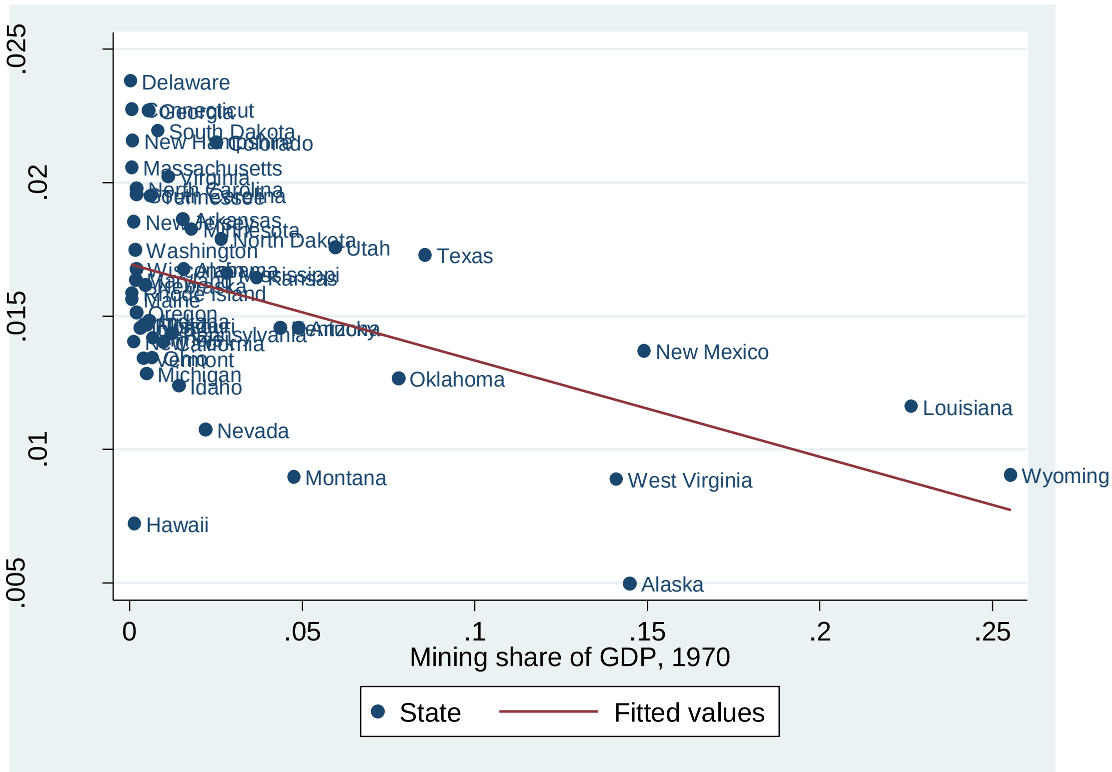
Primarily, we are concerned with whether overinvesting in Natural Resources has a negative effect on TFP growth, which would in turn lead to a long term decrease in the rate of economic growth.

We use a measure similar to that of Sachs and Warner. The independent variable we will be using, NATSHARE, is composed of dividing the total output of the mining sector by the total industrial output of the state, or GDP. We have chosen to use the mining sector to represent the natural resource dependence of- a state for a variety of reasons. One is that it provides the clearest example of the Dutch Disease phenomenon, as the presence of mineral deposits or oil is one of the clearest examples of a commodity which does not require much innovation or TFP growth to develop. It merely must be extracted from the ground and sold in crude form. The other reason is that the NAICS and SIC definitions of the mining sector are nearly identical, so this would preclude a conversion between systems, simplifying the construction of a longer dataset.

The Bureau of Economic Analysis maintained by the Department of Commerce compiles statistics on the composition of United States Gross Domestic Product by State. From their online database we were able to obtain data on the size on the composition of the GDP of each U.S. state and use it to construct our variable NATSHARE. This data is classified according to two systems: SIC and NAICS. The SIC classification covers- the time period from 1967-1997 and the NAICS system covers data from 1997-present. For our regressions, we will be testing the years from 1970-1999. We chose 1970 in 1967 because we needed to use U.S. census estimates for population data, which are measured on the decade.

From this BEA data, we were able to construct the variable NATSHARE by dividing the size of the SIC and NAICS Industry classification “Mining” by the total industrial output. This measure includes both the extraction and refinement of both minerals and oil.

We can start out by running a basic growth regression on the log of GDP/Capita in 1999 on the NATSHARE variable that we have developed. In the following graph, the growth rate of GDP/Capita is plotted against the Mining share of GDP in 1970.



From this graph we can see that, while most states did not have a high mining sector to begin with, there is a clear negative trend associated with the presence of a large reliance on the Mining Sector.

These results would seem to indicate that there is indeed a statistically significant negative relationship between the NATSHARE variable and the growth rate of a U.S. state. However, before accepting these results as an accurate indicator, there are a few sources of bias that we must address. In addition to potential omitted variable bias, there is also the possibility that this is merely evidence of convergence. One of the main feature of the Solow growth model is that the growth rates of less developed economies tend to be higher than the growth rates of more developed economies. To account for this possibility, we show in column (2) of Table 1 an additional regression that was run using the log of state GDP/Capita in 1970 as a controlling variable. We are controlling for absolute convergence, not conditional convergence because, following Barro and Sala-I Martin(1991) we assume that within the same country, conditions are roughly equal, therefore we do not need additional control variables. From these results we can see that, while there is a statistically significant convergence effect in regression (2), the coefficient for NATSHARE in the second regression is still negative, significant, and only slightly less than in regression (1).

Table 1.

$Mining_{1970}/GDP_{1970}$	-0.036	-0.033
	(0.009)**	(0.009)**
$\ln(GDP/cap)_{1970}$		-0.008
		(0.003)*
Constant	0.017	0.093
	(0.001)**	(0.029)**
R^2	0.25	0.35
Observations	50	50

$p<0.05$*; ** $p<0.01$

Table 1. This table shows the results of regressions of GDP/Capita growth from 1970-1999 on several explanatory variables. the Mining/GDP measure is constructed from NAICS and SIC estimates for size of the mining sector in 1970. Standard Errors are reported in parentheses, with asterisks(*) denoting significance level.

When applying the Natural Resource Curse logic to states, rather than countries, there are a few considerations that must be taken into account. One is that as established by Glaesar and Gottlieb, states are in a spatial equilibrium with regards to both Labor and Capital flows.

To account for this spatial equilibrium, we adopt the methodology specified by Glaesar and Gottlieb(2009), which they developed from earlier work by Rosen (1979) and Roback (1982), in order to determine how natural resource dependence affects the Total Factor Productivity of a regional economy.

Like Glaesar and Gottlieb, our analysis starts with the typical production function used by growth Economists: $A^i_t K^\alpha L^{1-\alpha}$, a Cobb-Douglas production function where K represents capital, L represents labor and A represents Total Factor Productivity. Like Glaesar and Gottlieb(2009), we will be making the simplifying assumption of considering L to be composed of both skilled and unskilled labor.[1] We also follow their methodology in assuming that total capital K is a geometric weighted average of non-traded and traded capital, so that total output is

$A^i_t\ K_N^{\alpha\gamma}K_T^{1-\alpha\gamma}\ L^{1-\alpha}$. In this equation K_N represents non-traded capital and K_T represents traded capital.

According to Glaesar and Gottlieb, The assumption of spatial equilibrium between states means that at any given time the number of workers (population) in a state is subject to the following equality condition:

$$\theta^i_t\ G_T^{\beta}G_N^{1-\beta} = \theta^i_t W^i_t (P^i_t)^{\beta-1}$$

where θ is amenities, G_T is the consumption of traded goods, G_N is the consumption of non-traded goods, W is wages, and P is prices, and β represents the share of traded goods in total utility. The basic idea is that workers derive utility from their real wage, which is to say that they prefers to live in a place where the ratio of their nominal wages to the nominal price of goods in the area is the highest. The above equation indicates that a worker must be living in a place where their consumption of goods and amenities is equal to the amount of goods and amenities they can buy with their real wage. This is important to our United States framework because it indicates that if there is an increase in the real wage available to a worker in any given state that he does not live in, he will move to that state. This could potentially skew the results from our previous regressions, as an increase in the Total Factor Productivity of a state would cause an increase in wages, which would cause an increase in population, which would negatively affect GDP/Capita due to an increase in the population.

From the above equations, Glaesar and Gottlieb basically formulate three main equations that can be used to solve for population, wages, and the prices of non-traded goods. These equations are reproduced here:

(1)

(2)

(3)

These equations show that the equilibrium conditions for population, wages, and the prices of goods are dependent on state level TFP, in addition to other factors. This is because increasing

[1] Glaesar and Gottlieb page 991

TFP leads to increasing wages, which attracts more workers, which leads to an increase in population, which ultimately leads to an increase in the demand for goods and amenities in the area, which raises prices. The effect of TFP on these parameters is represented by the λ_A variables in the -above equations. To determine any detrimental effects of natural resources on the growth of state real wages, which ultimately is the measure of welfare that previous and current natural resource literature is concerned with, the main question we must answer is: What effect does a natural resource boom have on total factor productivity?

Glaesar and Gottlieb provide a methodology to determine this measure. From the previous equations, Glaesar and Gottlieb show that one can calculate- δ_A, the total effect of any variable X_t^i , which in our case is NATSHARE, the share of natural resources in total exports, on the productivity of the traded goods sector.

——— = (4)

where and are the population and wage coefficients obtained from regressions of wages and population on the natural resource share .Basically, an increase in TFP leads to a growth in both population and wages. By looking at the effect of natural resources and wages, we can use the above equation to infer the effect of Natural Resources on TFP. In addition, we can assume that when we take the derivative of equation 4, the same equation will also apply to the growth rates of , , and In order to determine the amount by which the share of natural resources affects- the growth of the productivity of the non-traded sector, we will run regressions of the growth rates of GDP/Capita and growth rate of population over the period form 1970-1999 on the variable NATSHARE, the share of mining in GDP at the beginning of the period. We use five year averages instead of yearly ones in order to control for any changes in population or GDP that may be due to natural fluctuations from the business cycle. We also calculate this measure for the growth rate of the entire 30 year period from 1970-1999. This estimate should show us the amount by which the share or mining in GDP affects the TFP growth of the state. The estimates for δ_A can be seen in Table 2.

Table 2.

Entire Period	
$\delta_{A\ 70\text{-}99}$	-0.02759
	(0.0076)**
Five year Intervals	
$\delta_{A\ 70\text{-}74}$	0.084
	(0.0281)**
$\delta_{A\ 75\text{-}79}$	0.0412
	(0.013)**
$\delta_{A\ 80\text{-}84}$	-0.0692
	(0.0120)**
$\delta_{A\ 85\text{-}89}$	-0.133
	(0.0104)**
$\delta_{A\ 90\text{-}94}$	-0.0746
	(0.0209)**
$\delta_{A\ 95\text{-}99}$	-0.124
	(0.0209)**

* $p<0.05$; ** $p<0.01$

Table 2. This table shows five year average measures of $\delta_{A,}$ which is the effect of the mining sector on TFP growth. Standard errors are in parentheses. The measure of δ_A the entire 30 year period is shown at the top. See how natural resource investement share had a positive effect on TFP growth in the 1970s, but a negative one from 1980-1999, whereas overall, the cumulative effect over the 30 year period is negative.

IV. Results.

Following the methods of Glaesar and Gottlieb, and with the assumption that their formula can be applied to growth rates, we have found results that suggested that having a large natural resource sector had substantial, positive effects on TFP growth for the period from 1970-1974 and 1975-1979, but then had significant negative effects after that. Overall, from the period 1970-1999, the effect of a large resource sector on TFP growth was negative.

It is interesting to note that these numbers reflect the movement of oil prices in this era. As can be seen in the following chart, in the 1970s, oil prices were high due to the oil shocks that were a result of the various OPEC oil embargoes of that era, whereas from 1980 on, oil prices dropped significantly and stayed low until the early 2000s. These movements can be seen in Figure 1 below. Thus it would seem that TFP growth attributable to the mining and oil sector follows the price of oil quite nicely. As the price of oil grows, so grows TFP, and as it falls, the growth rate of TFP does as well. Over the entire 30 year period we can see that the effect of natural resource dependence on TFP growth is negative. So does it follow then, that the effect of natural resource dependence of TFP growth is dependent entirely on the prices of the goods in question?

From our data at least, this seems likely. This would indicate that natural resource dependent states are overinvested in natural resources to the point where they cannot replace the loss in economic activity caused by falling prices. It also indicates that the only benefits that can be accrued from the harvest of natural resources are those that are directly obtained from selling them. Thus for long term growth, perhaps it is not beneficial for states to depend so heavily on natural resources.

It is important to note that there are a plethora of other variables that are influenced by the natural resource curse that we were not able to account for. Factors such as corruption and local variation between political practices are much harder to quantify at the state level, yet previous research at the national level has indicated that they may indeed play a large role.

It is also worth noting that there are a few factors potentially biasing our results. We were only able to analyze the mining sector, due to limitations on available data and there are other sectors of the economy to consider as well, such as timber and other primary resources. Therefore it is possible that the high correlation we see between our results and the price of oil is due to the large presence of oil within the composition of our explanatory variable. Nevertheless, even supposing that oil were the only resource that had this negative effect, this would still have significant implications. This is because oil is clearly one of the most integral commodities of the modern developed economy, and many states must often make policy on how best to exploit it.

Figure 1.

http://zfacts.com/p/847.html

This graph shows the movement of real oil prices over the period from 1960-2008. Note that the decline of oil prices occurs in the period 1980-1984, the first period in our sample for which TFP growth attributable to NATSHARE is negative.

Source: Energy Information Administration.

V. Conclusions

From this data, we see clear results that there is a clear negative effect overall on the size of a state's oil and mining sector and the growth rate in TFP for this state. Yet from our more focused analysis of the five year periods, we also see that this relationship seems to be in part, based largely on the price of oil. When oil prices are high, there appears to be an overall positive relationship between the TFP growth of a state and the size of the natural resource sector, when oil prices are low, a negative one.

This lends support to the theory that overall, an investment in the natural resource sector can have a negative effect on TFP growth because it is so highly dependent on the price of the good in question. As Van der Ploegg and Poelhekke(2009) argue, this volatility could lead to an overall decrease in investment, which could lead to long term decreases in growth. The channel provided by Koren and Tenreyro (2007) may also apply here. If the fortunes of a state are too highly tied to the price of one commodity, then they will overinvest in this commodity when prices are high, to the point where they will not be able to make up for the shortfall in revenues and economic activity when prices are low. thus, by being tied disproportionately to one very volatile commodity, their fortunes will ebb and flow with the prices of this commodity, making consistent investment and TFP growth unlikely. A well diversified state, on the other hand, would be able to switch focus to other industries to make up for the shortcoming. This would allow other economic activity to occur that would enable the growth of TFP.

Thus it is possible, that, at least in regards to oil and mining, a sort of natural resource curse does apply to U.S. states. An overinvestment in oil during times when prices were high may lead to an inability to switch resources to production of other goods when prices are low, thus leading to a long term overall depression in growth.

This raises questions about several relevant policy issues. Should state governments discourage or encourage further expansion of drilling and oil production? Should the governments of states with large natural resource wealth take measures to abate increasing dependence on such wealth? Our data would suggest that perhaps they should.

Further research should focus on an analysis of other sectors as well as oil and mining. It should also seek to apply the spatial equilibrium assumptions we have used here to regressions of data that include other controlling variables, such as political factors and the size of sectors such as research and development and the other control variables used by Papyrakis and Gerlagh(2006). As mentioned previously in the literature review, the strongest results nationally came from combining the Dutch disease channels with explanatory variables based on political factors, and it would be interesting to see whether this holds true for U.S. states. For example, does rent seeking by oil companies themselves account for the overinvestment in natural resources? It would also be worthwhile to determine how much a lack of growth in some U.S. states affects the well-being of the nation as a whole.

VI. Data Appendix

For data on state- by- state GDP in the years 1963-2008 I have used the NAICS and SIC measures of GDP in current dollars. The SIC data ends in 1997 and is replaced by the NAICS data for the same period.

We obtained data on population from the United States Census. We obtained this data using the Center for Disease Control's websites at http://www.cdc.gov/.

Our measure of the independent variable NATSHARE is constructed from the NAICS and SIC measure for mining output. This measure is defined in both systems as "all establishments primarily engaged in mining. The term mining is used in the broad sense to include the extraction of minerals occurring naturally: solids, such as coal and ores; liquids, such as crude petroleum; and gases such as natural gas. The term mining is also used in the broad sense to include quarrying, well operations, milling (e.g., crushing, screening, washing, flotation), and other preparation customarily done at the mine site, or as a part of mining activity."[2]

In order to express the dollar estimates for both GDP/Capita and NATSHARE in real terms, we have used CPI annual average estimates compiled by the U.S. Department of Labor Bureau of Labor and statistics obtained from ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

VIII. Bibliography

Andersen, Jørgen Juel and Silje Aslaksen(2007) "Constitutions and the Resource Curse." *Journal of Development Economics*, 87, 227-246.

Barro, Robert J., and Xavier Sala-i-Martin. 2003. *Economic Growth.* MIT Press Cambridge, MA.

Bhattacharyya, Sambit and Roland Hodler(2010) "Natural Resources, Democracy, and Corruption" *European Economic Review*, 54, 608-621.

Bond, Stephen and Adeel Malik(2009) "Natural Resources, Export Structure, and Investment." *Oxford Economic Papers*,61, 675-702.

[2] http://www.bea.gov/regional/definitions/nextpage.cfm?key=Mining

Brunschweiller, Christa N. and Erwin H. Bulte(2008) "The Resource Case revisted: A tale of paradoxes and red herrings." *Journal of Environmental Economics and Management,* 55, 248-264.

Glaesar, Edward and Joshua D. Gottlieb(2009) "The Wealth of Cities: Agglomeration Economies and Spatial Equilibrium in the United States." *Journal of Economic Literaure,* 47, 983-1025.

Hodler, Roland(2004) "The curse of natural resources in fractionalized countries" *European Economic Review,* 50, 1367-1386.

Koren, Miklos and Silvana Tenreyro(2007) "Volatility and Development", *Quarterly Journal of Economics,.*

Lane, Phillip R. and Aaron Tornell(1999) "The Voracity Effect" *American Economic Review,* 89:1, 22-46.

Lederman, Daniel and William F. Maloney(2007) "Trade Structure and Growth" *Natural Resources, Neither Curse nor Destiny,* Stanford University Press.

Manzano, Ozmel and Roberto Rigobon(2001): "Resource Curse or Debt Overhang?" *Natural Resources, Neither Curse nor Destiny,* Stanford University Press.

Papyrakis, Elissaios and Reyer Gerlagh(2007) "Resource abundance and economic growth in the United States" *European Economic Review* 51, 1011-1039.

Perrson, Torsten and Giuido Tabellini(2004) "Constitutions and Economic Policies" *Journal of Economic Perspective,* 18:1, 75-98.

Ramey, Garey, and Valerie A. Ramey(1995) "Cross-Country Evidence on the Link between Volatility and Growth" *American Economic Review,* 85:5, 1138-1150.

Roback, Jennifer. 1982. "Wages, Rents, and the Quality of Life." *Journal of Political Economy,* 90:6, 1257–78.

Rosen, Sherwin. 1979. “Wage-Based Indexes of Urban Quality of Life.” *Current Issues in Urban Economics*, 74–104. Baltimore and London: Johns Hopkins University Press.

Sachs, Jeffrey and Andrew Warner(2001) “The curse of natural resources” *European Economic Review*. 45

Sachs, Jeffrey and Andrew Warner(1995) “Natural Resource Abundance and Economic Growth”, NBER WORKING PAPER, Cambridge, MA

Van Der Ploeg, Frederick and Steven Poelhekke(2009) “Volatility and the Natural Resource Curse” *Oxford Economic Papers*,61, 727-760

World Bank, 1997. Expanding the measure of wealth. Environmentally sustainable development studies and Monographs series 17. World Bank, Washington DC.