Resource Curses: Evidence from the United States 1880-2012

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Abstract

The resource curse literature offers conflicting evidence on the existence of a resource curse and the mechanisms through which it might act on growth. The debate is further muddied by historical evidence that some countries seem to have experienced resource blessings. This paper uses new state-level panel datasets spanning 1880-2012 to investigate the existence of a resource curse in the context of the American states. The paper finds that different commonly studied resources (oil and gas, other minerals, and agriculture) had different effects in different time periods. For the period 1980-2000, a period that is widely studied, we find evidence of a resource curse in the United States in time series and cross section. The broader analysis shows that this period, although widely studied, is atypical. The magnitude of the effect is larger than for any other period. Analysis using detailed state data on GDP by sector indicates that over 1980-2000, the negative effect of resources on growth was much smaller in magnitude than the negative effects of agriculture on growth. Two interrelated mechanisms through which resources may affect growth are political institutions and labor markets. The results suggest that institutions and labor market channels including volatility, economic conditions, and asymmetric effects of increases and decreases in resources are relevant for understanding the relationship between resources and growth.

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1. Introduction

The economic resource curse literature is large and has conflicting results both broadly and within the sub-literature focused on the American states. Following the early papers by Sachs and Warner (1995, 1997), scholars have examined the extent to which the curse holds across different measures of resources including stocks and flows of resources and different economic outcomes including growth and income. The results are mixed. Sachs and Warner (1995, 1997), Sala-i-Martin and Subramanian (2003), Papyrakis and Gerlagh (2004) and other papers find evidence of a curse, and Alexeev and Conrad (2009) and Cavalcanti, Mohaddes and Raissi (2011) do not. Within the United States context, the results are also quite mixed. Papyrakis and Gerlagh (2007), Goldberg et al (2008), and James and Aadland (2011) find evidence of a resource curse, but Boyce and Emery (2011) and Michaels (2011) do not. A related paper by Allcott and Keniston (2013) does not find evidence of Dutch disease.

Not only is there a conflict within the economics literature about the existence of a curse, but the curse literature runs counter to themes regarding the benefits of natural resources for growth over longer time periods.[1] J.H. Habakkuk (1962) linked American growth to natural resources. These themes are exemplified by papers like Wright (1990), which emphasizes the extent to which American industrial success in the late nineteenth and early twentieth centuries was built on natural resources, and Keay (2007), which documents the role of resources in Canadian growth and income levels. Parts of the literature on the industrial revolution in England and the broader Great Divergence

[1] Although as Sachs and Warner (2001, p. 832) note, "when one measures natural resource intensity using historical data, the ratios as a percent of GDP are much smaller than the ratios that many countries have achieved in the mid-to-late 20th century. Sweden, Australia and the United States in earlier times never approached the level of natural resource intensity we see today in the Gulf –States."

literature also emphasize coal as having played a central role in England's development (Allen 2009, Pomeranz 2001).[2]

This paper new state-level data sets spanning 1880-2012 to explore the extent to which resources affected economic outcomes in the American states. The paper finds that different commonly studied resources (oil and gas, other minerals, and agriculture) had different effects in different time periods. In some periods for some resources there was a negative relationship between state resources and state growth, but in other periods there was no relationship or a positive relationship. For the period 1980-2000, a period that is widely studied, we find evidence of a resource curse in the United States in time series and cross section. The broader analysis shows that this period, although widely studied, is quite atypical. While much is made of the negative effect during this period, analysis using detailed state data on GDP by sector indicates that over 1980-2000 the negative effect of oil and gas on growth was considerably smaller in magnitude than the negative effects of agriculture on growth.

The paper presents evidence on two interrelated types of mechanisms through which resources might act on growth. The first mechanism is institutions (Mehlum et al 2006, Cabrales 2011, van der Ploeg 2011). State political institutions including governor, legislature, and judiciary were weaker in the South during much of the period that we examine (Besley et al 2010, Berkowitz and Clay 2011). Political competition in the South improved dramatically after the passage of the Voting Rights Act in 1965 and further amendments in 1970. We test whether the South has a different relationship between resources and growth than the non-South and whether these relationships change. The

[2] For an opposing view, see Clark and Jacks (2007), who review the evidence on the importance of coal for the industrial revolution.

South has a more positive relationship between resources and growth, possibly because individuals are being drawn out of relatively lower productivity sectors, such as agriculture, than in the non-South. The relationship between the South and resources becomes statistically significantly more positive after 1970. This is consistent with political institutions being stronger and thus better able to manage shocks.

The second mechanism is labor market shocks. We examine three components – volatility in resource shares, asymmetry in the effects of increases and decreases in resources, differences in effects of increases during periods of low and high growth – and add controls for population growth. Volatility has been widely discussed in the resource curse literature. Volatility is negative, because labor and capital cannot instantaneously move into other sectors (van der Ploeg and Poelhekke 2009, Jacks et al 2011). Booms and busts may have different effects on growth, for example if drawing labor and capital in is more or less difficult than moving it out of the sector (Allcott and Keniston 2013, Carrington 1996, Black et al 2005, Jacobsen and Parker 2014). Further, the ability to reallocate labor and capital may depend on the general market conditions (Davis and Haltiwanger 1990, 1992, 1999, Caballero and Hammour 1994, 1996). In periods of low growth, increases in resources may be absorbing unused or underused labor and capital, while in periods of high growth they may be competing for these assets. Controls for population growth are included, because population inflows or outflows may have higher or lower shares of workers. In particular, this is a period of large population movements into the South and West. In some cases, these populations had large shares of retirees. For other minerals, the coefficients on low growth, asymmetry and volatility are not statistically significant and small. For oil and gas, all three are statistically significant.

Volatility is negatively associated with growth; increases during periods of low growth are positively related to growth; and declines are more negatively related to growth than increases.

This data set can be used replicate many of the findings from previous studies of the resource curse in the United States including Papyrakis and Gerlagh (2007), Goldberg et al (2008), James and Aadland (2011), Boyce and Emery (2011), and Michaels (2011). The divergent findings are largely due to the use of different dependent variables, measures of resources, estimation techniques, and time frames.

2. Literature Review

Measures of resources

Before considering resource curses, it is important to note that the definition of resources varies considerably across papers. The original Sachs and Warner paper and many later papers, including some papers on the United States, use a broad definition of natural resources. These definitions include both renewable and nonrenewable resources. For example, in their original papers, Sachs and Warner's (1995, 1997) main measure included exports of fuels and non-fuel primary products. The latter include food and live animals; beverages and tobacco; crude materials (inedible); animal and vegetable oils, fats, and waxes; and non-ferrous metals. As an alternative measure, Sachs and Warner use the share of mineral production in income. This measure includes oil and gas, metals, and nonmetals.

Other papers focus primarily on oil and gas. Using country-level data, Ross (2006, 2012) focuses on oil in his paper and book. Haber and Menaldo (2011) examine the effects of oil, total fuel production (oil, natural gas, and coal) and total resource production (oil, natural gas, coal, precious metals, and industrial metals). In United States context, Michaels (2011) uses oil and gas; Goldberg et al (2008) use oil and coal; Allcott and Keniston (2013) use oil and gas and coal; and Boyce and Emery (2011) use employment in mining (which includes oil, coal and other minerals).

Although many papers, including Sachs and Warner, use gross value of resources, some papers use value added. For example, in their study of the United States, Papyrakis and Gerlagh (2007) use "The share of the primary sector's production (agriculture, forestry, fishing, and mining) in GSP for 1986." In their study of U.S. counties, James and Aadland (2011) also use the share of primary sector's production in GSP.

Resource Curses in the United States

A very large number of papers have examined resource curses in a wide variety of contexts. Here the focus is the literature on the resource curse in the United States. Table 1 summarizes the identification, outcome measure, resource measure, unit of analysis, time periods, and findings of the main papers. The papers are grouped by type of identification. Goldberg, Wibbles, and Mvukiyehe (2008) is included twice, because they present both cross sectional and time series analysis. Sachs and Warner (1997) is included for comparison. Wright (1990) is included, because it discusses the United States and is widely cited in the resource curse literature.

The papers that apply cross sectional analysis to U.S. data – Papyrakis and Gerlagh (2007), Goldberg, Wibbles, and Mvukiyehe (2008), and James and Aadland (2011) – all find that resources are a curse. This is despite using different time periods, outcome measures, and resource measures.

It is worth noting that Wright (1990) shows that U.S. exports were increasingly intensive in non-reproduceable resources. He infers from this resources were advantageous for industrial growth. As will be discussed further later, resources may be positively or negatively related to growth in income in different time periods. And the relationship between resources and different types of growth – industrial and income – may differ at the state and national level.

The results are mixed for the time series analysis. Using state data, Goldberg, Wibbles, and Mvukiyehe (2008) find resources are a curse, while Boyce and Emery (2011) find resources are a blessing. Using county data Michaels (2011) and Allcott and Keniston (2013) find that resources are positively related to outcomes.

In section 6, the main findings for key papers are replicated. The analysis suggest that differences in findings are the result of differences in identification, specifications, and time period.

Resource Curses: Mechanisms

The literature discusses a number of mechanisms through which resources adversely affect growth. These include institutions, volatility, and labor market shocks. It is also important to control for population trends when doing analysis over long time periods, because they may affect measures of per capita income.

Political institutions can affect growth, particularly if countries or states with weak institutions are unable to realize gains from resources (Mehlum et al 2006, Cabrales 2011, van der Ploeg 2011). In the U.S. context Southern states are viewed as having had weaker institutions during certain time periods. From the turn of the century through roughly 1970, a single party dominated state politics in the former Confederate states.

The party controlled both the legislature and the governorship. Following the Voting Rights Acts of 1965 and its 1970 amendment, political competition began to increase in Southern states. Besley et al (2010) find that these changes led to increases in per capita income. If stronger institutions led to changes in resource production or use of resource income, then the relationship between resources and growth may have changed. Metcalf and Wolfram (2014) provide evidence that institutions affect volatility in oil production. More open competitive political institutions reduce volatility.

Resource sectors tend to be volatile, and volatility has been examined as a channel through which resources may affect growth (van der Ploeg and Poelhekke 2009, Jacks et al 2011, Williamson 2011). Compared to countries, American state membership in the United States, a single large economically diversified country, mediates some of the volatility effects, including currency effects. Booms and busts can, however, affect the state labor market, investment in physical capital, investment in human capital, and state tax revenues. States with high resource revenues often attempt, not always successfully, to buffer against volatility in state government income.

Resources can affect growth through labor markets (Sachs and Warner, 1995, van der Ploeg, 2011). In the international context, this is often referred to as Dutch Disease. Allcott and Keniston (2013) examine the question: Do resource booms and busts cause Dutch Disease in rural counties with resource production? For 1969-2011, they find resource booms are associated with increases in employment, earnings, population, wages and manufacturing wages in counties with positive oil and gas production at any point during the sample period. Interestingly, despite the pre-condition for Dutch Disease, higher wages, they find that manufacturing growth is positively associated with booms.

They attribute this to firms selling some of their output locally and local demand shocks causing increased production. Carrington (1996), Black et al (2005), and Jacobsen and Parker (2014) examine labor shocks created by construction of the Alaskan pipeline and the Appalachian coal boom and the Western oil boom in the 1970s and 1980s. All three examine the effect on the manufacturing sector and, like Allcott and Keniston (2013), find no negative effects on manufacturing.[3] While the literature has largely focused on the negative effects of resources, the effects could be positive, if resources draw workers out of low productivity sectors.

Two mediating factors for resources may be whether the national economy is doing relatively well or poorly and whether the state share of resources is increasing or decreasing. Both of these are related to the broader literature on the 'cleansing' effects of recessions (Davis and Haltiwanger 1990, 1992, 1999, Caballero and Hammour 1994, 1996). In the context of a robust national or state economy, resource growth may draw workers from other sectors and growth specifically in oil may capture increased prices.[4] Increased prices may differentially hurt states with high resource shares, if the resources are used more intensively in those states than in other states. Conversely, if the national economy is not doing well, resource growth may not draw workers from other sectors and declines specifically in oil may capture decreased prices. Decreased prices may differentially help states with high resource shares, if the resources are used more intensively in those states than in other states.

[3] Cadena and Kovak (2013) show that during the Great Recession Mexican immigrants helped equilibrate local labor markets. This may be occurring during these earlier periods.

[4] There is a large macroeconomic literature on oil prices and recessions. See Hamilton (2011, 2012) and Kilian and Vigfusson (2014). Kilian and Vigfusson (2014) discuss nonlinearity of the relationships.

Over long time periods, it is important to control for population flows more broadly. For example the South and West experienced large population gains as the result of favorable climate and the advent of air conditioning. Population gains or losses may affect growth both in the short run – as the labor market adjusts – and in the longer run – if in-migrants or out-migrants are disproportionately inside or outside of the labor market.

3. Data and Identification

Data on per capita state personal income are available decadally for 1880-1920 and annually beginning in 1929. State incomes for 1880-1920 are from Klein (2013) and Easterlin et al (1957), and state incomes for 1929-2012 are from the Bureau of Economic Analysis (BEA). State GDP data for 1963-2012 are from the BEA. Data were adjusted to 2010 dollars using the US CPI data from Officer and Samuelson's website *Measuring Worth*. Decennial population values by state from the Censuses of Population were interpolated for intervening years.

The sample includes the 48 contiguous states. In particular, it excludes Alaska, Hawaii, and the District of Columbia. Alaska and Hawaii enter the sample late (1960), and Alaska is an extreme outlier in terms of resource intensity. The federal government dominates the District of Columbia's economic activity.

To investigate the importance of different measures of resources, we use state data on gross and value added measures and aggregate and disaggregate measures of resources. The gross value of total minerals measure is very similar to Sachs and Warner's mineral resource measure, in that it contains oil and gas, metals, and nonmetals. The coverage of total minerals is slightly broader, in that it contains more than the 23 minerals covered by Sachs and Warner. Data on total minerals and the subseries are taken from the *Census of Mines and Quarries*, *Mineral Resources of the United States*, *Minerals Yearbook,* and the Energy Information Agency website. For more detail, see the data appendix. For primary products, detailed state by industry value added components of GDP data from the BEA is used. These are the same data used by Papyrakis and Gerlagh (2007). The primary sector data is disaggregated into oil and gas, other minerals, and agriculture.[5] The gross value of total minerals series and the value added series for mining (oil and gas + other minerals) from the BEA are highly correlated, as are the gross and value added series for oil and gas and the gross and value added series for other minerals.[6]

The effects of these measures of resources on growth are measured over three time periods and at two data frequencies. The time periods are 1880-2000, 1929-2000, and 1963-2012. For 1880-2000, the data are gross state value of total minerals at a decadal frequency. For 1929-2000, the data are gross state value of total minerals at decadal and annual frequencies. For parts of the analysis, data on gross value of total minerals is disaggregated into the gross value of other minerals and of oil and gas. For 1963-2012, the data are state value added of primary product at annual frequency. For parts of the analysis, the gross value of primary products is then disaggregated into the value added of other minerals, oil and gas, and agriculture.

Figure 1 shows trends in unweighted average oil and gas, other mineral, and total mineral value (the sum of the two series) as share of state income.[7] Total mineral values

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[5] Technically the sector is agriculture, fisheries, and forestry. For convenience, it is simply referred to as agriculture.
[6] Over the period for which the two series overlap, the correlation between gross and value added total minerals is 0.98; the correlation between gross and value added oil and gas is 0.98; The correlation between gross and value added other minerals is 0.95.
[7] The unit of observation is a state, and averages are averages across states.

rose above 10 percent in three periods: 1929, 1937-1940, and in the early to mid 1980s. For most of 1929, the economy was still booming. The economy began to slow down in 1930, affecting demand for minerals, which were inputs into construction and manufacturing. In the late 1930s, the economy was recovering from the Great Depression and returning to high mineral shares. In the early to mid 1980s, the oil crisis caused a spike in the value of oil and gas. In the late 1990s, total mineral value was the smallest it has been relative to income over the 120-year span.

The other minerals component was a large but declining share of total mineral value. In 1950, 1970, and 1990 other minerals were 4.75, 3.42, and 2.70 percent of state income. These can be broken down into coal, non-metals (e.g. stone, sand, clay), and metals. In 1950 coal, nonmetals, and metals were 26, 42, and 32 percent of other minerals. By 1970, coal, nonmetals, and metals were 19, 49, and 32 percent of other minerals. By 1990, they were 31, 43, and 25 percent of other minerals.

Figure 2 plots trends in oil and gas; other minerals; agriculture, forestry, and fishing; and all primary products (the sum of the three series). Primary products peaked at 10 percent of income in 1981 and declined rapidly thereafter. Beginning in 2000, primary has begun to increase as a share of income.

Appendix Table 1A presents summary statistics. Per capita growth in income has exhibited substantial variation, particularly at the one-year level. Extreme values are typically from the 1930s when the country was going into and out of the great depression. Some states have very high values of total mineral production/income. Wyoming was above 50 percent in many years, and Arizona, Louisiana, Montana, and Nevada were above 50 percent in at least one year.

Appendix Table 2A shows total mineral value as a share of state income at 40-year intervals by state. There is considerable variation both across states and within states over time in total value of mineral production as a share of income.

Time Series Identification

To identify the effects of resources on growth in state per capita income, two strategies are pursued, one based on production and one based on a measure of endowment. Identification of the effects of the value of mineral production on growth in state per capita income comes from variation within state in the value of mineral production as a share of income over time. The estimated equation is:

(1) $PCgrowth_{st} = a_0 + a_1(\text{total mineral/income})_{st-1} + a_2 state_s + a_3 year_t \times south_s + \varepsilon_{st}$

PCgrowth is growth in per capita income in state s between t-1 and t, where t is either a year or a decade. $(\text{total mineral/income})_{st-1}$ is the value of total mineral production as a share of state personal income at time t-1. State is state fixed effects. The state fixed effects capture long run differences in state growth. Year x South allows the year fixed effects to differ for the South (former Confederate states) and non-South. Year fixed effects capture shocks that affect all states in the same way. The interaction with the South captures convergence between the South and non-South over time for reasons unrelated to resources. Standard errors are clustered by state. Some specifications allow the effect of a_1, the coefficient on resources, to vary by time period.

Endogeneity

One concern with the foregoing analysis is that mineral production could be endogenous. Endogeneity can be relevant in two time periods. In the nineteenth century and in a few cases the early twentieth century, population growth and state investments led to 'discovery' and development of deposits. Paul David and Gavin Wright (1997) present evidence on state investments and subsequent mineral development.[8]

Later in the twentieth century, state policies seem to have had less influence the development of deposits. State influence could occur through ownership of deposits or taxation. American states own rights to small percentages of mineral deposits. Specific estimates are difficult to find. A recent Congressional Research Service Report concluded: "It is estimated that local, state, and federal governments control about 1/3 of all mineral rights in the United States."[9] The federal government controls most of this one-third.[10] States do tax mineral production. The literature on taxes suggests that production is fairly insensitive to taxes.[11] Large multinational corporations generally make decisions about production based on conditions in world markets. Changes in prices are often driven by positive or negative supply shocks that originate in other states or countries.

While endogeneity is difficult to test, many of the changes in Figures 1 and 2 appear to be exogenous. In Figure 1, the recovery of the economy from the Great Depression and the onset of World War II in Europe drove the increase in total minerals above 10 percent. Exogenous factors such as the oil embargo led to the boom in oil and gas in the 1970s and its bust in the 1980s. In Figure 2, the agricultural boom in the early 1970s was caused by a rapid expansion in exports. Exports remained high through the 1970s but profitability eroded because of higher costs. Exports fell during the 1980s (Henderson et al 2011).

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[8] Clay (2011) presents additional evidence on state investments.
[9] Wittmeyer (2013).
[10] Gorte et al (2012).
[11] See Chakravorty, Gerking and Leach (2011), Kunce, Gerking, Morgan, Maddux (2003), and Deacon (1993).

Nevertheless a problem would arise if growth in state income caused contemporaneous or subsequent mineral production to rise (or fall) as a share of income. To address these issues, our specifications include state fixed effects and year x South fixed effects. These remove any growth effects specific to a state or a year within and outside of the South. Changes in value of resources as a share of state income would only be endogenous if they were in response to lagged state-specific growth in per capita income controlling for state and year x South fixed effects.

To further explore endogeneity, we construct a measure of endowment.[12] We divide states into high and low mineral endowment states based on their average resource share of income. States with averages above 2 percent for oil and gas over 1900-2000 are classified as high. Similarly, states with averages above 3 percent for other minerals over this period are classified as high. For oil and gas and other minerals, 27 and 35 percent of states are classified as high. For the BEA data, averages are taken over the sample period, 1963-2012. States with averages above 1 percent for oil and gas, 1 percent for other minerals, and 3 percent for agriculture are classified as high. For these three resources, 27, 29, and 31 percent of states are classified as high. While average share is not a perfect proxy of endowment, it does capture production over a very long time period.

One issue with endowment is that it is a characteristic of the state and so does not vary over time.[13] As a result, a different estimation technique needs to be used. Following Acemoglu et al (2001), Nunn and Qian (2011), and Berkowitz and Clay (2011), we first estimate cross sectional differences across states in a specific period. We

[12] Brunnschweiler (2008) shows that whether one uses stocks or flows of resources has a large impact on the empirical effect of resources on growth in the cross-country context using cross sectional identification. This raises the question of whether using stocks and flows will matter in time series.

[13] One could also examine proven reserves, which does change over time, or economically relevant reserves, which also changes over time, but the variable of interest is endowment.

then estimate time series effects, where the measured effect is the difference across types of states relative to the difference in the (omitted) baseline period.

The cross sectional equation is:

(2) $PCgrowth_{st} = b_0 + b_1(high\_state)_s + b_3 year_t \times south_s + \varepsilon_{st}$

The time series equation is:

(3) $PCgrowth_{st} = a_0 + a_{1t}(high\_state)_s + a_2 state_s + a_3 year_t \times south_s + \varepsilon_{st}$

High_state is an indicator variable for whether a state has high resource endowment and is based on average resource production over long time periods. State is state fixed effects. Year x South allows the year fixed effects to differ for the South (former Confederate states) and non-South. Standard errors are clustered by state. The effect of a_{1t}, the coefficient on high state, is allowed to vary by time period.

4. Time Varying Effects of Resources

The analysis begins by showing the time series and cross sectional effects of the value of total minerals on growth in per capita income. It then allows the effects of oil and gas and other minerals to differ. It closes by investigating the effects of endowments.

Total Mineral: Time Series and Cross Section

Table 2 examines the time series effects of total minerals on growth in per capita income. The analysis uses three data sets: decadal data for 1880-2000, annual data for 1929-1999, and annual value added data for 1963-2012. In the initial specifications in columns 1-3, a single coefficient on resources is estimated for the whole time period. In columns 1 and 2 for 1880-2000 and 1929-1999, the coefficients on total minerals are not statistically significant from zero and differ in sign. In column 3 for 1963-2012, the coefficient is negative and statistically significant.

Columns 4-6 allow the effects of minerals on growth to differ across 20-year time periods. Across all three specifications, the base period is 1980-2000. In column 4, in the base period the coefficient on the value of minerals as a share of income lagged 10 years is negative and statistically significant at the 10 percent level. Using the coefficients from column 4, the top figure in Figure 3 plots the net effects and the 95 percent confidence intervals over time. In two periods – 1940-1960 and 1960-1980 – the coefficients are statistically significantly different than the coefficient in the base period and the net effects are positive. In the remaining periods, the coefficients are not statistically significantly different from zero, and the net effects are negative.

In column 5, in the base period the coefficient on the value of minerals as a share of income lagged 1 year is negative but not statistically significant. Using the coefficients from column 5, the bottom figure in Figure 3 plots the net effects and the 95 percent confidence intervals over time. In the remaining periods 1929-1940, 1940-1960, and 1960-1980, the effects are statistically significantly different than the coefficient in the base period, and the net effect is positive. The differences in effects in columns 4 and 5 and the associated figures for the 1920-1940 periods reflect differences in lags (10-year vs. 1-year) and in time periods (1920-1940 vs. 1929-1940).

In column 6, in the base period the coefficient on value added of minerals as a share of income lagged 1 year is negatively and statistically significant. In the remaining periods 1963-1980, and 2000-2012, the effects are statistically significantly different than the coefficient in the base period and the net effect is negative. Columns 7 and 8 compare the gross and value added measures of total mineral over the same time period 1963-1999. The coefficients differ in magnitude, but the patterns are consistent across the two regressions. The coefficient on total mineral is negative and statistically significant in the base period and positive and statistically significant in the 1963-1980 period. The sum of the base and differential is negative but close to zero for 1963-1980. This suggests that differences in columns 5 and 6 were due to differences in time periods.

For comparison with Table 2 and with the broader literature, Table 3 shows the cross sectional results over the same 20-year periods. Despite the difference in identification, the effects of minerals on growth vary over time in ways that are similar to Figure 3. The coefficient on resources is negative and statistically significant in only three of the six time period periods. The coefficient is negative and statistically significant for 1880-1900 and for 1920-1940. The issue for 1900 is that the 1880 resource measure and income were very high for western states, which were experiencing booms in copper, silver, gold, lead, and zinc. It is not wholly surprising that they should be growing slowly, given that their per capita incomes were more than double the national average. The coefficient is also negative and statistically significant in 1980-2000, which is consistent with Papyrakis and Gerlagh (2007) and James and Aadland (2011). In the remaining three periods, it is not statistically significant, and in two of those periods the coefficient is small and positive. The final two columns investigate the effect of minerals over the period 1900-2000. The first uses the state mean of total mineral as a share of income, while the second uses total mineral as a share of GPD in 1900. In both cases the coefficient on minerals is negative and statistically significant.

Tables 2 and 3 highlight the variability over time in the relationship between minerals and growth.

Oil and Gas, Other Minerals, and Agriculture: Time Series

Columns 1-3 of Table 4 re-estimate the regressions in columns 4-6 of Table 1, but decompose total minerals into oil and gas and other minerals.[14] To reduce the number of time periods reported, the sample period begins in 1929 or after. Across columns 1-3, oil and gas has a large negative and statistically significant coefficient for the base period 1980-2000. Using the coefficients from column 2, Figure 4 plots the net effects and the 95 percent confidence intervals for oil and gas and for other minerals. Aside from 1980-2000, the net effect of oil is small and insignificant. In contrast, for three of the four periods, the effect of other minerals on growth is positive and statistically significant.

The BEA data covers value added from all sectors, including agriculture. Column 4 adds agriculture to the mineral data, together they comprise the primary sector. Two things are notable. First, adding agriculture has very little effect on the coefficients on oil and gas and on other minerals. Second, the coefficient on agriculture in the base period is negative and very large (-0.796), much larger than the coefficient on oil and gas (-0.154). The net effects of agriculture in other periods vary in magnitude, but remain substantially larger than the net effects of oil and gas.

Columns 5 and 6 compare the gross and value added effects over identical time periods. As in Table 2, the magnitudes differ, but the effects are qualitatively similar across the two specifications. That is, in the baseline period, the coefficients on oil and gas are negative and statistically significant, the differential effects for 1963-1980 are positive and statistically significant, and the net effects of oil and gas are negative during 1963-1980. In the baseline period, the coefficients on other mining are negative but not statistically significant, the differential effects are positive and statistically significant, and the net effects of other minerals are positive.

[14] Coal is included in other minerals, because the BEA stopped reporting it separately in 1997.

Table 4 highlights the extent to which different resources had different effects on growth in different time periods.

Endowments: Time Series

Table 5 uses classification of states into high and low endowment states and the three data sets to explore patterns of growth. In column 1 of Table 5, the cross sectional results for 1980-2000 indicate that states with high oil and gas or high other mineral grew statistically significantly more slowly than states with low oil and gas or other minerals when growth is measured at 10-year intervals. These patterns hold across the cross sectional results in columns 3 and 5 when growth is measured at 1-year intervals. Column 5 also includes agriculture, which is negative but not statistically significant. In columns 2 and 4 and 6, the difference between high and low oil and gas states was large, positive, and statistically significantly different than the difference in 1980-2000 in every period except in the 1929-1940 period for one year lags. The difference between high and low other mineral states was positive, although not always statistically significantly different than the difference in 1980-2000. In column 6, the pattern also holds for agriculture.

The period 1980-2000 appears to have been a bad period for all resources, particularly oil and gas. Aside from this period, growth of states with high resource endowments appears on net to have been similar to or better than states with low resource endowments.

5. Effects of Resources on Growth: An Exploration of Mechanisms

This section investigates a number of mechanisms through which resources might act as growth. The analysis focuses on 1-year periods from 1929-1999.[15]

[15] 10-year intervals offer insufficient observations to identify large numbers of variables.

Table 6 explores three factors – volatility, population growth, and the effect of a state being a former Confederate state (South). Volatility has been discussed as a possible mechanism in the literature. Volatility is measured as the standard deviation of the resource share over the previous 5 years (t-5 to t-1). Population growth is a control that can capture any disruptions associated with large population movements and address the fact that population movements may include different shares of workers than the base population. There are at least two possible reasons for the differential effects in the South relative to the non-South. One would be that resources were pulling workers in the South out of lower productivity sectors such as agriculture. The other is that Southern political institutions were on average weaker than non-South political institutions along measures such as competition for the governorship and the composition of the state legislature.

Column 1 presents a baseline specification. The coefficient on other minerals is positive and statistically significant, and the coefficient on oil and gas is negative and statistically significant.

Column 2 adds measures of population growth and of resource volatility to the variables in column 1. The coefficients on population growth and on the standard deviation of oil and gas are negative and statistically significant. The negative coefficient on oil and gas becomes insignificant, suggesting that some of the negative effect may have been driven by volatility.

Column 3 allows the effect of resources to differ between the South and non-South. The coefficients on resources in the South are both positive. In the case of oil and gas, the coefficient is statistically significantly different than the coefficient for the non-South.

Column 4 combines analysis of population growth and volatility with differential effects of resources in the South and non-South, and column 5 adds differential time effects of resources. The results are similar to the results in columns 2 and 3. Notably, the coefficients on the differential effects of other minerals and oil and gas after 1970 are very small and not statistically significantly different than the effects before 1970.

Column 6 allows the southern interaction effects to differ by time period. There are four categorical variables non-South before 1970 (omitted), non-South after 1970, South before 1970, and South after 1970. F-tests indicate that the oil and gas and other mineral coefficients on South after 1970 are statistically significantly different (higher) than the oil and gas and other mineral coefficients on South before 1970 and non-South after 1970. The increase in the coefficients in the South from pre-1970 to post-1970 suggests that improved state political institutions may have played a role.

It is worth noting that adding controls has not dramatically changed the coefficients on other minerals L1 and oil and gas L1 from column 1 to column 6. That is, production of other minerals is still positively related to growth, possibly because they are inputs into local production such as steel, construction, or electricity. Production of oil and gas is negatively, although not always statistically significantly, related to growth. The net effect of oil and gas in the South across the specifications in columns 3-6 is close to zero.

In sum, Table 6 confirms the heterogeneity of the effect of resources on growth. For other minerals, the effect on growth was positive and statistically significant. For oil and gas, the effect on growth was negative, but not always statistically significant. In both cases, the magnitude of the effect varied across regions and time periods. The effects of resources on growth in the South were positive and appear to have been concentrated in the post-1970 period. Volatility had a negative effect, but was only statistically significant for oil and gas. Population growth had a negative and statistically significant effect, possibly because population changes are disruptive and may have involved disproportionate numbers of non-workers.

While Table 6 provides evidence on volatility, population growth, and the effect of being a former Confederate state, other factors may also affect the relationship between resources and growth. Table 7 explores two possibilities. One is that the effects of a one-unit increase in resources and a one-unit decrease might differ. There is no a priori reason to believe that booms and busts have symmetric effects. The other is that effects of changes in resources may change depending on whether the country was experiencing low growth or not. As discussed earlier, both of these are related to the broader literature on the 'cleansing' effects of recessions. It may be that declines, whether resource specific or economy wide, lead to reallocation of resources and so spurred growth. An indicator variable for low growth was constructed that is set to 1 if average growth across all states was less than 1 percent, and 0 otherwise. Roughly 25 percent of the observations are for low growth years.

Table 7 shows that the affects of resources are asymmetric and are influenced by overall growth. Column 1 allows the effect of increases and decreases to differ. For oil and gas, the coefficient for declines is negative and statistically significantly different than zero. A one-percent increase in oil and gas/income had a -0.017 effect on growth. A one-percent decrease had a 0.084 (= 0.0166 + 0.0673) effect on growth.

Column 2 allows the effect of resources to differ during periods of low growth. For oil and gas, the coefficient for low growth is positive and statistically significantly different than zero. A one-percent increase in oil and gas/income had a -0.076 effect on growth. A one-percent increase during a period of low growth had a 0.013 (= 0.0888 - 0.0760) effect on growth. During periods of low growth, changes in oil and gas have very small effects on growth in income.

Column 3 includes asymmetry and low growth, and column 4 adds controls for population growth and volatility. The results are similar to the results in columns 1 and 2. The coefficients on population growth and the two measures volatility are all negative, and coefficients on population growth and volatility of oil and gas are statistically significant.

Column 5 allows the effect of resources to differ between the South and non-South and before and after 1970. As in Table 6, the coefficients on resources in the South are both positive, and the coefficient on oil and gas is statistically significant. The coefficients on the differential effects of other minerals and oil and gas after 1970 are not statistically significantly different than the effects before 1970.

Column 6 allows the southern interaction effects to differ by time period. The results in terms of sign and statistical significance are quite similar both to the results in earlier columns and to the results in Table 6.

Using data from 1929-1999, Tables 6 and 7 presented new evidence on resources and growth. Volatility, population growth, have been a former Confederate state, asymmetric effects of booms and busts, and differential effects of resources during periods of high and low growth are all relevant for understanding the effects of resources on growth. Focusing on any one channel can be problematic, because it can cause researchers to miss the fact that multiple channels are important.

6. Relationship to the Literature

Our cross sectional growth results in Table 3 are in line with previous cross sectional results in the literature. These include Papyrakis and Gerlagh (2007) and James and Aadland (2011). Because Papyrakis and Gerlagh use state data, we can replicate their results exactly. For James and Adland (2011), we can replicate their results qualitatively. In the interest of brevity, we do not report the results here.

Although our focus has been on growth in per capita income, two papers suggest that it may be worth looking at levels of per capita income. Using state data, Goldberg et al (2008) find a resource curse using cross sectional income regressions over 1929-2002. Using international data, Alexeev and Conrad (2009) show that in cross section a number of measures of resources including value of oil and of minerals per capita and value of oil and of minerals as a share of income are positively related to income in 2000.[16] Both sets of authors use logs of resources.

Table 8 report the results of the cross sectional regressions. Column 1 does a regression similar to Goldberg et al, Table 1 column 1. For the purposes of comparison with our earlier results, we regress the log of per capita income in 2000 on the log of per capita income in 1930, include an indicator variable for South, and exclude Alaska and Hawaii. Despite these modifications, our estimate of the resource curse is nearly identical (-0.0342 vs. -0.0301) to theirs.

Columns 2-5 present results in the spirit of Alexeev and Conrad. Our sample and Alexeev and Conrad's sample are very different – states vs. countries – and the controls

[16] They also use value of hydrocarbon deposits per capita.

are somewhat different. Their regressions include controls for latitude and region. We include a dummy variable for South. In columns 2-5, the coefficients on measures of oil and on measures of total minerals are negative and statistically significant.[17] Table 8 suggests that focusing on income does not resolve the puzzle of the (cross-sectional) resource curse in the U.S. context.

Goldberg, Wibbles, and Mvukiyehe (2008) find a resource curse in time series, where resources are oil plus coal. Table 2, column 2, and Table 6, column 1, have the regressions that are closest to theirs. While the two sets of specifications differ, their results for oil and coal are consistent with what we find for oil and gas.[18]

While we been able to replicate a resource curse for papers using cross sectional identification and for the time series results in Goldberg, Wibbles, and Mvukiyehe (2008), we have not yet accounted for Boyce and Emery (2011) and Michaels' (2011) findings on the relationship between oil and income. Boyce and Emery use a two-sector small open economy model to show that per capita income will be higher and growth slower in states with natural resource bases. They show that state per capita income is positively related to the share of employment in the mining sector over the period 1970-2001. Michaels (2011) uses county-level data on 675 oil-abundant and nearby counties located in 12 southern and western states. Abundance is related to whether the county included part of an oil field with at least 100 million barrels of oil. The bulk of the oil-abundant counties are located in Texas, Louisiana, and Oklahoma. He uses a variety of dependent variables including sectoral shares, employment density, population density, family and per capita income, education, and infrastructure.

[17] We follow their specifications and use ln(resources + 1).

[18] In unreported regressions, we replicate their results. Their specifications differ from ours in that they include large number of control variables and lack of year fixed effects.

For comparison with Boyce and Emery (2011), Columns 1-4 of Table 9 investigate the relationships between state per capita income and oil and total mineral income. Over the period 1970-1998, the coefficient on Oil/income in column 1 and on Total Mineral/income in column 2 are positive and significant. This is consistent with Boyce and Emery's finding that mining employment share is positively related to income.[19] Columns 3 and 4 estimate the same equations over the period 1929-1999. The coefficients are of mixed signs and not statistically significant. This suggests that the relationship between per capita income and mineral production may have varied over time.

For comparison with Michaels (2011), we focus on his results on Ln(Per Capita Income) covering 1959-1989.[20] He finds that oil abundant counties had higher per capita income in 1959, but that this advantage declined over time. In column 5 of Table 9, we can replicate the basic pattern of falling per capita income from 1959 to 1969, rising income from 1969 to 1979, and falling income from 1979 to 1989 in Figure 3 of Michaels (2011). For consistency with our earlier results, we use income in the decadal years 1960, 1970, 1980, and 1990.

One issue is what to do about identifying the baseline year 1959, since that is key to the finding of positive, negative, or mixed results. Michaels (2011) states: "In order to identify $\beta\tau$ for a given baseline year τ, this specification omits the intercept and county fixed effects but adding these last terms has no effect on the estimates of the differential

[19] Boyce and Emery regress mining employment share in year t on annual real per capita GSP in year t. In Table 9, we report regressions of resources in year t on annual real per capita GSP in year t. The relationships are similar if resources are lagged one year.

[20] In the baseline, he also includes seven exogenous control variables – longitude, latitude, rainfall, arid, semiarid, distance to the nearest ocean, and distance to the nearest navigable river – that are interacted with decade as controls.

effect of oil abundance over time."[21] The baseline year appears to be identified by the seven exogenous controls plus the dummy for oil abundant. Michaels' summary statistics indicate that in 1959 oil abundant counties had higher per capita income than control counties.

It is common to run a cross sectional regression to provide evidence on the baseline year. In our cross section, reported in column 6, the effect of oil endowment is negative but not statistically significant with inclusion of a dummy variable for the South.[22] Restricting the sample to the twelve states in Michaels' sample in columns 7 and 8 gives qualitatively similar results. The difference appears to be primarily related to the level of aggregation. Oil abundant counties have higher per capita income than control counties in 1959, which oil abundant states have lower per capita income than control states in 1960. It is possible for both of these to be true.

7. Conclusion

This paper presents new evidence on the relationship between resources and growth at the state level in the United States over the period 1880-2012. The paper finds that different resources (oil and gas, other minerals, and agriculture) had different effects in different time periods. For the period 1980-2000, we present evidence of a resource curse in the United States in time series and cross section. Two points are worth noting. First, this period, although widely studied, is atypical. The magnitude of the negative effect of resources on growth is larger than for any other period. Second, the negative effect of resources on growth over 1980-2000 was much smaller in magnitude than the negative effects of agriculture on growth.

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[21] Michaels (2011), p. 36

[22] The result is similar if the dummy variable for the South is omitted.

The paper also investigates two interrelated types of mechanisms through which resources may have affect growth – political institutions and labor markets. The results suggest that institutions and a variety of labor-market related channels including volatility, economic conditions, and asymmetric effects of increases and decreases in resources are all relevant for understanding the relationship between resources and growth. A researcher focused on any one channel would evidence in support of that channel, but would miss the fact that multiple channels are important. While the research sheds new light on the mechanisms through which resources act on growth, more work remains to be done.

In addition to shedding new light on resources and growth in the United States context, the findings suggest that related work in the international and subnational contexts should use time series data, control for population growth, and consider multiple mechanisms.

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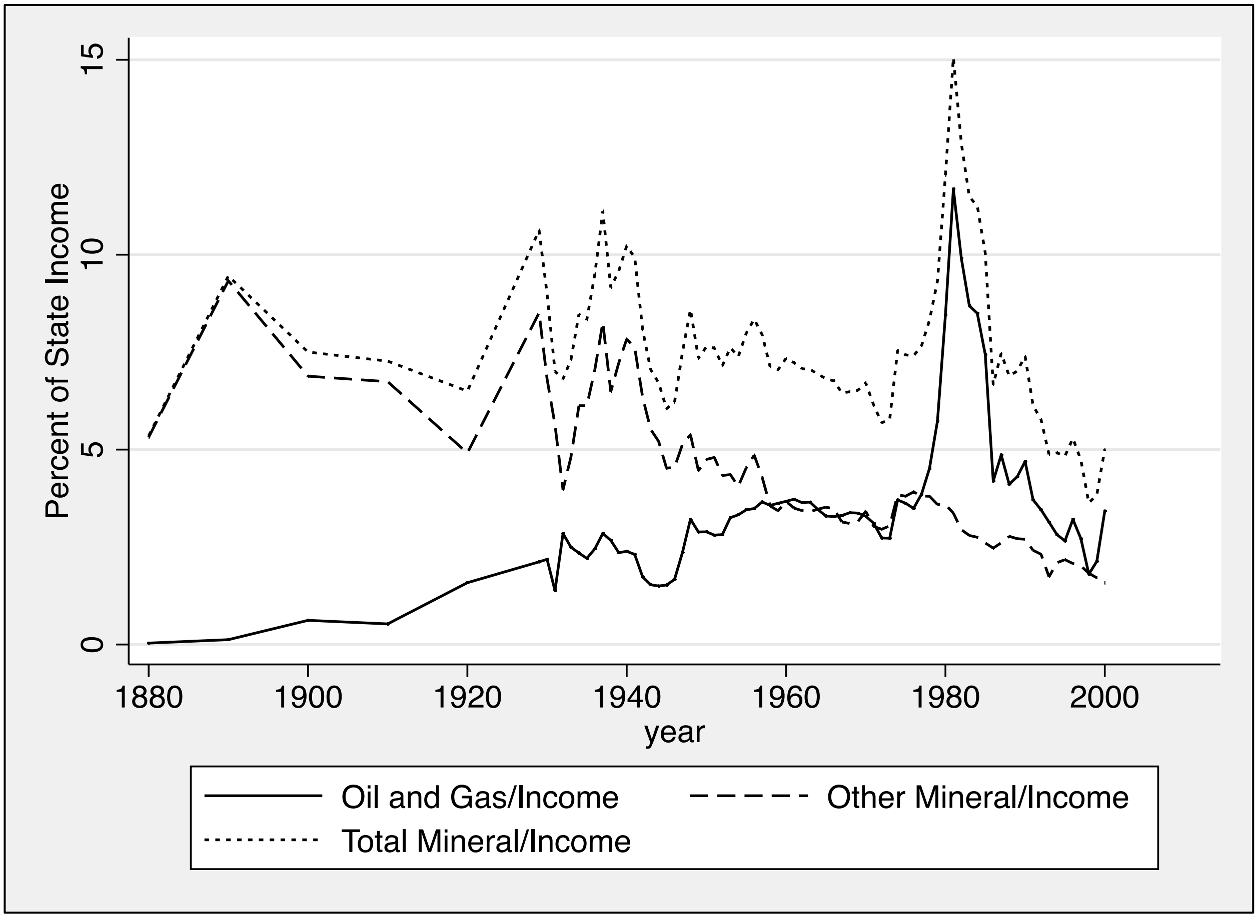
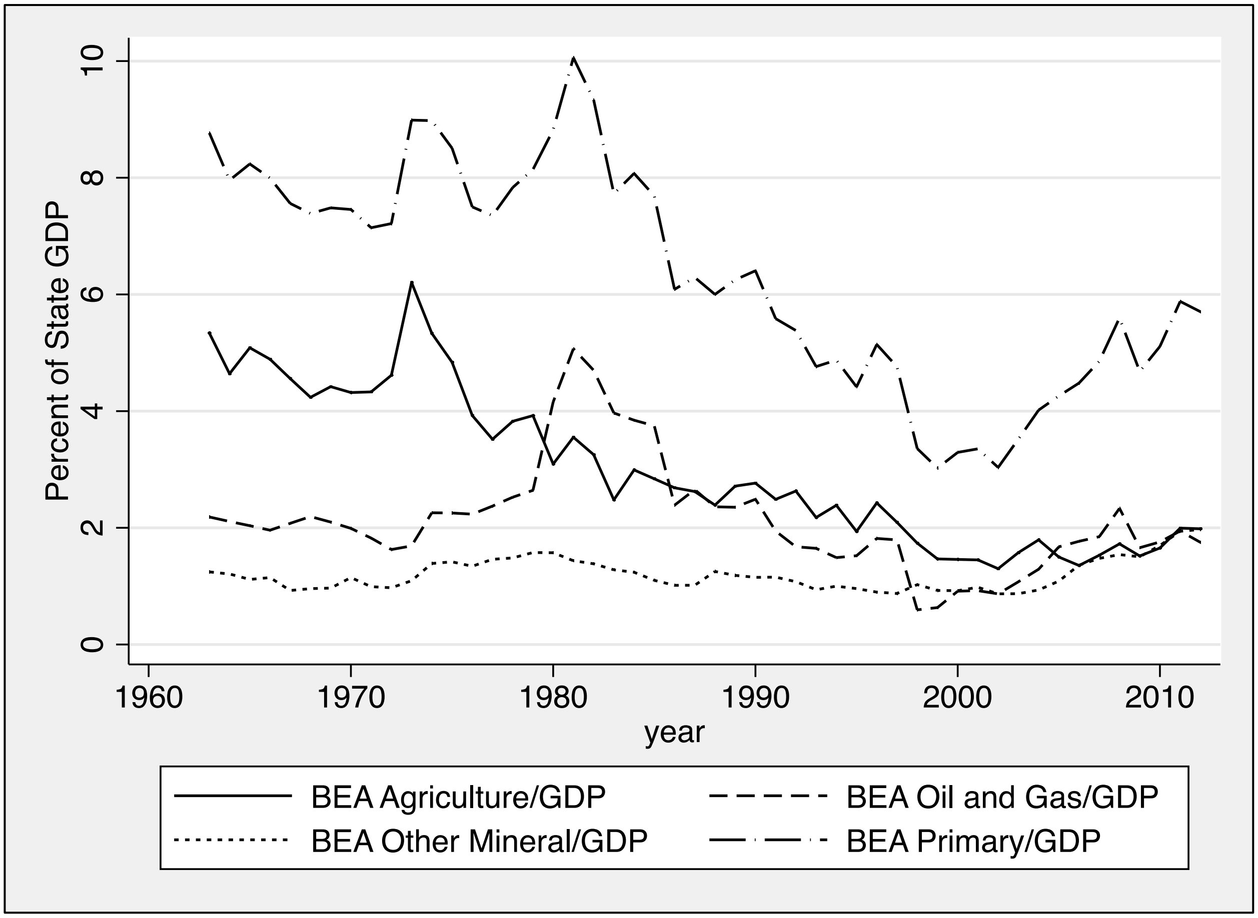
Figure 1: Gross Value of Total Minerals, Oil and Gas, and Other Minerals as a Share of State Income, 1880-2000



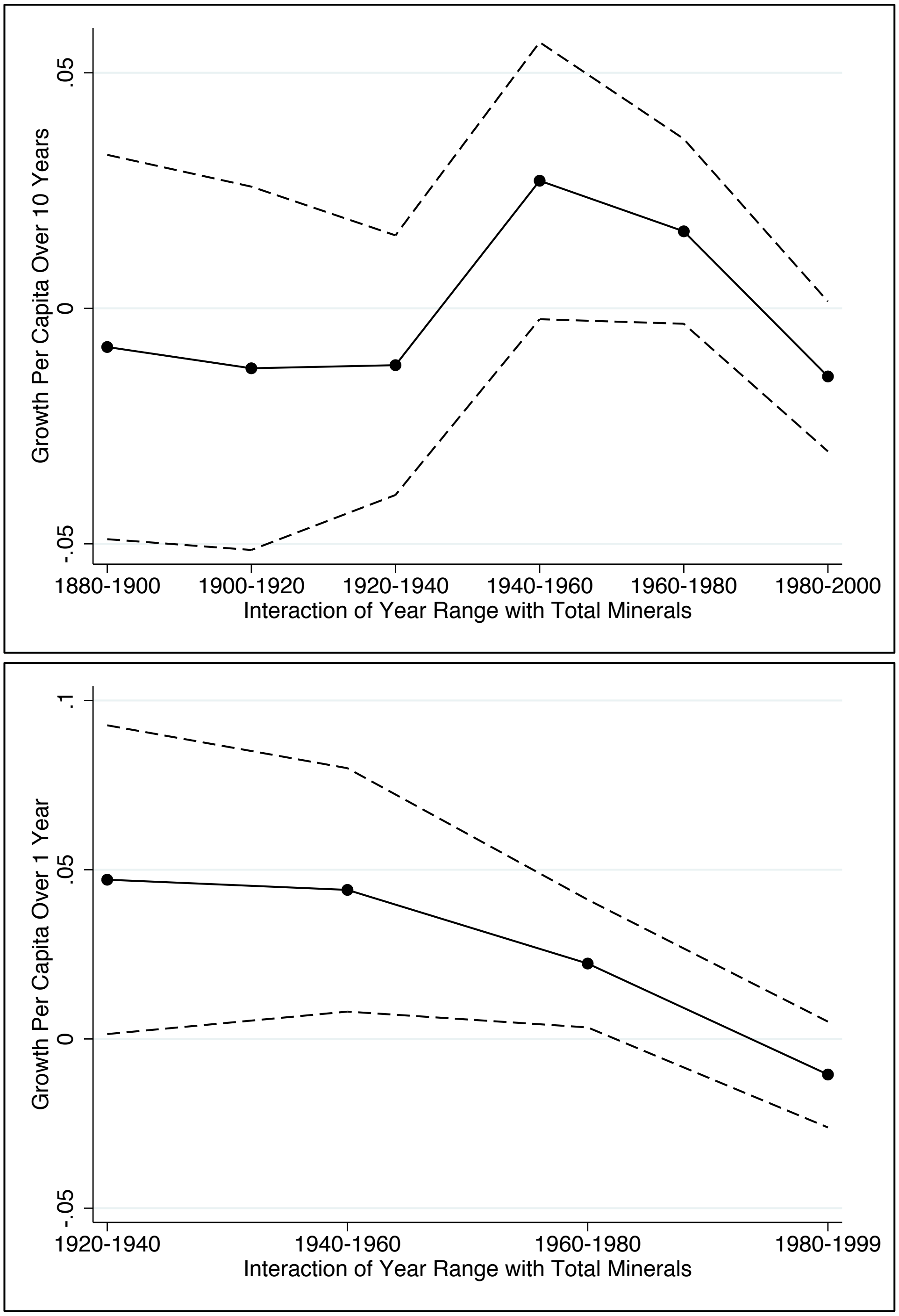
Notes: Income is state personal income. Percentages are unweighted averages across all states in a particular year. The variables are (resources x 100)/income. Other minerals includescoal, non-metals (e.g. stone, sand, clay), and metals.

Figure 2: Value-Added of Primary Products, Oil and Gas, Other Minerals, and Agriculture as a Share of State GDP, 1963-2012



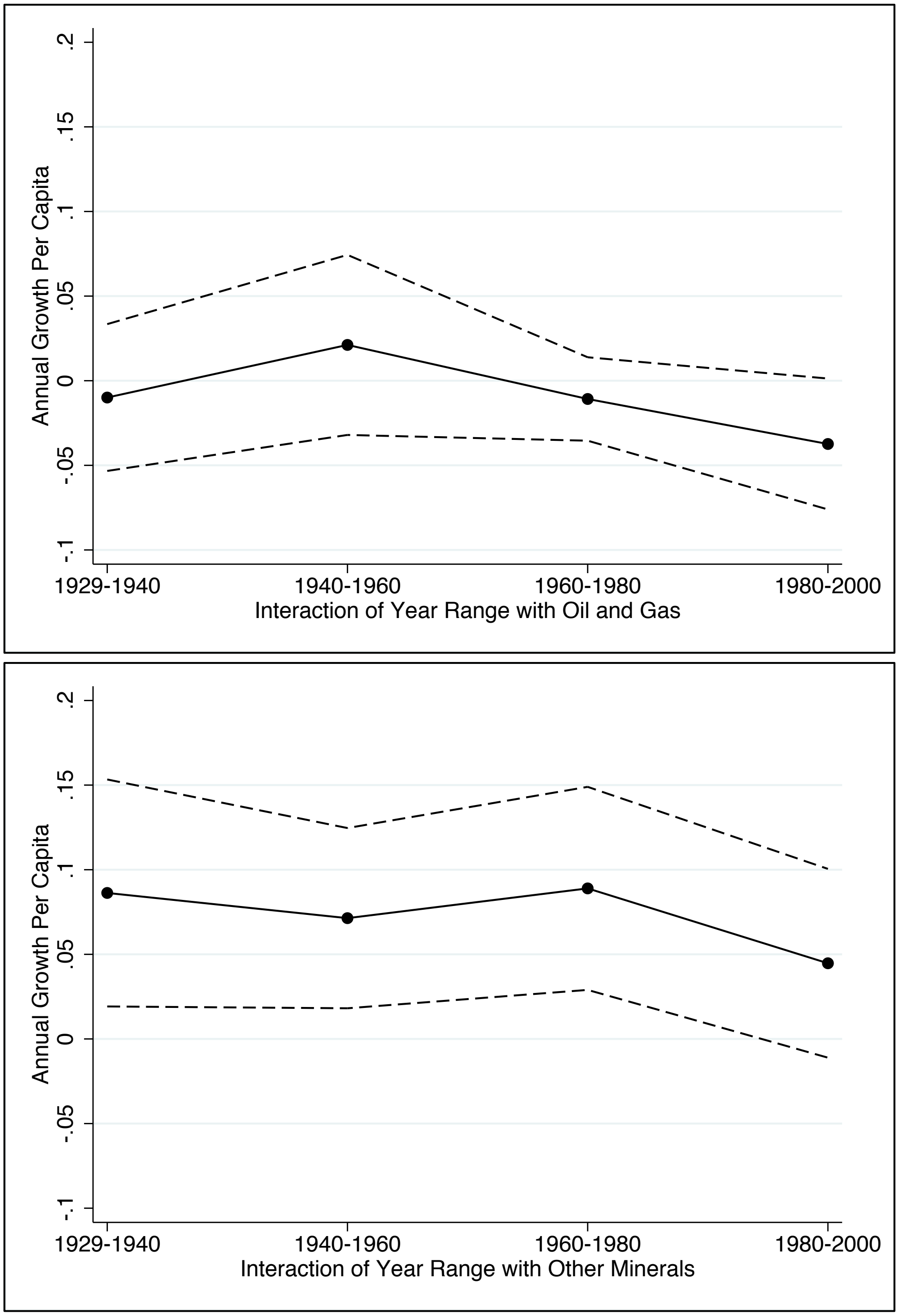
Notes: Percentages are unweighted averages across all states in a particular year. The variables are (resources x 100)/GD. Agriculture includes forestry and fishing. Other minerals includes coal, non-metals (e.g. stone, sand, clay), and metals.

Figure 3: Effects of Oil and Gas and Other Minerals on Growth in Income per Capita with 95% Confidence Intervals, 1880-2000 and 1929-1999



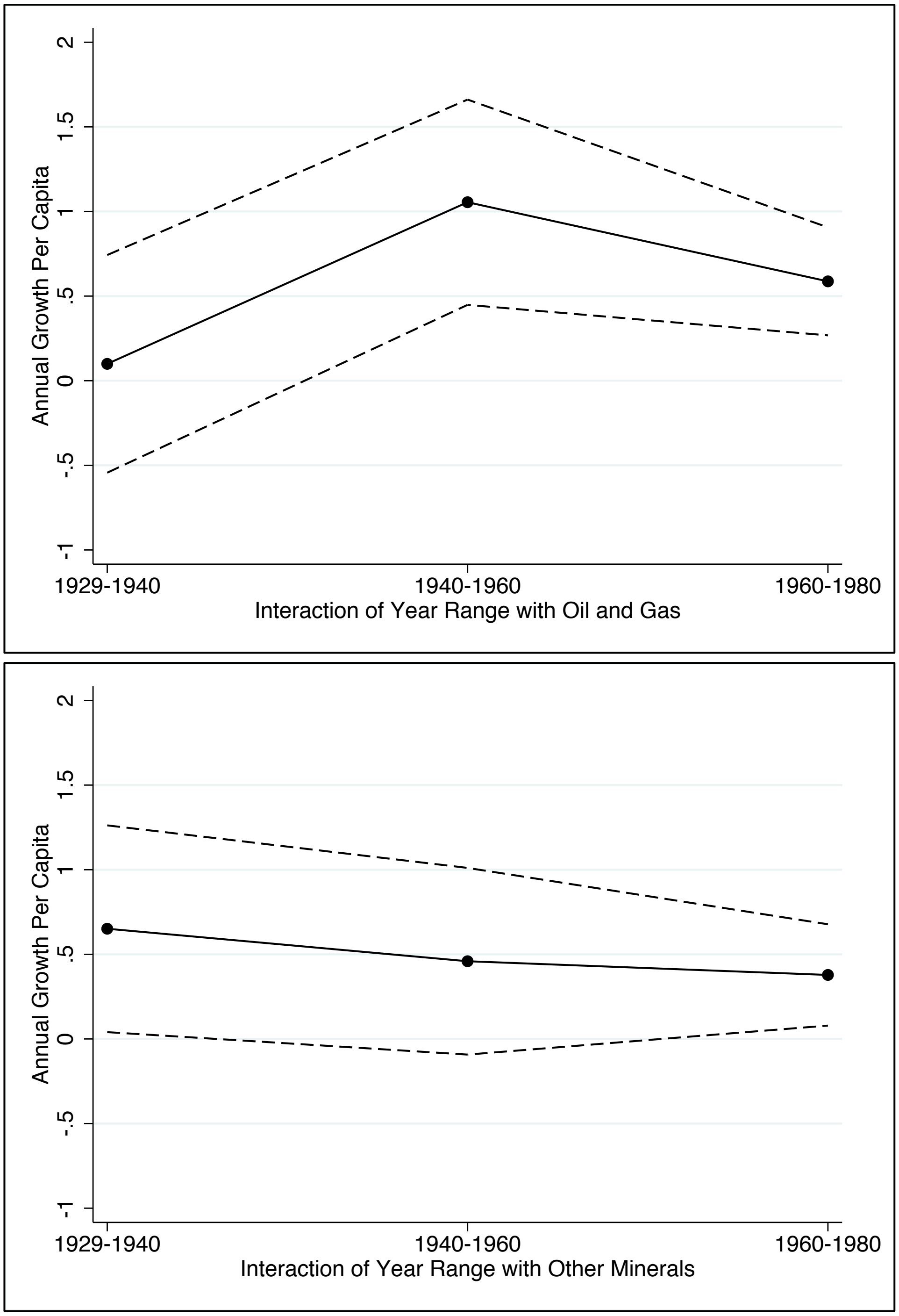
Notes: Based on Columns 4 and 5 of Table 2. Income is state personal income. Values of resources are gross values as percentages of income. The plot shows the effect of a 1 percent increase in Total Value/Income on (annualized) growth in per capita income.

Figure 4: Effects of Oil and Gas and Other Minerals on Growth in Income per Capita with 95% Confidence Intervals, 1929-1999



Notes: Based on Column 2 of Table 4. The regresssion uses annual values of income and reports effects at 20 year intervals. Values of resources are gross values as percentages of income. The plot shows the effect of a 1 percent increase in Oil and Gas/Income or Other Minerals/Income.

Figure 5: Effects of Endowment on Oil and Gas and Other Minerals on Growth in Income per Capita with 95% Confidence Intervals



Notes: Based on Column 4 of Table 5. The regresssion uses annual values of income and reports effects at 20 year intervals. States are classified as low (0) or high (1) in a resource based on long run average values of resources as measured by gross values as percentages of Income. The plot shows the difference between being a high oil and gas (high other mineral) state and a low oil and gas (low other mineral) state in various periods relative to the baseline (cross sectional) differences.

Table 1: Literature Review of Economic Resource Curses

Paper	**Identifica-tion**	**Outcome measure**	**Resource Measure**	**Unit of Analysis**	**Time period**	**Find curse**
Sachs Warner 1997	Cross sectional	Average annual growth pc GDP	Primary products(ag, forest, fish, mining)/exports, minerals/GDP	Country	1970-1990	Y growth
Papyrakis and Gerlagh 2007	Cross sectional	Average annual growth pci	Primary sector share of GDP in 1986 (value added)	State	1986-2000	Y growth
James and Aadland 2011	Cross sectional	Annual growth pci	Primary sector share of state GDP in 1980 (value added)	County (w state FE)	1980-1995	Y growth
Goldberg, Wibbles, Mvukiyehe 2008	Cross sectional	Income pc	Coal + oil	State	1929-2002	Y income
Wright 1990		Manuf. net exports	Non-reproducible resources	US export sector-year	1879-1940	N
Goldberg, Wibbles, Wvukiyehe 2008	Time series	Annual growth pci	Ln(coal + oil)/state income	State	1929-2002	Y growth
Boyce and Emery 2011	Time series	Income pc, growth pci	Mining share employment	State	1970-2001	Y growth, N income
Michaels 2011	Time series	Income, employment, population, infrastructure	Oil reserves	County in southern states	1890-1990	N income
Allcott and Keniston 2013	Time series	Employment, earnings, population	Oil and gas production	Rural counties	1969 (with some pretrends) -2011	N earnings

Table 2: Minerals and Growth in Per Capita Income, Time Series

	(1) Growth 1880-2000 L10	(2) Growth 1929-1999 L1	(3) Growth 1963-2012 BEA L1	(4) Growth 1880-2000 L10
Total Mineral x100/Income	-0.00447 (0.00930)	0.0116 (0.0189)	-0.0985*** (0.0335)	-0.0145* (0.00791)
Total Min x 1880-1900				0.00625 (0.0185)
Total Min x 1900-1920				0.00173 (0.0193)
Total Min x 1920-1940				0.00239 (0.0112)
Total Min x 1940-1960				0.0416*** (0.0136)
Total Min x 1960-1980				0.0308*** (0.00488)
Observations	574	3,360	2,128	574
R-squared	0.602	0.667	0.579	0.613
	(5) Growth 1929-1999 L1	(6) Growth 1963-2012 BEA L1	(7) Growth 1963-1999 L1	(8) Growth 1963-1999 BEA L1
Total Mineral x100/Income	-0.0105 (0.00777)	-0.0971*** (0.0262)	-0.0398*** (0.0133)	-0.0709** (0.0301)
Total Min x 1920-1940	0.0576*** (0.0166)			
Total Min x 1940-1960	0.0546*** (0.0135)		0.0323*** (0.00629)	
Total Min x 1960-1980	0.0328*** (0.00545)	0.0579*** (0.0123)		0.0620*** (0.0113)
Total Min x 2000-2012		0.0667*** (0.0172)		
Observations	3,360	2,128	1,728	1,728
R-squared	0.669	0.582	0.560	0.559

Notes: Growth is growth in real per capita state personal income. L10 and L1 refer to the intervals at which growth in per capita income is measured. For L10, measurement is between decades, e.g. from 1940 to 1950. The time spans encompass the full range of dates including the lag. For example, the growth regressions in column 1 include growth from 1880-1890 and for every decadal interval up to 1990-2000. BEA is value added by resources x 100 divided by GDP. All other columes are gross value of resources x 100 divided by income. All regressions have state and year x south fixed effects. Standard errors are clustered at the state level and are in parentheses. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Table 3: Minerals and Growth in Per Capita Income, Cross Section

	(1) Growth 1880-1900	(2) Growth 1900-1920	(3) Growth 1920-1940	(4) Growth 1940-1960
Total Mineralx100/Income	-0.0222**	-0.0182	-0.0236**	0.00108
Lagged20	(0.0105)	(0.0145)	(0.0102)	(0.00401)
PC Income Lagged20	-1.510***	-2.175***	0.871*	-2.617***
	(0.288)	(0.426)	(0.436)	(0.146)
South	-1.309***	-0.638	0.672*	-0.299**
	(0.341)	(0.412)	(0.367)	(0.119)
Observations	47	48	48	48
R-squared	0.629	0.668	0.197	0.913
	(5) Growth 1960-1980	(6) Growth 1980-2000	(7) Growth 1900-2000	(8) Growth 1900-2000
Total Mineralx100/Income	0.00707	-0.0137***		
Lagged20	(0.00424)	(0.00267)		
PC Income Lagged20	-1.125***	-0.266		
	(0.241)	(0.431)		
South	0.462***	0.144	0.0748	0.0529
	(0.0981)	(0.101)	(0.0516)	(0.0566)
State Mean Total			-0.00607***	
Mineral/Income			(0.00194)	
Total Mineral/Income				-0.00741***
Lagged100				(0.00205)
PC Income Lagged100			-0.770***	-0.751***
			(0.0620)	(0.0531)
Observations	48	48	48	48
R-squared	0.755	0.376	0.932	0.935

Notes: Growth is growth in real per capita state personal income. Total minerals are gross value of resources x 100 divided by income. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Table 4: Resources and Growth in Per Capita Income, Time Series

	(1) Growth 1930-2000 L10	(2) Growth 1929-1999 L1	(3) Growth 1963-2012 BEA L1	(4) Growth 1963-2012 BEA L1	(5) Growth 1963-1999 L1	(6) Growth 1963-1999 BEA L1
Other Mineralx100 /Income	0.00733	0.0447	-0.00478	-0.0666	-0.0120	-0.0125
	(0.0287)	(0.0277)	(0.0503)	(0.0529)	(0.0189)	(0.0698)
Other x 19291940	0.0293	0.0415*				
	(0.0214)	(0.0241)				
Other x 1940-1960	0.0322	0.0267				
	(0.0226)	(0.0242)				
Other x 1960-1980	0.0433**	0.0442***	0.0966***	0.114***	0.0499***	0.0953***
	(0.0165)	(0.0161)	(0.0269)	(0.0252)	(0.0155)	(0.0260)
Other x 2000-2012			0.105**	0.110*		
			(0.0430)	(0.0588)		
OilGasx100/Income	-0.0385**	-0.0374*	-0.115***	-0.154***	-0.0528**	-0.0879*
	(0.0167)	(0.0192)	(0.0359)	(0.0423)	(0.0213)	(0.0473)
OilGas x 1929 1940	0.0179	0.0274				
	(0.0138)	(0.0195)				
OilGas x 1940-1960	0.0378	0.0585***				
	(0.0276)	(0.0196)				
OilGas x 1960-1980	0.0258***	0.0266***	0.0483***	0.0609***	0.0222**	0.0526***
	(0.00867)	(0.00984)	(0.0137)	(0.0138)	(0.00899)	(0.0149)
OilGas x 2000-2012			0.00725	0.0175		
			(0.0553)	(0.0645)		
Agriculturex100/Income				-0.796***		
				(0.157)		
Agriculture x 1960-1980				0.401***		
				(0.0863)		
Agriculture x 2000-2012				-0.154*		
				(0.0877)		
Observations	336	3,360	2,128	2,128	1,728	1,728
R-squared	0.729	0.669	0.584	0.623	0.561	0.560

Notes: Growth is growth in real per capita state personal income. L10 and L1 refer to the intervals at which growth in per capita income is measured. For L10, measurement is between decades, e.g. from 1940 to 1950. The time spans encompass the full range of dates including the lag. For example, the growth regressions in column 1 include growth from 1880-1890 and for every decadal interval up to 1990-2000. BEA is value added by resources x 100 divided by GDP. All other columes are gross value of resources x 100 divided by income. All regressions have state and year x south fixed effects. Standard errors are clustered at the state level and are in parentheses. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Table 5: Resources Endowments and Growth in Per Capita Income, Time Series

	(1) Growth 1980-2000 L10	(2) Growth 1930-2000 L10	(3) Growth 1980-2000 L1	(4) Growth 1929-1999 L1	(5) Growth 1980-2000 BEA L1	(6) Growth 1963-2012 BEA L1
Other_High	-0.265**		-0.219***			
	(0.106)		(0.0803)			
OilGas_High	-0.392***		-0.464***			
	(0.106)		(0.0663)			
Other_High x		0.291		0.651**		
1929-1940		(0.273)		(0.304)		
Other_High x		0.648**		0.459		
1940-1960		(0.257)		(0.274)		
Other_High x		0.421***		0.378**		0.249
1960-1980		(0.146)		(0.149)		(0.174)
OilGas_High x 1929-		0.672**		0.0996		
1940		(0.286)		(0.320)		
OilGas_High x 1940-		0.913***		1.055***		
1960		(0.279)		(0.301)		
OilGas_High x 1960-		0.526***		0.587***		0.605***
1980		(0.175)		(0.159)		(0.206)
BEA Other_High					-0.180*	
					(0.106)	
BEA OilGas_High					-0.367***	
					(0.107)	
BEA Ag_High					-0.118	
					(0.0984)	
Other x 2000-						0.222
2012						(0.246)
OilGas_High x						0.985***
2000-2012						(0.265)
Ag x 1960-1980						0.475***
						(0.147)
Ag x 2000-2012						0.504**
						(0.240)
Observations	96	336	960	3,360	960	2,128
R-squared	0.193	0.726	0.513	0.668	0.510	0.581

Notes: Growth is growth in real per capita state personal income. L10 and L1 refer to the intervals at which growth in per capita income is measured. For L10, measurement is between decades, e.g. from 1940 to 1950. The time spans encompass the full range of dates including the lag. For example, the growth regressions in column 1 include growth from 1880-1890 and for every decadal interval up to 1990-2000. Other_High is a dummy variable that is 1 if the long run state average is great than 3 and 0 otherwise. OilGas_High is a dummy variable that is 1 if the long run state average is great than 2 and 0 otherwise. BEA Other_High is a dummy variable that is 1 if the long run state average is great than 1 and 0 otherwise. BEA OilGas_High is a dummy variable that is 1 if the long run state average is great than 1 and 0 otherwise. BEA Ag_High is a dummy variable that is 3 if the long run state average is great than 2 and 0 otherwise. BEA is value added by resources x 100 divided by GDP. All other columes are gross value of resources x 100 divided by income. Columns 1, 3, and 5 have year x south fixed effects. Columns 2, 4, and 6 have state and year x south fixed effects. Standard errors are clustered at the state level and are in parentheses. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Table 6: Resources and Growth: Institutions, Volatility, and Population Growth

	(1)	(2)	(3)	(4)	(5)	(6)
	Growth L1	Growth L1	Growth L1	Growth L1	Growth L1	Growth L1
	1930-1999	1930-1999	1930-1999	1930-1999	1930-1999	1930-1999
Other Mineral x 100	0.0856***	0.0928***	0.0858***	0.0923***	0.0920***	0.0946***
/Income	(0.0312)	(0.0286)	(0.0312)	(0.0289)	(0.0297)	(0.0297)
OilGas x 100/Income	-0.0418**	-0.0183	-0.0589***	-0.0320**	-0.0321**	-0.0221
	(0.0161)	(0.0124)	(0.0134)	(0.0131)	(0.0146)	(0.0163)
Population Growth		-0.305***		-0.304***	-0.304***	-0.303***
		(0.0769)		(0.0772)	(0.0773)	(0.0770)
Volatility Other Min		-0.0203		-0.0208	-0.0201	-0.0202
		(0.0986)		(0.0984)	(0.0985)	(0.0988)
Volatility OilGas		-0.157***		-0.143***	-0.144***	-0.136***
		(0.0376)		(0.0393)	(0.0397)	(0.0400)
Other Mineral x			0.120	0.0929	0.0905	
South			(0.0891)	(0.0903)	(0.0895)	
OilGas x			0.0502***	0.0346**	0.0356**	
South			(0.0147)	(0.0151)	(0.0137)	
Other Mineral x					0.00509	
Post-1970					(0.0171)	
OilGas x					-0.00111	
Post-1970					(0.0109)	
Other Mineral x						0.135
South pre-1970						(0.110)
Other Mineral x						0.0128
Non-South post-1970						(0.0169)
Other Mineral x						0.287*
South post-1970						(0.151)
OilGas x						-0.00176
South pre-1970						(0.0200)
OilGas x						-0.0180
Non-South post-1970						(0.0147)
OilGas x						0.0243
South post-1970						(0.0192)
Observations	3,168	3,168	3,168	3,168	3,168	3,168
R-squared	0.612	0.617	0.612	0.617	0.617	0.617

Notes: Growth is growth in real per capita state personal income. L1 refers to the intervals at which growth in per capita income is measured. For L1, measurement is between years, e.g. from 1940 to 1941. The time spans encompass the full range of dates including the lag. All columes are gross value of resources x 100 divided by income. Population growth is growth from t-1 to t and is interpolated between census years. Volatility is the standard deviation of resource shares from t-5 to t-1. In columns 3-5, South and Post-1970 are dummy variables where 0 = non-South or pre-1970 (omitted) and 1 = South or post-1970 (including 1970) and In column 6, there are four dummy variables, where 0 = non-South, pre-1970 (omitted), 1 = South, pre-1970, 2 = non-South, post-1970, and 3 = South, post 1970. All regressions have state and year x south fixed effects. Standard errors are clustered at the state level and are in parentheses. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Table 7: Resources and Growth: Asymmetries and Periods of Low Growth

	(1)	(2)	(3)	(4)	(5)	(6)
	Growth	Growth	Growth	Growth	Growth	Growth
	1930-1999	1930-1999	1930-1999	1930-1999	1930-1999	1930-1999
Other Mineral x 100	0.0856***	0.0835**	0.0829**	0.0909***	0.0926***	0.0957***
/Income	(0.0317)	(0.0345)	(0.0362)	(0.0306)	(0.0313)	(0.0315)
OilGas x 100/Income	-0.0166	-0.0760***	-0.0528***	-0.0369***	-0.0461***	-0.0339**
	(0.0174)	(0.0141)	(0.0109)	(0.00898)	(0.0159)	(0.0148)
Other Mineral x	0.0120		0.0108	0.0134	0.0150	0.0162
Decline	(0.0273)		(0.0290)	(0.0302)	(0.0300)	(0.0299)
Oilgas x	-0.0673***		-0.0414***	-0.0375***	-0.0359***	-0.0369***
Decline	(0.0134)		(0.0106)	(0.0112)	(0.0108)	(0.0104)
Other Mineral x		0.00625	0.00567	0.00976	0.00941	0.00891
Low Growth		(0.0274)	(0.0295)	(0.0273)	(0.0268)	(0.0268)
Oilgas x		0.0888***	0.0686***	0.0812***	0.0854***	0.0856***
Low Growth		(0.0211)	(0.0213)	(0.0180)	(0.0194)	(0.0197)
Population Growth				-0.331***	-0.329***	-0.327***
				(0.0765)	(0.0766)	(0.0761)
Volatility Other Min				-0.0432	-0.0462	-0.0464
				(0.0903)	(0.0900)	(0.0901)
Volatility OilGas				-0.149***	-0.116**	-0.105*
				(0.0446)	(0.0525)	(0.0553)
Other Mineral x					0.0908	
South					(0.0893)	
OilGas x					0.0456***	
South					(0.0140)	
Other Mineral x					0.00728	
Post-1970					(0.0157)	
OilGas x					-0.0173	
Post-1970					(0.0127)	
Other Mineral x						0.143
South pre-1970						(0.116)
Other Mineral x						0.0165
Non-South post-1970						(0.0156)
Other Mineral x						0.329**
South post-1970						(0.143)
OilGas x						0.00125
South pre-1970						(0.0215)
OilGas x						-0.0375*
Non-South post-1970						(0.0188)
OilGas x						0.0160
South post-1970						(0.0188)
Observations	3,168	3,168	3,168	3,168	3,168	3,168
R-squared	0.614	0.615	0.616	0.621	0.622	0.622

Notes: Growth is growth in real per capita state personal income. L1 refers to the interval at which growth in per capita income is measured. For L1, measurement is between years, e.g. from 1940 to 1941. The time spans encompass the full range of dates including the lag. All columes are gross value of resources x 100 divided by income. Decline is a dummy variable indicating a decline in resources as a percentage of Income from t-2 to t-1. 0 = no decline, 1 = decline. Low growth is a dummy variable indicating that average annual growth in Income per capita across all states from t-1 to t is below 1 percent. 0 = normal growth, 1 = low growth. Population growth is growth from t-1 to t and is interpolated between census years. Volatility is the standard deviation of resource shares from t-5 to t-1. In columns 3-5, South and Post-1970 are dummy variables where 0 = non-South or pre-1970 (omitted) and 1 = South or post-1970 (including 1970) and In column 6, there are four dummy variables, where 0 = non-South, pre-1970 (omitted), 1 = South, pre-1970, 2 = non-South, post-1970, and 3 = South, post 1970. All regressions have state and year x south fixed effects. Standard errors are clustered at the state level and are in parentheses. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Table 8: Cross Sectional Results for Comparison to Goldberg et al and Alexeev and Conrad

	(1) Ln(PCI)	(2) Ln(PCI)	(3) Ln(PCI)	(4) Ln(PCI)	(5) Ln(PCI)
Ln(Total Min x 100/Income)	-0.0342**				-0.0829***
	(0.0151)				(0.0243)
Ln(PC Income) in 1930	0.329***				
	(0.0433)				
South	0.103***	-0.101**	-0.0987**	-0.0972**	-0.107***
	(0.0358)	(0.0415)	(0.0374)	(0.0393)	(0.0394)
Ln(Oil x 100/Income)		-0.0746***			
		(0.0268)			
Ln(Oil per capita)			-0.0143***		
			(0.00404)		
Ln(Total Min per capita)				-0.0528***	
				(0.0134)	
Observations	48	48	48	48	48
R-squared	0.710	0.254	0.293	0.393	0.411

Notes: PCI is real per capita state personal income. All natural logs are Ln(variable +1). Unless noted, all variables are measured in 2000. All columes are gross value of resources x 100 divided by income. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Table 9: Time Series Results for Comparison to Boyce and Emery and Michaels

	(1) Ln(PCI) 1970-1999	(2) Ln(PCI) 1970-1999	(3) Ln(PCI) 1929-1999	(4) Ln(PCI) 1929-1999
OilGas x 100/Income	0.00454***		-0.00141	
	(0.000803)		(0.00182)	
Total min x 100/Income		0.00268***		0.000878
		(0.000544)		(0.00155)
Observations	1,440	1,440	3,646	3,646
R-squared	0.963	0.962	0.974	0.974

	(5) Ln(PCI) 1960-1990	(6) Ln(PCI) 1960	(7) Ln(PCI) 1960-1990	(8) Ln(PCI) 1960
OilGas_High x 1970	-0.0296*		-0.0256	
	(0.0155)		(0.0460)	
OilGas_High x 1980	0.0321		0.0327	
	(0.0234)		(0.0611)	
OilGas_High x 1990	-0.0643**		-0.0578	
	(0.0254)		(0.0791)	
OilGas_High		-0.0613		-0.0224
		(0.0470)		(0.112)
South		-0.304***		
		(0.0486)		
Observations	192	48	48	12
R-squared	0.987	0.461	0.984	0.003

Notes: PCI is real per capita state personal income. All natural logs are Ln(variable +1). All columes are gross value of resources x 100 divided by income. OilGas_High is a dummy variable that is 1 if the long run state average is great than 2 and 0 otherwise. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

Table 1A: Summary Statistics

	N	Mean	SD	Min	Max
Annual PCI Growth, 1 year	3,760	2.107	6.396	-37.38	50.70
Annual PCI Growth, 10 years	3,566	2.441	2.081	-7.226	15.61
Average Oil & Gas/Income > 2%	4,325	0.271	0.444	0	1
Average Other Mineral/Income > 3%	4,325	0.354	0.478	0	1
BEA Average Agriculture/GDP > 3%	2,400	0.313	0.464	0	1
BEA Average Oil & Gas/GDP > 2%	2,400	0.271	0.444	0	1
BEA Average Other Mineral/GDP > 1%	2,400	0.292	0.455	0	1
BEA Agriculture/GDP	2,400	3.106	3.604	0.137	37.19
BEA Oil and Gas/GDP	2,400	1.838	4.744	0	37.13
BEA Other Mineral/GDP	2,400	1.236	2.461	0	20.39
BEA Primary/GDP	2,400	6.181	7.152	0.186	50.85
BEA Total Mineral/GDP	2,400	3.075	6.127	0	48.71
Oil and Gas/Income	3,694	2.897	7.778	0	84.97
Other Mineral/Income	3,694	4.238	6.999	0	61.74
Total Mineral/Income	3,694	7.135	11.65	0	116.5

Notes: Variables divided by income and GDP have been multiplied by 100 and so are percentages.

Table 2A: Total Mineral/Income by State in 1880, 1920, 1960, and 2000

State	1880	1920	1960	2000
Alabama	0.64	8.15	4.40	3.09
Arizona	12.73	37.77	15.31	1.94
Arkansas	0.05	1.46	6.38	2.62
California	5.58	4.79	3.18	1.12
Colorado	27.05	7.49	8.38	3.00
Connecticut	0.73	0.15	0.22	0.08
Delaware	0.61	0.15	0.08	0.05
Florida	0.00	2.12	1.79	0.42
Georgia	0.47	0.41	1.38	0.69
Idaho	19.55	4.59	4.56	1.12
Illinois	1.60	3.32	2.19	0.49
Indiana	0.95	3.10	2.05	0.78
Iowa	1.16	1.36	1.75	0.63
Kansas	2.18	8.68	10.41	4.30
Kentucky	0.75	10.19	8.43	3.95
Louisiana	0.00	5.22	36.29	20.89
Maine	1.33	0.39	0.76	0.28
Maryland	2.03	0.92	0.79	0.25
Massachusetts	0.39	0.12	0.22	0.08
Michigan	5.08	3.94	2.29	0.89
Minnesota	0.19	9.52	7.02	0.91
Mississippi	0.65	0.00	7.44	1.61
Missouri	1.60	1.68	1.71	0.88
Montana	26.62	14.51	12.79	7.42
Nebraska	0.02	0.04	3.39	0.35
Nevada	46.20	24.84	9.51	4.79
New Hampshire	0.66	0.54	0.41	0.14
New Jersey	1.35	0.36	0.35	0.09
New Mexico	3.33	10.98	36.26	22.08
New York	0.45	0.24	0.55	0.17
North Carolina	0.61	0.30	0.61	0.33
North Dakota	0.00	0.65	6.61	8.67
Ohio	2.02	3.30	1.75	0.75
Oklahoma		27.58	17.51	10.03
Oregon	3.15	0.32	1.39	0.31
Pennsylvania	8.70	12.63	3.23	0.98
Rhode Island	0.83	0.19	0.30	0.07
South Carolina	0.06	0.24	0.91	0.55
South Dakota	17.90	1.55	3.70	1.36
Tennessee	0.78	2.76	2.51	0.54
Texas	0.00	6.38	21.92	6.36
Utah	25.91	16.61	23.68	5.87
Vermont	4.12	4.19	3.08	0.39
Virginia	0.89	3.03	2.75	0.81
Washington	3.04	1.28	1.05	0.34
West Virginia	3.82	39.37	23.61	12.98
Wisconsin	0.27	0.66	0.88	0.24
Wyoming	15.49	23.91	57.55	56.04