When Are Resources Curses and Blessings?
Evidence From the United States 1880-2012

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Following Sachs and Warner (1995, 1997), the relationship between natural resources and growth has attracted extensive attention from economists and policymakers. One challenge in terms of understanding the relationship between natural resources and economic growth is that the literature is large and reaches different conclusions about the existence of a curse and, for papers that find a curse, the conditions under which a curse may exist. This paper uses new state-level panel datasets spanning 1880-2012 to investigate the relationship between natural resources and growth in the context of the American states. The paper has four main findings. First, the relationship between growth and natural resources varies across types of natural resources – agriculture, fossil fuels, and other minerals – and over time. In some periods the relationship is negative and in other periods it is positive or not statistically significantly different from zero. Second, the effect of resources on growth differs depending on whether the change is an increase or a decrease in the resource and whether the economy is in a period of low growth or not. Third, for the period 1980-2000, a period that is widely studied, whether one finds evidence of a resource curse is highly sensitive to specification. Time series results differ depending on time intervals (decadal or annual), the type of natural resource, whether changes in resources are measured in total value or value added, and whether effects are allowed to differ in the South and non-South. Fourth, we can replicate many of the findings from previous studies of the resource curse in the United States. The divergent findings are largely due to the use of different dependent variables, measures of resources, estimation techniques, and time frames.

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1. Introduction

Economic growth is of central concern to economists. Following Sachs and Warner (1995, 1997), the relationship between natural resources and growth has attracted extensive attention from economists and policymakers. A primary reason is that a substantial number of countries and smaller geographic units are heavily dependent on production of natural resources. Thus, the prospect of resources slowing growth is a concern. One challenge is that the literature is large and reaches different conclusions about the existence of a curse and, for papers that find a curse, the conditions under which a curse may exist.[12] This is true both of the literature on country-level resource curses and the literature on the state-level resource curse in the United States.

This paper uses new state-level panel datasets spanning 1880-2012 to investigate the relationship between natural resources and growth in the context of the American states. Examining the American states is valuable, because they have diverse natural resource endowments, yet share a common federal government, currency, and tariffs. Further the United States has detailed state-level data spanning long periods of time, which makes it possible to examine how the relationship between natural resources and growth has changed over time. Finally, the South was much less economically and politically developed than the rest of the United States through the mid-twentieth century, so it is instructive to compare the effects of resources on the South and the non-South over time.

[1] 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, Black et al (2005), Papyrakis and Gerlagh (2007), Goldberg et al (2008), James and Aadland (2011) and Jacobsen and Parker (2014) find evidence of a resource curse, but Boyce and Emery (2011), Michaels (2011), Weber (2012, 2014) and Feyrer et al (2015) do not. A related paper by Allcott and Keniston (2013) does not find evidence of Dutch disease.

[2] Strikingly, the curse literature runs counter to themes regarding the benefits of natural resources for growth over longer time periods (see Habakkuk (1962), Wright (1990), Keay (2007), Allen (2009), and Pomeranz (2001)).

The time series analysis examines the effects of lagged changes in mineral shares of income on changes in growth in per capita income. 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). 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. Detailed state data on industry value added components of GDP from the BEA for 1963-2012 is used for oil and gas, other minerals, and agriculture.[3]

The paper has four main findings. First, the relationship between growth and natural resources varies across types of natural resources – agriculture, fossil fuels, and other minerals – and over time. In some periods the relationship between natural resources and growth or between agriculture, fossil fuels, and other minerals and growth is negative. In other periods it is positive or not statistically significantly different from zero. Second, the effect of resources on growth differs depending on whether the change is an increase or a decrease in the resource. Third, for the period 1980-2000, a period that is widely studied, whether one finds evidence of a resource curse is highly sensitive to specification. For example, time series results differ depending on time intervals (decadal or annual), the type of natural resource, whether changes in resources are measured as total value or value added, and whether effects are allowed to differ in the South and non-South. During much of the period that we examine, state political institutions were weaker and the economy was much more agricultural in the South than the non-South (Besley et al 2010, Berkowitz and Clay 2011). Fourth, we can 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.

[3] Technically the sector is agriculture, fisheries, and forestry. For convenience, it is simply referred to as agriculture.

This paper contributes to both the U.S. literature on resource curse and to the broader literature. Compared to previous work on the American states, this paper covers a much longer time period, examines effects across multiple subcategories of natural resources, and examines the effects on in the South and non-South. This paper is complementary to recent research at U.S. county-level that examines the effect of recent booms in natural gas due to the adoption of fracking technology. The broader literature has many distinct strands and typically focuses on countries, which differ from one another in important ways beyond natural resources. The main contribution of this paper is to highlight the importance of allowing effects to vary over time, across resources, and possibly across groups of countries. This paper also illustrates the value of trying to replicate results across studies to understand sources of differences.

2. Literature Review

This section briefly discusses measures of resources used by different authors, the literature on the relationship between natural resources and growth in the American States, and the literature on mechanisms through which resources affect growth.

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 natural 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, Black et al (2005) use coal; Goldberg et al (2008) use oil and coal; Michaels (2011) uses oil and natural gas; Boyce and Emery (2011) use employment in mining (which includes oil, coal and other minerals); Allcott and Keniston (2013) use oil and natural gas and coal; Weber (2012, 2014) uses natural gas; Jacobsen and Parker (2014) uses oil and natural gas; Feyrer et al (2015) uses natural gas.

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.

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 selected 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, including institutions and labor market shocks. 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 and Hauk 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. 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.

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.[4]

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.[5] 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. Data

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

[4] Cadena and Kovak (2013) show that during the Great Recession Mexican immigrants helped equilibrate local labor markets. Immigrants may have been helping to equilibrate local labor markets during these earlier periods.

[5] Using county level data, Jacobsen and Parker (2014) show that the boom and bust in oil and gas had asymmetric effects. 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.

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, we use detailed state by industry value added components of GDP data from the BEA. 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.[6] 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.[7]

The effects of these 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. Data on gross value of

[6] Technically the sector is agriculture, fisheries, and forestry. For convenience, it is simply referred to as agriculture.
[7] 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.

total minerals are also 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. The gross value of primary products is also 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. Total mineral values 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.[8]

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 products have begun to increase as a share of income.

Appendix Table 1A presents summary statistics.[9] Appendix Table 2A shows total mineral value as a share of state income at 40-year intervals by state. There is considerable variation both

[8] 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.

[9] 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.

across states and within states over time in total value of mineral production as a share of income. Figure 1A maps income and minerals over time.

4. Identification

Identification of the effects of the value of mineral production on growth in state per capita income comes from variation within state over time in the value of mineral production as a share of state income. Specifically, consider the following growth equation:

$$PCgrowth_{s,t} = a_0 + a_1 \left(\frac{TotalMineral}{Income}\right)_{s,t-2} + \rho_s + \theta_t + \phi_t * South_s + \epsilon_{s,t} \quad (1)$$

where $PCgrowth_{s,t}$ is growth in per capita income in state s between t-1 and t, where t is either a year or a decade. $\left(\frac{TotalMineral}{Income}\right)_{s,t-2}$ is the value of total mineral production as a share of state personal income at time t-2, ρ_s and θ_t are state and year fixed effects respectively. Year fixed effects capture shocks that affect all states in the same way. The interactions of year fixed effects with the South states dummy ($\phi_t * South_s$) allow the year fixed effects to differ for the South (former Confederate states) and non-South, and are included to capture convergence between the South and non-South over time for reasons unrelated to resources.

The minerals share in equation (1) is measured at t-2 instead of t-1 to avoid the automatic correlation between the explanatory mineral share variable, which contains state income in the denominator, and the dependent variable (growth rate between t and t-1). Furthermore, since our equation has lagged dependent variable we cannot estimate it by usual fixed effects approach (see e.g. Forbes (2000) for details). Instead we estimate growth regression (1) in first differences, which effectively removes the states fixed effects:

$$\Delta PCgrowth_{s,t} = a_0 + a_1 \Delta \left(\frac{TotalMineral}{Income}\right)_{s,t-2} + \theta_t + \phi_t * South_s + \Delta\epsilon_{s,t}, \quad (2)$$

where $\Delta PCgrowth_{s,t}$=$PCgrowth_{s,t} - PCgrowth_{s,t-1}$ is the annual difference in growth rates and $\Delta\left(\frac{TotalMineral}{Income}\right)_{s,t-2} = \left(\frac{TotalMineral}{Income}\right)_{s,t-2} - \left(\frac{TotalMineral}{Income}\right)_{s,t-3}$ is the difference in the minerals shares.

In some specifications we use decadal data, where we look at per capita income growth between t and t-10. In this case we estimate the following version of equation (2):

$$\Delta_{10} PCgrowth_{s,t} = a_0 + a_1 \Delta_{10}\left(\frac{TotalMineral}{Income}\right)_{s,t-20} + \theta_t + \phi_t * South_s + \Delta\epsilon_{s,t} \quad (3)$$

where $\Delta_{10} PCgrowth_{s,t} = PCgrowth_{s,t} - PCgrowth_{s,t-10}$ is the decadal difference in growth rates. Similarly, $\left(\frac{TotalMineral}{Income}\right)_{s,t-20} = \left(\frac{TotalMineral}{Income}\right)_{s,t-20} - \left(\frac{TotalMineral}{Income}\right)_{s,t-30}$ is difference in minerals between t-20 and t-30. $\left(\frac{TotalMineral}{Income}\right)_{s,t-20}$ is the minerals share measured at t-20 instead of t-10 to again avoid the automatic correlation between the explanatory mineral share variable and the dependent variable.

In some specifications we allow for the effect of a_1, the coefficient on resources share, to vary by time period. Standard errors are clustered by state.

One concern 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.[10]

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

[10] Clay (2011) presents additional evidence on state investments.

States."[11] The federal government controls most of this one-third.[12] States do tax mineral production. The literature on taxes suggests that production is fairly insensitive to taxes.[13] 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 appear to have been 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).

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, we estimate the equation in first differences and include 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.

5. Results

Our analysis begins by examining the effects of total minerals on growth. It then decomposes the effects into oil and gas, other minerals, and agriculture. Given the very different trajectory of

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[11] Wittmeyer (2013).
[12] Gorte et al (2012).
[13] See Chakravorty, Gerking and Leach (2011), Kunce, Gerking, Morgan, Maddux (2003), and Deacon (1993).

growth in the American South, we investigate whether the effects differ in the South and non-South. Drawing on the literature on booms and busts in resource extraction, we investigate whether there are asymmetric effects of increases and decreases in minerals. The section ends by comparing time series and cross sectional patterns in the data.

Total Minerals

Table 2 examines the time series effects of total minerals on growth in per capita income. In our analysis we use three different specifications for regression model (2): decadal data for 1880-2000, annual data for 1929-1999, and annual growth rate from value added data for 1963-2012.[14]

In columns 1, 3 and 5 the coefficient on resources is assumed to be constant over time. We find that in all three specifications the coefficient is negative, although in column 1 it is effectively zero. The effects using annual data are statistically significant, suggesting that resource abundance is a curse. The effects in columns 3 and 5 are of considerable magnitude: a one standard deviation increase in total minerals share in state income is associated with decline in the income per capita growth by about 0.5-1 percentage point.

We further explore the possibility that the effect of minerals on state product growth might differ over time. Columns 2, 4 and 6-8 estimate a version of growth regression (2) allowing for the coefficient on mineral share to differ across 20-year time periods. We use decadal growth rates (columns 2), annual growth rates (column 4), as well as value added annual growth rates (columns 6). In columns 7 and 8 we further restrict our sample to include only state-years observations for which we have both value added measure and total value of minerals.

We again find that regardless of the data used all coefficients on the annual data are negative.[15] In Figure 3 we plot the implied effect on growth rates of a one standard deviation increase in mineral share variable and include 95 percent confidence intervals. Figure 3 and

[14] The 1900-2000 regression uses data on minerals for 1880-1890.

[15] The decadal analysis examines much longer time horizons, so the coefficients are not directly comparable to the annual data.

coefficients from Table 2 suggest that the negative effect of minerals on growth is probably getting smaller over time.

Oil and Gas, Other Minerals, and Agriculture

Columns 1 and 2 of Table 3 re-estimate the regressions in columns 4 and 6 of Table 2, decomposing all minerals into oil and gas and other minerals.[16] Evidence presented in columns 1 and 2 suggests that oil and gas have large negative and statistically significant effects. Moreover, these effects vary over time: there are larger negative effects in the earlier periods and smaller, but still negative, in the later periods. Interestingly, the negative effects of oil and gas on growth is larger in magnitudes than the effects of other minerals. Using the coefficients from column 1, Figure 4 plots the effects of a one standard deviation increase in oil and gas share and other minerals share on state incomes growth over time together with the 95 percent confidence intervals. The effects of other minerals on growth appear to be almost constant over time, while the adverse effects of oil and gas get smaller over time.

Our value added data also contain information on value added in agricultural sector by states over 1960-2012. In column 3 we estimate the impact of resources share on growth while including the share of agriculture in state product.

Two things are notable. First, adding agriculture has very little effect on the coefficients on oil and gas and on other minerals. Second, the coefficients on agriculture are positive for the years 1960-2000; the effect of agriculture on growth becomes negative in 2000-2012, but is not statistically significant.

Table 3 illustrates the extent to which different resources had different effects on growth in different time periods. In particular, oil and natural gas have a negative effect on state growth, which becomes smaller over time. The effect of other mineral is negative but small and constant over time, while the effect of agriculture seems to be positive, especially in earlier periods.

South vs. Non South

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

Table 4 presents the differential results of the effects of minerals on growth in Southern vs Non Southern states over time.

Columns 1 and 2 in Table 4 show the impact (over different time periods) of total mineral share on growth for southern states and non-southern states respectively. As before, estimated coefficients are negative but there is no statistically significant difference between the South and non-South except for the last time period: 1980-2000.[17] Total mineral share of income in the South has a negative effect on growth, whereas the effect in the non-South is almost zero.

Columns 3 and 4 present the results separately for oil and gas and other minerals. As before we find negative statistically significant coefficients for oil and gas share, while coefficients are negative but less precisely estimated for the other minerals share. The effects of other minerals in the South are statistically significantly *more* negative in the South than in the non-South for 1929-1940 and 1940-1960. The effects of oil and gas are the reverse. That is, the effects of oil and gas in the South are statistically significantly *less* negative in the South than in the non-South for 1929-1940 and 1940-1960.

In columns 5 and 6 we add the share of agriculture and estimate the effects using value added measure of resources. We find that the coefficients on agriculture share are positive both in South and non-South in the 1960-2000, but the magnitudes are larger in the non-South and the effects are more precisely estimated. The effect of agriculture on growth becomes negative in 2000-2012. The negative effect is particularly large in the South.

Figure 5 plots the estimated effects on income growth for a one standard deviation increase in minerals and 95% confidence intervals based on coefficients presented in Table 5. Figure 2A shows additional plots of the coefficients for the South and non-South. Table 4 shows that while oil and natural gas have a negative effect both on southern and non-southern states, the effects are larger in magnitude (and more precisely estimated) for non-southern states, suggesting

[17] For ease of presentation, the regressions are reported for the South and non-South separately. Regressions using a full set of interaction effects are reported in Appendix Table 3A.

that non-southern states are particularly adversely affected. This adverse effect for non-southern states seems to decline over time (in absolute value).

Exploration of Mechanisms

Table 5 investigates mechanisms through which resources might affect growth. The analysis focuses on annual data from 1929-1999 and explores two possibilities.[18]

One possibility 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 should have symmetric effects. Second possibility is that effects of changes in resources may change depending on whether the country is experiencing low vs high growth. 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.

To test for asymmetric effects of decline vs increase in the share of natural resources, we define Decline dummy for each resource indicating whether a given resource declined as a share of state income from t-2 to t-1. To test for differential effect of minerals in recessions and booms, we construct an indicator variable for low growth in the country, which is equal to 1 if average growth across all states was less than 1 percent, and 0 otherwise. Roughly 25 percent of the observations fall into low growth years.

Table 5 shows that the effects of resources are asymmetric and are influenced by overall growth. Column 1 allows the effect of increases and decreases in natural resources shares to differ. For oil and gas, the coefficient on the interaction between oil share and decline dummy is negative and statistically significantly different from zero. Estimated coefficients suggest that a one-percent increase in oil and gas/income has a -0.196 effect on growth while a one-percent decrease has a positive 0.415 (= -1*(-0.196 - -0.219)) effect on growth rate.

[18] 10-year intervals offer insufficient observations to identify large numbers of variables.

Column 2 allows the effect of resources to differ during periods of low growth. Both for oil and gas and other minerals shares, the coefficients for low growth interaction are positive but not statistically significantly different from zero.

Column 3 includes both asymmetry and low growth effects. The results are qualitatively similar to the results in columns 1 and 2. Column 4 restricts the sample to 1963-1999 to make it comparable to BEA sample, which is used in Column 5. Consistent with Table 3, in the later period, the main effect of oil and gas is negative but not statistically significant. The effect of a decline in oil and gas in column 4 remains negative and statistically significant. The coefficient on decline is only about half as large as it was in columns 1 and 3.

Thus, Table 5 showed that increases and decreases in resource production can have asymmetric effects on growth.

Cross Sectional Results

For comparison with Table 2 and with the broader literature, Table 6 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 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. 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.

6. Relationship to the Literature

Our cross sectional growth results in Table 6 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.[19] Both sets of authors use logs of resources.

Table 7 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 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.[20] Table 7 suggests that focusing on income does not resolve the puzzle of the (cross-sectional) resource curse in the U.S. context.

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

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

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. [21]

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.

For comparison with Boyce and Emery (2011), Columns 1-4 of Table 8 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.[22] Columns 3 and 4 estimate the same equations over the period 1929-1999. The coefficients are of mixed signs and not statistically

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[21] 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.

[22] Boyce and Emery regress mining employment share in year t on annual real per capita GSP in year t. In Table 8, 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.

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.[23] 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 8, 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 β_τ 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 effect of oil abundance over time."[24] 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.[25] 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.

[23] 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.
[24] Michaels (2011), p. 36
[25] The result is similar if the dummy variable for the South is omitted.

7. Conclusion

This paper uses new state-level panel datasets spanning 1880-2012 to investigate the relationship between natural resources and growth in the context of the American states. The paper finds the relationship between growth and natural resources varies across types of natural resources – agriculture, fossil fuels, and other minerals – and over time. The effect of resources on growth also differs depending on whether the change is an increase or a decrease in the resource and whether the economy is in a period of low growth or not. For the period 1980-2000, a period that is widely studied, whether one finds evidence of a resource curse is sensitive to specification. For example, time series results differ depending on time intervals (decadal or annual), the type of natural resource, whether changes in resources are measured as total value or value added, and whether effects are allowed to differ in the South and non-South. We show that divergent findings of previous studies of the resource curse in the United States are largely due to the use of different dependent variables, measures of resources, estimation techniques, and time frames. An important implication is that future research on the resource curse in the United States and international contexts should allow effects to vary over time, across resources, and across groups of countries.

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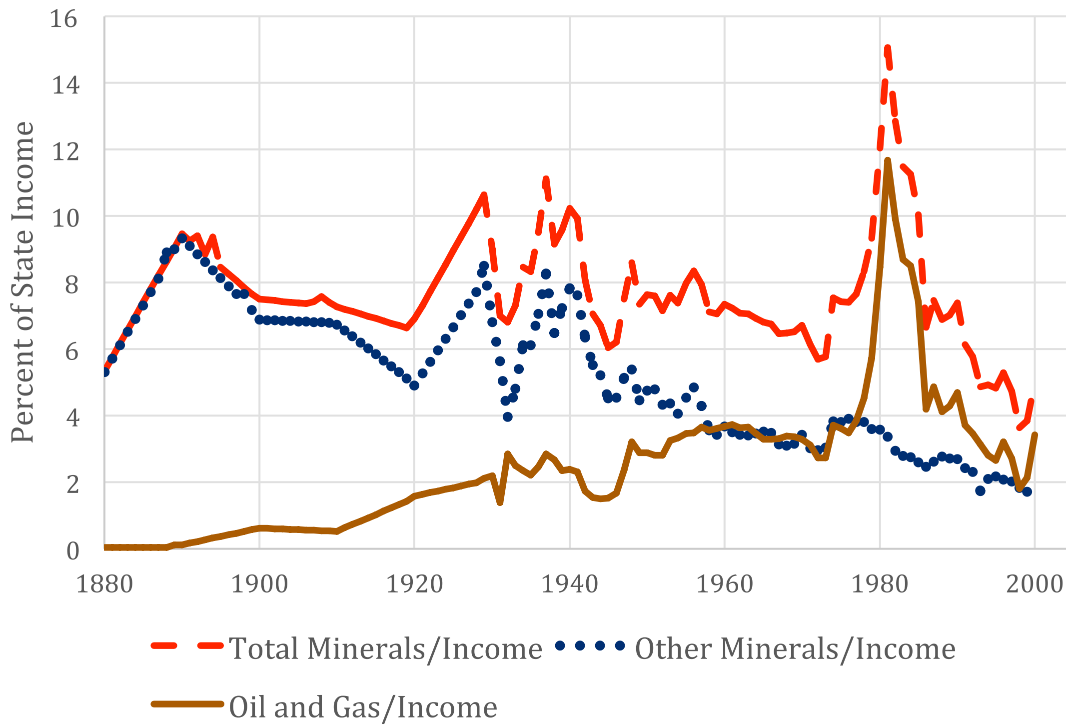
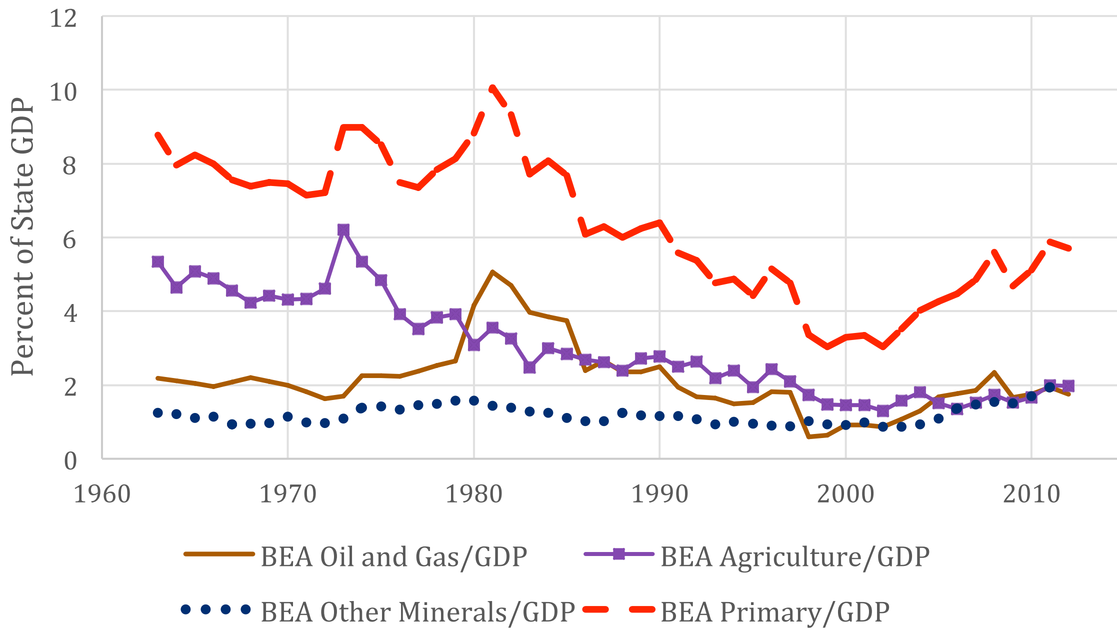
Figure 1: Gross Value of Total Minerals, Oil and Gas, and Other Minerals as a Share of State Income, 1880-2000



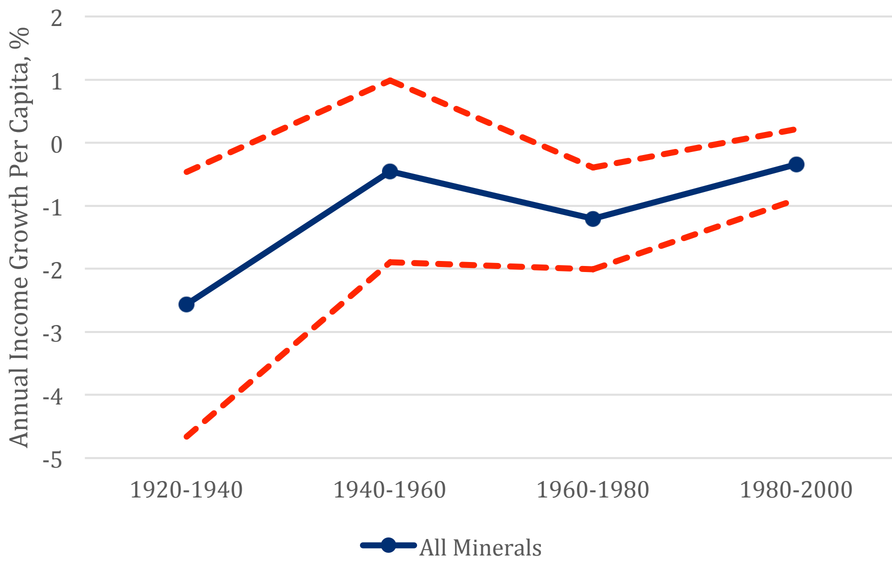
Notes: Income is state personal income. Percentages are unweighted averages across all states in a particular year. The variables are (resources x 100)/income. Other minerals include coal, non-metals (e.g. stone, sand, clay), and metals.

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



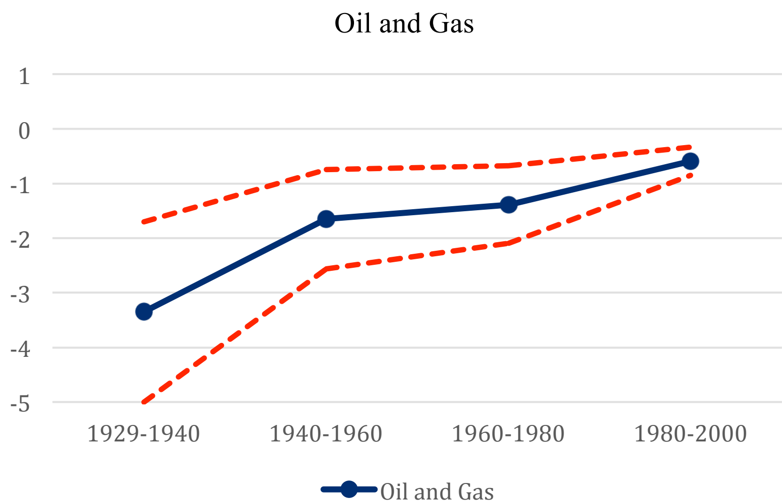
Notes: Percentages are unweighted averages across all states in a particular year. The variables are (resources x 100)/GDP. Agriculture includes forestry and fishing. Other minerals includes coal, non-metals (e.g. stone, sand, clay), and metals.

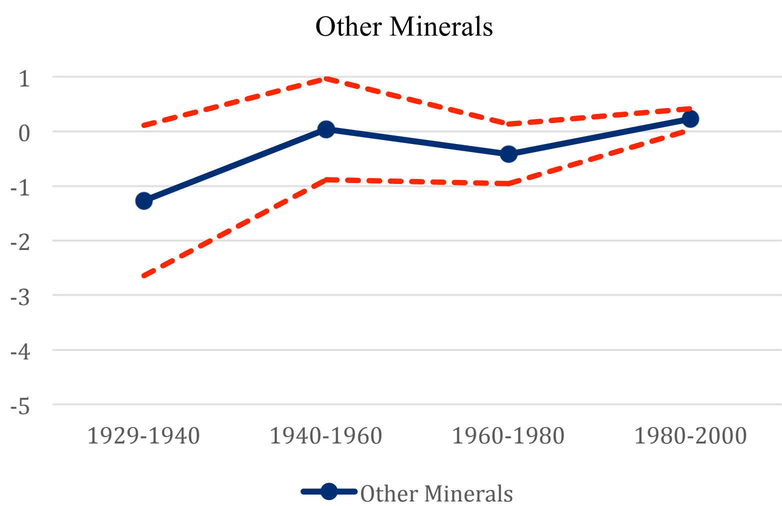
Figure 3: Effects of Minerals on Growth in Income per Capita with 95% Confidence Intervals, 1920-2000



Notes: Based on Column 4 of Table 2. Income is state personal income. Values of resources are gross values as percentages of income. The plot shows the effects for a one standard deviation increase in total minerals share and 95 confidence interval.

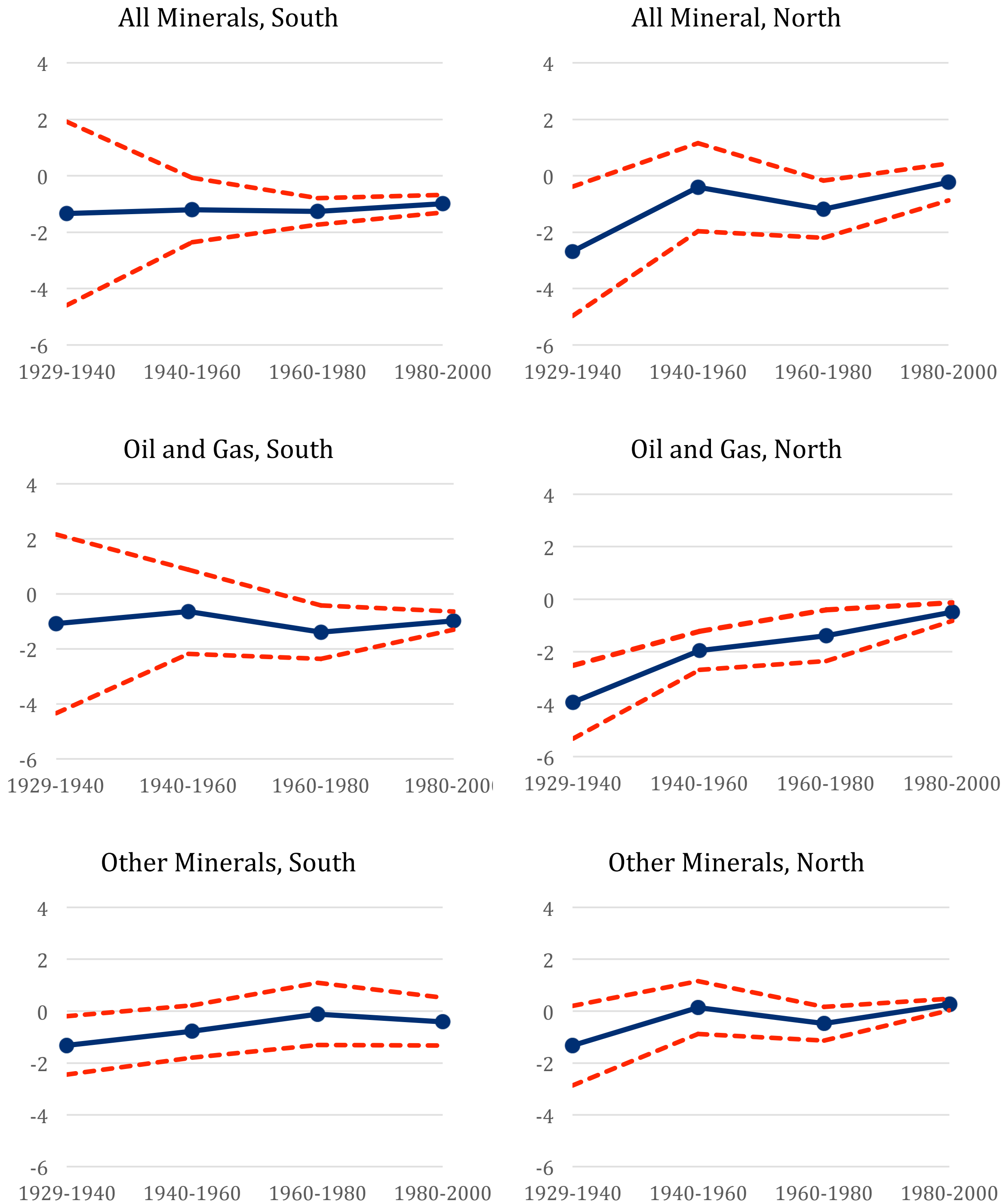
Figure 4: Effects of Oil and Gas and Other Minerals on Growth in Income per Capita with 95% Confidence Intervals, 1929-1999





Notes: Based on Column 1 of Table 3. 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 effects for a one standard deviation increase in total minerals share and 95 confidence interval.

Figure 5: Effects of Oil and Gas and Other Minerals on Growth in Income per Capita with 95% Confidence Intervals, 1929-1999, South vs Non South



Notes: Based on Table 4. Income is state personal income. Values of resources are gross values as percentages of income. The plot shows the effects for a one standard deviation increase in different minerals for South (former Confederate states) vs North (all other states) and 95% confidence interval.

Table 1: Literature Review of Economic Resource Curses

Paper	Identification	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

VARIABLES	(1) ΔGrowth 1900-2000, L10	(2) ΔGrowth 1900-2000, L10	(3) ΔGrowth 1929-1999, L1	(4) ΔGrowth 1929-1999, L1
ΔTotal Mineral x100/Income	-0.001		-0.180**	
	(0.0201)		(0.0753)	
ΔTotal Min X 1900-1920		-0.043*		
		(0.023)		
ΔTotal Min x 1920-1940		0.025		-0.467**
		(0.020)		(0.190)
ΔTotal Min x 1940-1960		-0.013		-0.083
		(0.026)		(0.131)
ΔTotal Min x 1960-1980		0.041**		-0.219***
		(0.018)		(0.073)
ΔTotal Min x 1980-2000		0.058***		-0.062
		(0.0167)		(0.050)
Observations	478	478	3,264	3,264
R-squared	0.637	0.649	0.416	0.418

VARIABLES	(5) ΔGrowth 1963-2012 BEA	(6) ΔGrowth 1963-2012 BEA	(7) ΔGrowth 1963-1999 BEA	(8) ΔGrowth 1963-1999
ΔTotal Mineral x100/Income	-0.225***			
	(0.0575)			
ΔTotal Min x 1960-1980		-0.260*	-0.260*	-0.167***
		(0.132)	(0.132)	(0.058)
ΔTotal Min x 1980-2000		-0.296***	-0.296***	-0.062
		(0.075)	(0.075)	(0.050)
ΔTotal Min x 2000-2012		-0.004		
		(0.190)		
Observations	2,032	2,032	1,632	1,632
R-squared	0.499	0.500	0.468	0.470

Notes: ΔGrowth is first difference of growth in real per capita state personal income. ΔTotal Min is the first difference in mineral share measured as gross value of resources x 100 divided by income. Mineral share variables in columns are lagged by one year to avoid endogeneity as described in the main text. 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. For L1, measurement is between consequetive years, e.g. from 1941 to 1942 etc. BEA is value added by resources x 100 divided by GDP. All regressions have 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: Resources and Growth in Per Capita Income, Time Series

	(1) ΔGrowth 1929-1999 L1	(2) ΔGrowth 1963-2012 BEA L1	(3) ΔGrowth 1963-2012 BEA L1
ΔOther Min x 1929-1940	-0.349*		
	(0.188)		
ΔOther Min x 1940-1960	0.0108		
	(0.127)		
ΔOther Min x 1960-1980	-0.113	-0.215	-0.189
	(0.075)	(0.177)	(0.178)
ΔOther Min x 1980-2000	0.062**	0.088	0.199
	(0.027)	(0.267)	(0.200)
ΔOther Min x 2000-2012		-0.733***	-0.737**
		(0.270)	(0.276)
ΔOilGas x 1929-1940	-0.859***		
	(0.210)		
ΔOilGas x 1940-1960	-0.423***		
	(0.116)		
ΔOilGas x 1960-1980	-0.355***	-0.297*	-0.180
	(0.091)	(0.150)	(0.180)
ΔOilGas x 1980-2000	-0.151***	-0.318***	-0.253***
	(0.033)	(0.075)	(0.086)
ΔOilGas x 2000-2012		-0.033	-0.039
		(0.164)	(0.168)
ΔAgriculture x 1960-1980			0.396***
			(0.076)
ΔAgriculture x 1980-2000			0.631***
			(0.095)
ΔAgriculture x 2000-2012			-0.311
			(0.334)
Observations	3,264	2,032	2,032
R-squared	0.420	0.501	0.517

Notes: ΔGrowth is first difference of growth in real per capita state personal income. All independent variables are lagged by one year to avoid endogeneity as described in the main text. L1 refers to the intervals at which growth in per capita income is measured. For L1 measurement is between consequetive years, e.g. from 1941 to 1942 etc. BEA is value added by resources x 100 divided by GDP. All regressions have 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 4: Resources and Growth in Per Capita Income: South vs non South

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔGrowth	ΔGrowth	ΔGrowth	ΔGrowth	ΔGrowth	ΔGrowth
	1929-2000	1929-1999	1929-2000	1929-1999	1963-2012	1963-2012
	L1	L1	L1	L1	BEA L1	BEA L1
	South	Not South	South	Not South	South	Not South
ΔMinerals x 1929-1940	-0.266	-0.478**				
	(0.290)	(0.201)				
ΔMinerals x 1940-1960	-0.241**	-0.072				
	(0.102)	(0.137)				
ΔMinerals x 1960-1980	-0.250***	-0.212**				
	(0.041)	(0.090)				
ΔMinerals x 1980-2000	-0.197***	-0.040				
	(0.028)	(0.058)				
ΔOther Min x 1929-1940			-1.075**	-0.326*		
			(0.411)	(0.186)		
ΔOther Min x 1940-1960			-0.639	0.033		
			(0.371)	(0.124)		
ΔOther Min x 1960-1980			-0.093	-0.118	-0.902	-0.169
			(0.438)	(0.078)	(0.893)	(0.181)
ΔOther Min x 1980-2000			-0.332	0.0631**	-1.628	0.249
			(0.339)	(0.026)	(1.004)	(0.198)
ΔOther Min x 2000-2012					-0.827	-0.745**
					(0.702)	(0.313)
ΔOilGas x 1929-1940			-0.217	-1.119***		
			(0.293)	(0.196)		
ΔOilGas x 1940-1960			-0.129	-0.558***		
			(0.137)	(0.102)		
ΔOilGas x 1960-1980			-0.279***	-0.394***	-0.615***	-0.001
			(0.086)	(0.138)	(0.063)	(0.266)
ΔOilGas x 1980-2000			-0.195***	-0.137***	-0.434***	-0.190
			(0.029)	(0.049)	(0.063)	(0.113)
ΔOilGas x 2000-2012					-0.314*	0.052
					(0.170)	(0.161)
ΔAgriculture x 1960-1980					0.152	0.411***
					(0.372)	(0.076)
ΔAgriculture x 1980-2000					0.410	0.646***
					(0.378)	(0.096)
ΔAgriculture x 2000-2012					-1.365***	-0.251
					(0.419)	(0.352)
Observations	748	2,516	748	2,516	471	1,561
R-squared	0.747	0.347	0.749	0.351	0.782	0.477

Notes: ΔGrowth is first difference of growth in real per capita state personal income. All independent variables are lagged by one year to avoid endogeneity as described in the main text. L1 refers to the intervals at which growth in per capita income is measured. For L1, measurement is between consequetive years, e.g. from 1941 to 1942 etc. South are former Confederate states. All regressions have year 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 and Growth: Periods of Low Growth

VARIABLES	(1) Growth 1929-1999	(2) Growth 1929-1999	(3) Growth 1929-1999	(4) Growth 1963-1999	(5) Growth 1963-1999, BEA
ΔOther Mineral x 100/Income	-0.055	-0.098	-0.066	0.079	-0.058
	(0.086)	(0.082)	(0.075)	(0.084)	(0.154)
ΔOilGas x 100/Income	-0.196*	-0.359***	-0.217*	-0.077	-0.195
	(0.117)	(0.072)	(0.115)	(0.062)	(0.199)
ΔOther Mineral x	-0.065		-0.070	-0.069	0.158
Decline	(0.103)		(0.112)	(0.051)	(0.382)
ΔOilgas x	-0.219**		-0.200*	-0.116***	-0.134
Decline	(0.102)		(0.105)	(0.041)	(0.138)
ΔOther Mineral x		0.017	0.029	-0.012	-0.613
Low Growth		(0.119)	(0.126)	(0.075)	(0.542)
ΔOilgas x		0.159	0.042	-0.093	-0.204
Low Growth		(0.114)	(0.118)	(0.113)	(0.247)
Observations	3,264	3,264	3,264	1,632	1,632
R-squared	0.417	0.417	0.417	0.471	0.471

Notes: Notes: ΔGrowth is first difference of growth in real per capita state personal income. All independent variables are lagged by one year to avoid endogeneity as described in the main text. All regressions have year x south fixed effects. 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. 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: 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	-0.022**	-0.018	-0.024**	0.001
Lagged20	(0.0105)	(0.014)	(0.010)	(0.004)
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	0.007	-0.014***		
Lagged20	(0.004)	(0.003)		
PC Income Lagged20	-1.125***	-0.266		
	(0.241)	(0.431)		
South	0.462***	0.144	0.075	0.053
	(0.0981)	(0.101)	(0.052)	(0.057)
State Mean Total			-0.006***	
Mineral/Income			(0.002)	
Total Mineral/Income				-0.007***
Lagged100				(0.002)
PC Income Lagged100			-0.770***	-0.751***
			(0.062)	(0.053)
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 7: 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)	-0.034**				-0.083***
	(0.015)				(0.024)
Ln(PC Income) in 1930	0.329***				
	(0.043)				
South	0.103***	-0.101**	-0.098**	-0.097**	-0.107***
	(0.036)	(0.042)	(0.037)	(0.039)	(0.039)
Ln(Oil x 100/Income)		-0.075***			
		(0.027)			
Ln(Oil per capita)			-0.014***		
			(0.004)		
Ln(Total Min per capita)				-0.053***	
				(0.013)	
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.

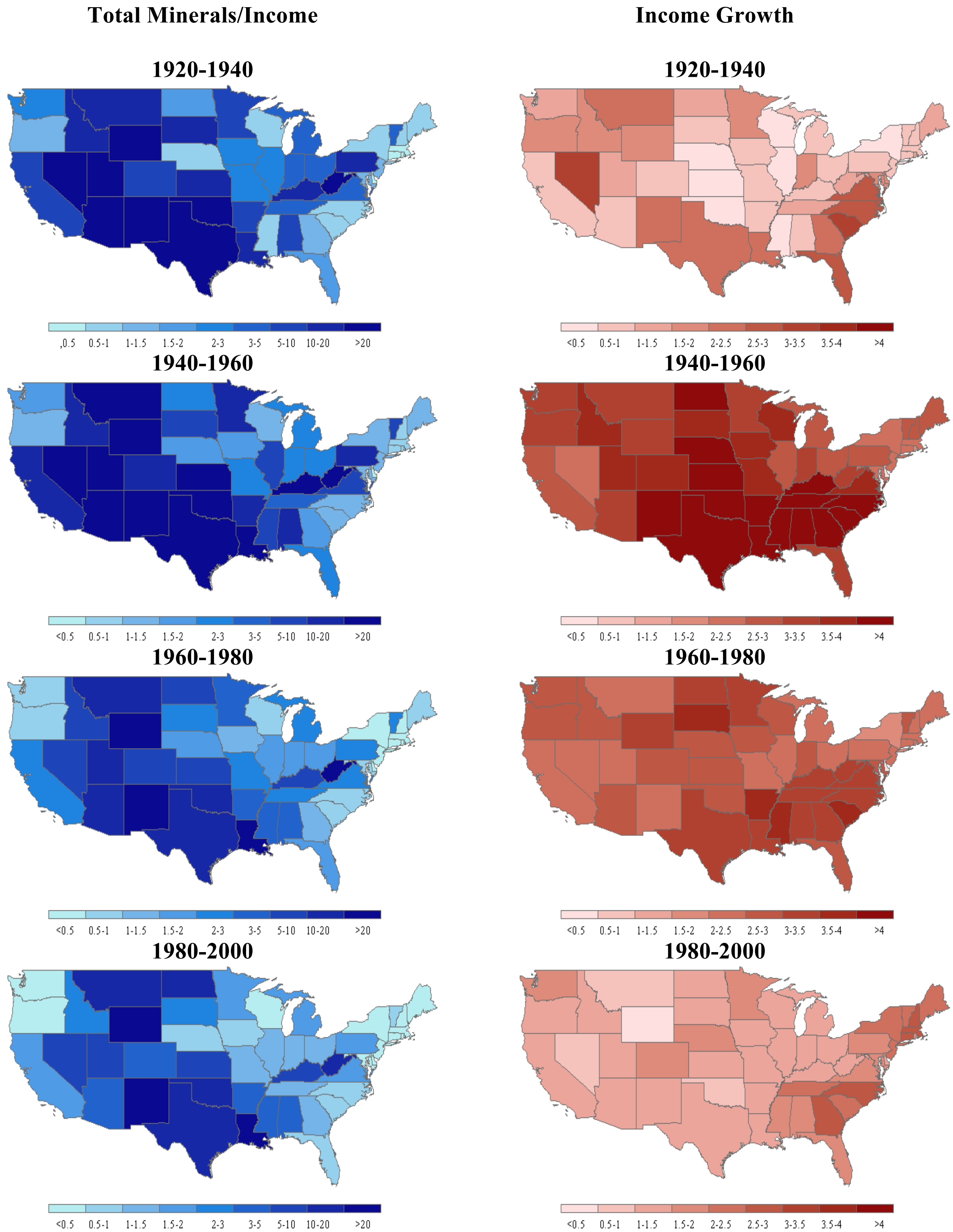
Table 8: Time Series Results for Comparison to Boyce and Emery and Michaels

	(1)	(2)	(3)	(4)
	Ln(PCI)	Ln(PCI)	Ln(PCI)	Ln(PCI)
	1970-1999	1970-1999	1929-1999	1929-1999
OilGas x 100/Income	0.004***		-0.001	
	(0.001)		(0.002)	
Total min x 100/Income		0.003***		0.001
		(0.001)		(0.002)
Observations	1,440	1,440	3,646	3,646
R-squared	0.963	0.962	0.974	0.974
	(5)	(6)	(7)	(8)
	Ln(PCI)	Ln(PCI)	Ln(PCI)	Ln(PCI)
	1960-1990	1960	1960-1990	1960
OilGas_High x 1970	-0.029*		-0.026	
	(0.016)		(0.046)	
OilGas_High x 1980	0.032		0.033	
	(0.023)		(0.061)	
OilGas_High x 1990	-0.064**		-0.058	
	(0.025)		(0.079)	
OilGas_High		-0.061		-0.022
		(0.047)		(0.112)
South		-0.304***		
		(0.049)		
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.

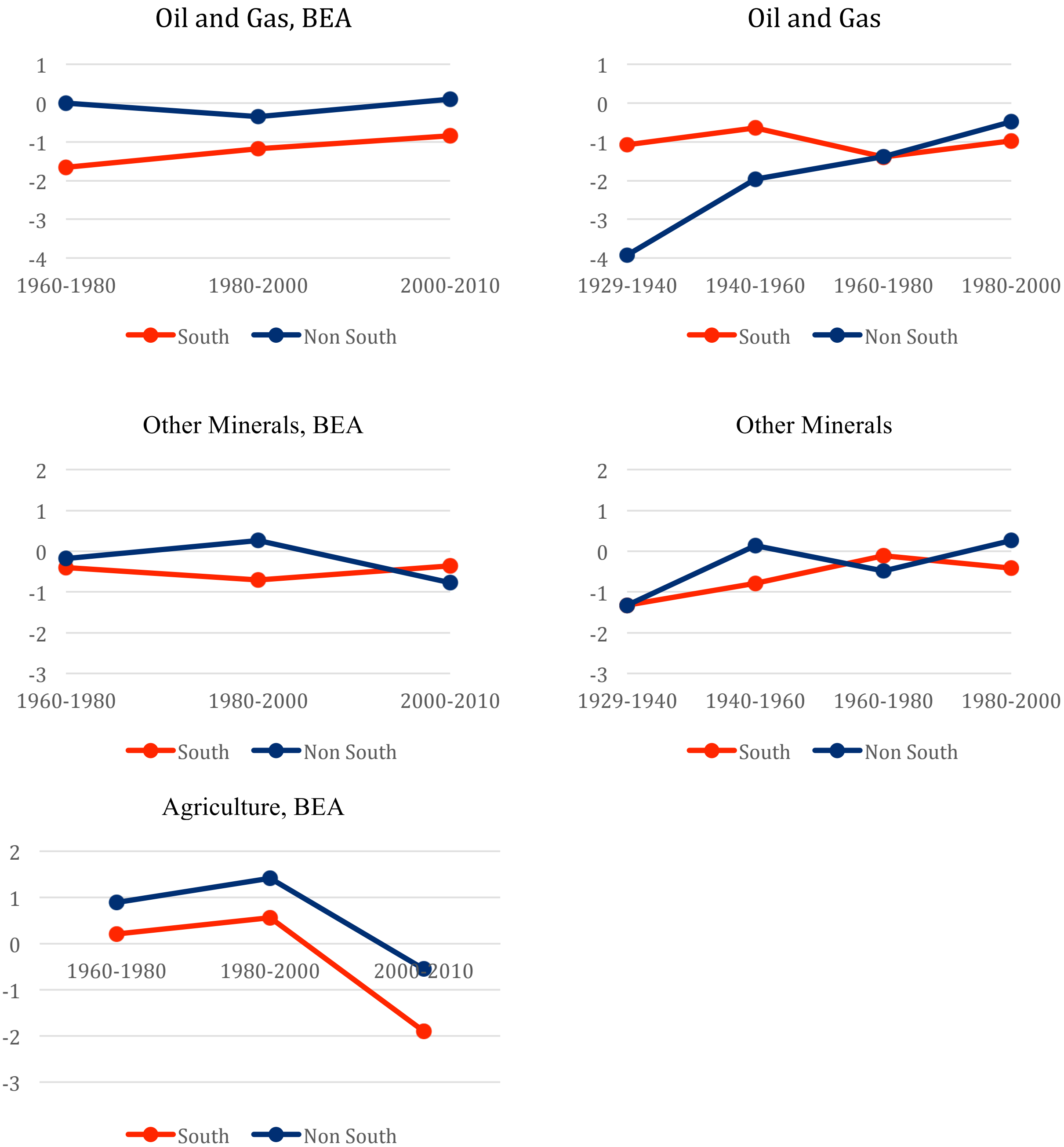
Appendicies

Figure 1A: Income and Total Minerals over Time



Notes: Income growth is state personal income growth. Total Minerals/Income is the average values of resources as percentages of income across different time periods.

Figure 2A: Effects of Oil and Gas and Other Minerals on Growth in Income per Capita, 1929-1999, South vs Non South



Notes: Based on Table 4. Income is state personal income. Values of resources are gross values as percentages of income. The plot shows the effects for a one standard deviation increase in different minerals and agriculture for South (former Confederate states) vs North (all other states) and 95% confidence interval.

Table 1A: Summary Statistics

	All States Std. Dev.	South Std. Dev.	Non South Std. Dev.
Annual PCI Growth, 1 year	6.38	6.29	6.41
Annual PCI Growth, 10 years	2.04	2.20	1.99
BEA Agriculture/GDP	2.03	1.39	2.18
BEA Oil and Gas/GDP	2.09	2.71	1.87
BEA Other Mineral/GDP	0.93	0.44	1.03
BEA Total Mineral /GDP	2.25	2.52	2.17
Oil and Gas/Income	3.90	4.99	3.51
Other Mineral/Income	3.63	1.23	4.08
Total Mineral L1/Income	5.48	5.04	5.61
Total Mineral L10/Income	6.02	5.51	6.16

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

Table 3A: Resources and Growth in Per Capita Income: South vs non South

VARIABLES	(1) ΔGrowth 1929-2000 L1	(2) ΔGrowth 1929-2000 L1	(3) ΔGrowth 1929-2000 BEA L1
ΔMinerals x 1929-1940	-0.478**		
	(0.202)		
South*ΔMinerals x 1929-1940	0.213		
	(0.339)		
ΔMinerals x 1940-1960	-0.072		
	(0.138)		
South*ΔMinerals x 1940-1960	-0.169		
	(0.168)		
ΔMinerals x 1960-1980	-0.212**		
	(0.089)		
South*ΔMinerals x 1960-1980	-0.038		
	(0.097)		
ΔMinerals x 1980-2000	-0.039		
	(0.057)		
South*ΔMinerals x 1980-2000	-0.158**		
	(0.063)		
ΔOther Minerals x 1929-1940		-0.326*	
		(0.187)	
South*ΔOther Minerals x 1929-1940		-0.749*	
		(0.428)	
ΔOther Minerals x 1940-1960		0.0330	
		(0.125)	
South*ΔOther Minerals x 1940-1960		-0.672*	
		(0.369)	
ΔOther Minerals x 1960-1980		-0.118	-0.169
		(0.078)	(0.181)
South*ΔOther Minerals x 1960-1980		0.025	-0.733
		(0.417)	(0.851)
ΔOther Minerals x 1980-2000		0.0631**	0.249
		(0.026)	(0.199)
South*ΔOther Minerals x 1980-2000		-0.395	-1.877*
		(0.318)	(0.955)
ΔOil and Gas x 1929-1940		-1.119***	
		(0.197)	
South*ΔOil and Gas x 1929-1940		0.902**	
		(0.338)	

Table continues on the next page

ΔOil and Gas x 1940-1960		-0.558***	
		(0.103)	
South*ΔOil and Gas x 1940-1960		0.429**	
		(0.165)	
ΔOil and Gas x 1960-1980		-0.394***	-0.001
		(0.139)	(0.268)
South*ΔOil and Gas x 1960-1980		0.116	-0.614**
		(0.161)	(0.274)
ΔOil and Gas x 1980-2000		-0.137***	-0.190
		(0.049)	(0.114)
South*ΔOil and Gas x 1980-2000		-0.058	-0.245*
		(0.057)	(0.128)
ΔAgriculture x 1960-1980			0.411***
			(0.076)
South*ΔAgriculture x 1960-1980			-0.260
			(0.355)
ΔAgriculture x 1980-2000			0.646***
			(0.096)
South*ΔAgriculture x 1980-2000			-0.236
			(0.364)
South	0.367	0.366	0.350
	(0.432)	(0.432)	(0.308)
Observations	3,264	3,264	1,632
R-squared	0.418	0.422	0.491

Notes: ΔGrowth is first difference of growth in real per capita state personal income. All independent variables are lagged by one year to avoid endogeneity as described in the main text. L1 refers to the intervals at which growth in per capita income is measured. For L1, measurement is between consequetive years, e.g. from 1941 to 1942 etc. South is a dummy wich is equal to1 for former Confederate states. All regressions have year 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.