When Are Natural Resources Curses and Blessings? Evidence From the United States 1936-2015

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This paper uses new state-level panel datasets spanning 1936-2015 to investigate the relationship between three natural resources – oil, coal, and agriculture – and a range of economic outcomes in the context of the American states. Our empirical strategy is closely related to Allcott and Keniston (2015) and Bartik (1991). We take a similar approach and relate changes in a range of economic outcomes with exogenous measures of resources – the interaction of national resource employment with cross sectional variation in resource reserves. The paper has three main findings. First, resource employment is positively and statistically significantly related to growth in per capita income. Second, resource employment is positively and statistically significantly related to growth in employment in a range of sectors including manufacturing, durables, nondurables, transportation, construction, retail and wholesale. Third, boom-bust cycles can cause a resource curse through asymmetric effects of increases and declines. The differential effects of busts in employment are large and statistically significant for oil during 1936-1969 and coal during 1970-2015.

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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. A closely related literature on Dutch disease examines the effects of resources on a range of other economic outcomes including sectoral employment, sectoral wages, and population. One challenge is that the combined literatures are large, and different papers reach different conclusions about the existence of curses or blessings.[1] This raises the question: When are natural resources curses or blessings?

To address this question, our paper uses new state-level panel datasets spanning 1936 to 2015 covering three natural resources – oil, coal, and agriculture – and a range of economic outcomes. Over this eighty-year period, each of these resource sectors have experienced increases and decreases in employment, and state economies have changed, potentially changing the relationship between resources and economic outcomes. Examining the American states is valuable, because states have diverse natural resource endowments, yet share a common federal government, currency, and tariffs. Further the United States has detailed state-level data spanning multiple resources covering long periods of time. This makes it possible to examine effects across multiple subcategories of natural resources, over the very short-run (one year) and the medium-run (five years), over different periods between 1936 and 2015 and across increases and decreases in resources.

Our empirical strategy is closely related to Allcott and Keniston (2015). Allcott and Keniston (2015) have a model of domestic Dutch disease in a common currency area with mobile labor. It is based

[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), Feyrer et al (2016) and Allcott and Keniston (2015) do not find evidence of a curse.

on a Melitz model of heterogeneous sectors and firms. The model allows positive or negative spillovers from the resource sector to the tradable sector. While the most commonly discussed externality is the loss of learning by doing in the traded sector, if there are benefits to agglomeration or the resource boom decreases the relative input cost of the tradable sector, the externality could be positive. Allcott and Keniston (2015) use a Bartik-style empirical strategy and correlate changes in a range of economic outcomes with an exogenous measure of resources – the interaction of national oil and gas employment with cross sectional variation in oil and gas reserves. We take a similar strategy and correlate changes in a range of economic outcomes with exogenous measures of resources – the interaction of national resource employment or income with cross sectional variation in resource reserves.

The paper has three main findings. First, resource employment is positively and statistically significantly related to growth in per capita income. This is consistent with a literature in economic history that emphasizes the benefits of resources for economic development.[2] The positive effects of changes in resource employment on growth measured over a 5-year period are larger and more consistent in significance than over a 1-year period, indicating that positive effects take some time to develop. The positive and significant relationship between resource employment and growth imply that the effects will depend on whether resource employment is increasing or decreasing. During the sample period, oil employment grew, and coal and agricultural employment declined. The state with the largest oil endowment experienced cumulative positive effects in growth in per capita income of 7 to 19 percent over 80 years. The state with the largest coal endowment and the state with the largest agriculture endowment experienced cumulative negative effects in growth in per capita income of 13 to 25 percent and 15 to 18 percent.

Second, resource employment is positively and statistically significantly related to employment in a range of sectors including manufacturing, durables, nondurables, transportation, construction, retail and wholesale. Consistent with models of Dutch Disease, we find resource employment increases wages.

[2] On the benefits of natural resources for growth over longer historical time periods see Habakkuk (1962), Wright (1990), Keay (2007), Allen (2009), and Pomeranz (2001).

Although our finding of positive relationships between resources and employment is in contrast to conventional models of Dutch Disease, our results are in line with the findings of a number of authors that have examined resources at the county level including Alcott and Keniston (2015), Michaels (2011), Weber (2012, 2014), and Feyrer et al (2015). These results suggest that local spillovers are important channels through which resources affect states.

Third, boom-bust cycles can cause a resource curse through asymmetric effects of increases and declines. This occurs when the effects of increases in employment on growth during booms are smaller than the effects of decreases in employment on growth during busts. A negative effect of boom-bust cycles is a form of a resource curse and is consistent with Black et al (2005) and Jacobsen and Parker (2015), who examine sets of treatment and control coal counties in Appalachia and treatment and control oil counties in the Western United States. The differential effects of declines in resource employment are large and statistically significant for oil employment during 1936-1969 and coal employment during 1970-2015.

This paper contributes to the U.S. literature on resource curse and to the broader literature by examining effects of multiple resource sectors (oil, coal, and agriculture), over a long time period (80 years), using a longer time interval (5 years) over which effects can occur, and using a range of outcome variables. The analysis complements time series work by other scholars at the U.S. county level and other levels of geographic aggregation, which tends to focus on individual resources. Our results suggest that analyses in other settings or other levels of geographic granularity may benefit from accounting for multiple resources and allowing for heterogeneous effects along a number of dimensions.

2. Literature Review

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

Measures of resources

The definition of resources varies considerably across papers, both in terms of the resources covered and whether the analysis focuses on resource income or resource employment. The original Sachs and Warner paper and many later papers, including some papers on the United States, use a broad definition of natural resources. In their original papers, Sachs and Warner's (1995, 1997) main measure included the value of exports of fuels and non-fuel primary products as a share of GDP. The latter include food and live animals; beverages and tobacco; crude materials (inedible); animal and vegetable oils, fats, and waxes; and non-ferrous metals. Although Sachs and Warner and other papers, 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.

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) uses mining (which includes oil, coal and other minerals); Allcott and Keniston (2015) use oil and natural gas; Weber (2012, 2014) uses natural gas; Jacobsen and Parker (2014) uses oil and natural gas; Feyrer et al (2015) uses natural gas. Most of these papers focus on resource employment, rather than resource income.

Our analysis examines three large resource sectors – oil, coal, and agriculture – and primarily focuses on resource employment. In the appendix, we present additional results for resource income.

Resource Curses in the United States

A very large number of papers have examined resource curses in a wide variety of contexts. Table 1 presents the literature on the resource curse in the United States. The papers that apply cross sectional analysis – Boyce and Emery (2011), Goldberg, Wibbles, and Mvukiyehe (2008) James and

Aadland (2011), and Papyrakis and Gerlagh (2007) – all find a curse despite that fact that the papers use different time periods, outcome measures, and resource measures.

The results are somewhat mixed for the time series analysis. Using state data, Goldberg, Wibbles, and Mvukiyehe (2008) find resources are a curse for growth. Boyce and Emery (2011) find resources are a curse for growth, but a blessing for income. Using county data Allcott and Keniston (2015) and Michaels (2011) find that oil and gas are positively related to a range of outcomes. Feyrer et al (2016) and Weber (2012, 2014) examine the recent effects of hydraulic fracturing and find positive effects on outcomes. Using county data, Black et al (2005) and Jacobsen and Parker (2014) find that the boom is smaller than the bust, leaving coal and oil and gas counties worse off after the boom-bust cycle than before.

A strand within economic history argues that natural resources were important drivers of growth. Some examples include Habakkuk (1962), Wright (1990), Pomeranz (2001), Wright and Czelusta (2004), Keay (2007), Allen (2009), and Fernihough and O'Rourke (2014). Other authors such as Mokyr (1976, 1992, 2009), Clark and Jacks (2007), McCloskey (2010) have argued that natural resources were not key drivers of growth, instead stressing other factors. In contrast to the curse literature, however, they generally do not argue that resources were a curse.

3. Conceptual Framework

How does a resource curse occur? Allcott and Keniston (2015) have a model of domestic Dutch disease in a common currency area with mobile labor. It is based on a Melitz model of heterogeneous sectors and firms. There are a large number of smaller geographic units within a larger area. Consumers maximize utility and share in the profits from the resource sector. The resource sector has Cobb Douglas production function and decreasing returns to scale. Other sectors are monopolistically competitive. Labor supply can be imperfectly elastic, and labor markets clear. The intuition of the model is fairly straightforward. Resource employment increases causing wages to increase if labor supply is not

perfectly elastic. Wages rise in traded sector, causing employment to decline in the traded sector. These sectoral shifts are only a public policy issue if there are externalities.

The model allows positive or negative spillovers from resource sector to the tradable sector. The most commonly discussed externality is the negative externality from the loss of learning by doing in the traded sector. As Allcott and Keniston (2015) note, however, "there could also be productivity spillovers to or from the non-tradable or upstream sectors, or other forms of externalities imposed by any sector." The externalities could also be positive, if there are benefits to agglomeration or the resource boom decreases the relative input cost of the tradable sector. A boom could allow replacement of imported coal with local coal in the tradable or electricity generation sectors or the replacement of imported petroleum with local petroleum in the refining or petrochemical sectors. There could be other positive externalities beyond agglomeration or input costs.[3]

While the model is static and considers a single resource sector, in practice one might expect effects of the resource sector on employment and other outcomes to be heterogeneous across a variety of dimensions. The extent of externalities may vary across resources such as oil, coal, and agriculture. The effects of a change in production of a resource on outcomes may differ over different time frames. For example, the effects over a one-year period may differ from the effects over a five-year period because of adjustment costs. The effects may differ over the course of the twentieth century due to changing production technology, transportation costs, capital markets and other factors. Effects may differ across increases and decreases in resources.[4] Effects may also differ across periods of high and low national growth, if externalities differ due to differences in labor and capital markets.[5] Finally, the effects may

[3] David and Wright (1997) argue that positive feedback between minerals and industry contributed to the growth of the economy between 1870 and 1910. For a survey of the U.S. historical literature on resources and growth, see Clay (2011).

[4] Carrington (1996), Black et al (2005), and Jacobsen and Parker (2014) examine booms and busts created by construction of the Alaskan pipeline and the Appalachian coal boom and the Western oil boom in the 1970s and 1980s. Recent papers on natural gas such as Feyrer et al (2016), Weber (2012, 2014) only observe the boom and not the bust. Henderson et al (2011) discuss boom-bust in agriculture.

[5] There is a literature on the 'cleansing' effects of recessions (Davis and Haltiwanger 1990, 1992, 1999, Caballero and Hammour 1994, 1996). There is also large macroeconomic literature on oil prices and recessions. See Hamilton

differ depending on the level of development of the economy. For example, for much of the twentieth century, the South was not as well developed as the North along many dimensions including infrastructure, human capital, physical capital and the quality of state institutions.[6]

4. Identification

We take a similar approach to Allcott and Keniston (2015) and use a reduced form estimating equation:

$$\Delta lnY_{it} = \tau_r \alpha_{ir} \Delta lnE_{rt} + \omega_t lnY_{i0} + \varphi_{dt} + \theta_i + \varepsilon_{it} \quad (1)$$

Y_{it} is an outcome in state *i* in year *t*. α_{ir} is endowment of resource r in the baseline period. E is national employment or income for resource *r* in time *t*. Y_{i0} is a baseline value of the outcome for state *i*. φ_{dt} are census division-year fixed effects, and θ_i are state fixed effects. We use robust standard errors that are clustered by state.[7]

The variable Y is logged, so $\Delta \ln Y_{it}$ is approximately equal to the growth rate in the outcome variable. Similarly, the variable E is logged, so $\Delta \ln E_{rt}$ is approximately equal to the growth rate in national resource employment. The changes are measured over one year (from t to t-1) or five years (from t to t-5). The resource curse can also involve resource income, which may differ from resource employment due to shifts in world prices and changes in technology that affect employment. In the appendix, we present additional specifications that focus on resource income instead of resource employment.

(2011, 2012) and Kilian and Vigfusson (2014). Kilian and Vigfusson (2014) discuss nonlinearity of the relationships.

[6] 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, Berkowitz and Clay 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.

[7] As a robustness check, we have bootstrapped the standard errors for some specifications. Bootstrapping does not change the statistical significance of the results.

The variable $\alpha_{ir}\Delta\ln E_{rt}$ is similar to Bartik (1991) shift share instruments. Here the cross-sectional variation comes from initial resource endowment instead of an industry's initial employment share. Similar to Allcott and Keniston, we use $\alpha_{ir}\Delta\ln E_{rt}$ on the right-hand-side and not as an instrument for changes in employment. The reason is that the exclusion restriction would not be satisfied. Resource booms can affect states through other channels in addition to changes in employment or income.

We use endowment of a resource at a specific point in time α_{ir}. [8] Like Allcott and Keniston, we divide endowment by the area of the state in square miles, because states differ both in their endowments and in other attributes such as their area. For example, the same endowment in Texas, which is 268,580 square miles and in Rhode Island, which is 1,545 square miles would potentially have very different impacts on the state economy. We provide further details on the construction of endowments below. As a result, the estimated τ_r is similar to elasticity, where τ_r is the differential effect of a one percent increase in employment in the state with the largest resource endowments per square mile.

Income per capita may be moving for reasons other than shifts in resource. These include shifts based on initial income or census division. To address this, we interact baseline income and census division with year fixed effects.

5. Data

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. Federal government dominates the District of Columbia's economic activity.

Resources

This paper examines the effects of three resources -- oil, coal, and agriculture. Oil and coal reserves in 1935 per square mile are used as a proxy for oil and coal endowments.[9] Oil and coal values are

[8] Allcott and Keniston construct fairly complicated time-varying endowments α_{irt}. We are in the process of constructing time-varying endowments as a robustness check.

[9] Coal reserves in 1935 are constructed using recoverable reserves in 1950 and coal production from 1935-1950 assuming past losses are equal to production.

from the *Minerals Yearbooks*.[10] Agriculture endowment is constructed using the farmland per square mile.[11] These data are available from the *1935 Census of Agriculture*. The endowment measures are further rescaled to be from 0 to 1 for the ease of the interpretation. Endowment is equal to 1 in the richest resource states (in 1935) and is equal to 0 in the poorest resource states for a given resource.

The first three panels of Figure 1 present the distribution of resources across states in 1935. There is considerable variation in resource endowments. Top oil states are Texas, California, and Oklahoma. Top coal states are North Dakota, West Virginia, and Kentucky. Top agriculture states are Iowa, Nebraska, and Kansas.

National employment for oil and gas and agriculture sectors for 1935-2015 are taken from the Bureau of Economic Analysis.[12] National coal mining employment is taken form U.S. Bureau of Labor Statistics. Figure 2 plots the national employment in different resource sectors over time. We see a general decline in the agricultural employment and in coal mining employment over time. Oil and gas employment was generally increasing through the early 1980s, declined into the mid-2000s, but has been increasing since then.

Outcome Variables

Figure 3a shows the evolution of income per capita over time. Data on state personal income are available annually beginning in 1929 from the Bureau of Economic Analysis (BEA).[13] One can see the effects of major events including the Great Depression, WWII, and the Great Recession. Figure 3b plots the distribution of the five-year annualized income growth rate. The average growth rate is around 2.5% per year, with majority of the observations fitting between -2% and 12%.

[10] Natural gas price in 1935 were much smaller than

[11] The current approach for agriculture follows that of oil and coal, which values each ton of coal or barrel of oil at the 1935 national price. Thus each acre of farmland is treated as having equal value. An alternative approach is to use 1935 average state rather than national land values to measure endowment. With the advent of commercial fertilizer and irrigation, the relative values of land shifted over time.

[12] Value of natural gas reverses in 1935 was much smaller than the value of oil reserves, so we focus on oil reserves only when constructing the oil endowment.

[13] Data were adjusted to 2010 dollars using the US CPI data from Officer and Samuelson's website Measuring Worth. Population values by state are from the decennial Censuses of Population. These values were linearly interpolated for intervening years.

The last panel of Figure 1 presents the average income per capita in 1929-1934, which is the baseline income. There is substantial regional variation in income, which reflects regional differences in economic development. Many states in the Northeast are in the top quartile, and many states in the South are in the bottom quartile.

Figure 4 plots the average state employment in non-resource sectors: manufacturing, construction, transportation, wholesale, and retail over 1970-2015.[14] Manufacturing employment was fairly constant until 2000, with small ups and downs in 1970-1980. During 2000-2010 manufacturing employment slowly decreases. Number of people employed in other sectors, however, almost doubled during the study period. Average state employment was almost 300,000 in 1970, and it has increased to almost 600,000 in 2015. Number of people employed in wholesale, transportation and construction sectors has increased from around 100,000 to almost 200,000.

Table 2 presents the summary statistics for the main variables used in the analysis. Summary statistics for other variables are available in the Appendix Table 1A.

6. Results

Main Effects

Table 3 examines the effect of resource employment on growth in per capita income. Columns 1-3 compare the effects of changes in resource employment interacted with endowment on growth in per capita income in the very short term – over one year – for the period 1936-2015 and for two subperiods, 1936-1969 and 1970-2015. The one-year interval assumes that changes in resource employment will immediately translate into growth in income. The effects for oil are positive and significant for oil for the whole period and for the later period. Otherwise the effects are not significant, although they are generally positive. Columns 4-6 compare these effects in the medium term – over five years – for the period 1936-2015 and for two subperiods, 1936-1969 and 1970-2015. All of the coefficients on resource employment interacted with endowment are positive and 8 of the 9 are statistically significant. Given that

[14] State specific employment by sectors is not available prior to 1970.

positive (or negative) spillover effects will likely take time to develop, we will focus in the remainder of the paper on 5-year intervals.[15]

Magnitudes of the effects are sizeable for states with large endowments. Figure 5 shows the effect of a one standard deviation increase in employment five years previously for each resource for the top state, where endowment equals 1, for 1936-2015 and for 1970-2015 from columns 4 and 6 of Table 3. A state with X% the endowment per square mile of the top state would experience an effect that is X% of the top state. The magnitudes of the effects are similar across the two time periods. In the top states for the three resources the increases for would be 0.57, 0.46, and 0.34 for oil, coal, and agriculture in 1936-2015 and 0.69, 0.51, and 0.33 for 1970-2015.

Table 3 suggests that resources are either a blessing or have no effect. Specifically, none of the coefficients are negative and statistically significant, which is what we would expect if resources were a curse.

Channels for Resources to Affect Growth

Manufacturing provides one possible channel through which resources may affect growth. Table 4 explores the effects on manufacturing employment and wages as well as mining and agricultural wages. Column 1 shows the results for income growth from column 6 of Table 3 for comparison. Column 2 shows that the coefficients on national resource employment interacted with endowment are positive and significant for manufacturing employment. The positive relationship between resource employment and manufacturing employment is consistent with the findings of Allcott and Keniston (2015) and with recent work by Weber (2012, 2014), Feyrer et al (2016) on the county impacts of the fracking boom in oil and natural gas. A one standard deviation increase in national employment for oil, coal or agriculture would be associated with 0.26, 0.17 and 0.18 of a standard deviation increases in growth in manufacturing employment.

The Allcott and Keniston model suggests that increases in resource employment should increase wages both in the resource sector and in the manufacturing sector. Columns 3 and 4 show the effects of

[15] Selected results for one-year effects are presented in the appendix.

resources on wages in their own sectors. Changes in oil and coal employment interacted with endowment are positively and significantly related to changes in state mining wages. Changes in agricultural employment interacted with endowment is positively and significantly related to changes in state agricultural wages. Column 5 explores the effects of resource employment interacted with endowment on manufacturing wages. The coefficients on coal and agriculture employments are positive and significant. For the coefficients that are statistically significant in columns 3 to 5, the magnitudes of the effects of a one standard deviation increase in employment range from a low of 0.15 of a standard deviation for manufacturing wages to a high of 0.87 of a standard deviation for mining wages for coal.

Table 5 explores employment effects for a variety of subsectors including durable goods, nondurable goods, petroleum and coal processing, construction, and transportation, wholesale, retail and services. The coefficient on oil employment interacted with endowment is uniformly positive and is significant for five sectors including: manufacturing (from Table 4), durable goods, nondurable goods, petroleum and coal processing, and transportation. The coefficient on coal employment interacted with endowment is nearly always positive and is significant for six sectors including: manufacturing, durable goods, construction, transportation, wholesale, and retail. The coefficient on agricultural employment interacted with endowment is often positive but it only significant for manufacturing. For the coefficients that are statistically significant in columns 2 to 8, the magnitudes of the effects of a one standard deviation increase in employment range from a low of 0.25 of a standard deviation for transportation for coal to a high of 0.54 of a standard deviation for transportation for oil.

Resource employment is generally positively and often statistically significantly associated with employment in a variety of related sectors including manufacturing. This suggests that resource curses in the form of a direct negative association between resource employment and growth or employment in other sectors are probably rare in the United States context.

Heterogeneous Effects

A number of papers including Allcott and Keniston (2015), Black et al (2005), and Jacobsen and Parker (2014) suggest that there may be differential effects of increases and decreases in resource

employment and that the relationships between resources and growth may vary over time. Table 6 allows increases and decreases to have different effects. Significance denotes whether the coefficient differs statistically significantly from zero. Declines have positive coefficients, because they are multiplied by negative numbers. The coefficients for increases and decreases in resource employment columns 1-3 vary. Nine of the coefficients are positive and significant, eight are positive but not significant, and one (coal, post 1970) is negative but not significant. In appendix Table 6A.1, we report the same regression where the coefficient for decline is measured relative to the coefficient for increase. The coefficients on declines in oil employment interacted with oil endowment and agricultural employment interacted with agricultural endowment in 1936-1969, and declines in coal employment interacted with coal endowment in 1970-2015 are statistically significantly larger than the coefficients for increases.

In appendix Table 6A.2, we examine two other factors beyond declines in employment that may also affect the relationship between resources and growth, the differential effects of periods of low growth and of a state being in the South. Low growth is defined as periods in which growth is 1 percent or less. None of the interaction effects of low growth in columns 1-4 are statistically significant. The South is defined states that were members of the confederacy. None of the interaction effects of South growth in columns 1-4 are statistically significant.

Figure 6 shows the effect of a one standard deviation increase (boom, dark gray) and decrease (bust, light gray) in employment for each resource for two time periods: 1936- 2015 and 1970-2015. In both time periods for each of the booms, the magnitude is smaller than the magnitude for the busts. The boom-bust literature has primarily focused on post-1970 time period. As noted above, the differential decline for coal is positive and statistically significant for the post-1970 period. All of these results are consistent with boom-bust cycles leaving resource areas worse off than they were before the cycle.

Figures 7 and 8 shows the realized effect and the cumulative effect on growth for the top resource state (endowment = 1) using the coefficients from Tables 3 and 6 and actual national changes in resource employment. In Figure 7, the realized effects for oil are typically positive, although there are some large negative effects in the 1980s. The realized effects for coal and agriculture are largely negative, although

there are some periods of positive returns. In Figure 8, the cumulative effects over the period 1936-2015 for the top oil, coal, and agriculture states are 19, -13, and -18 percent using the coefficients from Table 3 and 7, -25, and -15 percent using the coefficients from Table 6.[16] Increases in coal employment have had substantial positive cumulative effects on growth. Conversely, declines in coal employment and agricultural employment have had large cumulative negative effects on growth.

To further explore the boom and bust effects, in Table 7 we present state-level analysis that is similar to the county-level analysis in Allcott and Keniston (2015), Black et al (2005), and Jacobsen and Parker (2014). We present result for the following four outcome variables: per capita income growth, changes in total employment, changes in employment in mining and manufacturing sectors.

Panel A presents the results for the analysis similar to the in Allcott and Keniston (2015) using state level data for the years 1969 -2011. In particular, we estimate the following specification

$$\Delta lnY_{it} = \eta_1 \alpha_i \Delta lnE_t + \eta_2 (\text{Decline} = 1) \alpha_i \Delta lnE_t + \eta_3 (\text{Year} \geq = 2000) \alpha_i \Delta lnE_t lnY_{i0} + \varphi_{dt} + \theta_i + \varepsilon_{it}, \quad (2)$$

Here α_{ir} is state oil endowment scaled from zero to one, ΔlnE_{rt} is the change in national employment in oil and gas sector, lnY_{i0} is per capita income in initial period, φ_{dt} and θ_i are division by year and state fixed effects. "Decline" dummy is an indicator for whether national oil and gas employment declined between t and t-1. Compared to specification (1) this specification includes interactions between employment growth and dummies for whether national employment was declining and whether the effect is different in more recent period. Thus, η_1 measures the baseline effect of employment growth, η_2 shows the change in the effect of employment growth during periods of decline, and η_3 indicate whether the effect of employment growth is different in more recent (after 2000) period.

This state-level analysis gives qualitatively similar results to Allcott and Keniston's (2015) county analysis. For example, in column 1, the main coefficient on oil is positive and statistically significant, the coefficient on oil after 2000 is negative and statistically significant, and the coefficient on

[16] The effects are proportional to a state's scaled endowment. The 75th percentile of the distribution of endowments for oil, coal and agriculture are 0.30, 0.20, and 0.77.

declines is negative and statistically significant. The negative and significant coefficient on declines relative to increases is striking, given the positive and significant coefficient on oil in appendix Table 6A. Appendix Table 7A explores the difference between the results in Table 6 and Table 7. The primary difference is attributable to the different time intervals – five years (Table 6) vs. one year (Table 7).

Panel B presents results similar to Jacobsen and Parker (2014). Specifically, we estimate the following specification:

$$\Delta lnY_{it} = \gamma_t OilRichState_i TimePeriod_t + \omega_t lnY_{i0} + \varphi_{dt} + \theta_i + \varepsilon_{it} , \quad (3)$$

where *OilRichState* is a dummy which is equal to one for states in the top 75th percentile of oil reserves in 1935, conditionally on nonzero oil reserves in the state. Time periods are defined as follows: Early Boom (1975–1979), Peak Boom (1980–1981), Bust (1982–1985), and Post Bust (1986–1998). So each of the γ_t shows the effects during different time periods for the oil rich states vs. other states.[17] The results in column 5 are similar to the results in Jacobsen and Parker (2014). During the five-year boom period top oil states had statistically significantly faster growth in income per capita than other states and during the thirteen-year post-bust period they had statistically significantly slower growth in income per capita than other states. The net effect was to leave oil rich states worse off after the boom-bust cycle than they were before it began.

Panel C is similar to Black et al (2005) and estimates the following specification:

$$\Delta lnY_{it} = \gamma_t CoalRichState_i TimePeriod_t + \omega_t lnY_{i0} + \varphi_{dt} + \theta_i + \varepsilon_{it} , \quad (4)$$

where time periods are defined as follows: Boom (1970–1977), Peak (1978–1982), and Bust (1983–1989). *CoalRichState* is a dummy, which is equal to one for states in the top 75th percentile of coal reserves in 1935, conditionally on nonzero coal reserves value in the state. So each of the γ_t shows the effects in different time periods for the coal rich state vs. other state. The results in column 9 are similar to the results in Black et al (2005). During the eight-year boom period top coal states had statistically significantly faster growth in income per capita than other states and during the seven-year post-bust

[17] We include year fixed, effects which absorb the levels of those times dummies. State fixed effects absorb *OilRichState* dummy.

period they had statistically significantly slower growth in income per capita than other states. The net effect was to leave coal rich states worse off after the boom-bust cycle than they were before it began.

Why do Some Papers on the American States Find a Curse?

Thus far we have shown that resources are positively related or unrelated to growth in per capita income and that resource can have negative impacts on growth through boom-bust cycles. These results are consistent with a number of other papers that focus on the individual resources, shorter time periods, or subsets of counties.

There are, however, other papers in the literature that argue that resources are a curse. Why are these papers finding a curse? Some of the results are from cross-sectional regressions. Table 8 provides cross sectional growth regressions that are very similar to regressions presented by other scholars. Column 1 is similar to Boyce and Emery (2011) Table 3 column 1. One difference is that we exclude Alaska and Hawaii, and so have 48 states. The coefficient on mining employment is negative and significant. Column 2 is similar to Papyrakis and Gerlagh (2007) Table 1 column 2. The coefficient is negative and significant. Column 3 presents a regression similar to Goldberg et al (2008), Table 1 column 1. The coefficient on resources is negative and significant. Columns 4-5 present results in the spirit of Alexeev and Conrad (2009). Our sample and Alexeev and Conrad's sample are very different – states vs. countries. In columns 4-5, the coefficients on oil and on total minerals are negative and statistically significant. Table 8 suggests that focusing on income does not resolve the (cross-sectional) resource curse in the U.S. context.

Two papers, however, find a resource curse in time series. In both cases, it appears that the results are driven by specification choices. Boyce and Emery (2011) conclude that growth is negatively related (and income is positively related) to the share of employment in the mining sector over the period 1970-2001. Their primary measure – mining employment share – is likely to be endogenous. In addition, to match their model their regressions have three interaction effects: i) mining employment share x real price growth, ii) mining employment share x population growth, and iii) mining employment share x mining employment growth. Goldberg, Wibbles, and Mvukiyehe (2008) include lagged income and lagged

income growth as controls. In both cases, the choice of specification likely accounts for their conclusion that resources are a curse in time series.

7. Conclusion

This paper contributes to the literature on the resource curse in the United States by examining effects of multiple resource sectors – oil, coal, and agriculture at the state level in the United States over the period 1936-2015, using different time intervals over which effects can occur and a range of outcome variables. We find that increases in resource employment are positively and significantly related to growth in per capita income and to employment in a range of sectors. Over the sample period, there is above average growth in per capita income for states with oil endowments relative to states with no endowment, because of rising oil employment, and below average growth in per capita income for states with coal and agricultural endowments, because of declining coal and agricultural employment.

This paper complements research that examines the effects of resources on outcomes at the county level at the United States. One line of research has focused on the extent to which there are positive or negative spillovers from resources to other industries. Another line of research has examined boom-bust cycles. Consistent with these lines of research, we find positive spillovers from resources to other sectors and evidence that boom-bust cycles can cause a resource curse through asymmetric effects of increases and declines. The differential effects of busts in employment are large and statistically significant for oil during 1936-1969 and coal during 1970-2015.

This paper contributes to the debate within economic history regarding the importance of resources for growth. We find increases in resource employment are positively and significantly related to growth in per capita income for the period 1936-2015 and for the sub-period 1936-1969. To further explore the historical effects of resources, one would like to push the analysis back in time. One of the difficulties in doing so is the low frequency of state per capita income estimates – decadal – prior to 1929 and the fact that six western states entered the U.S. between 1890 and 1912. Oil, coal, and agricultural

employment were on average trending up during the nineteenth and early twentieth centuries. One can speculate that resources were likely to have been a blessing in the United States prior to 1936.

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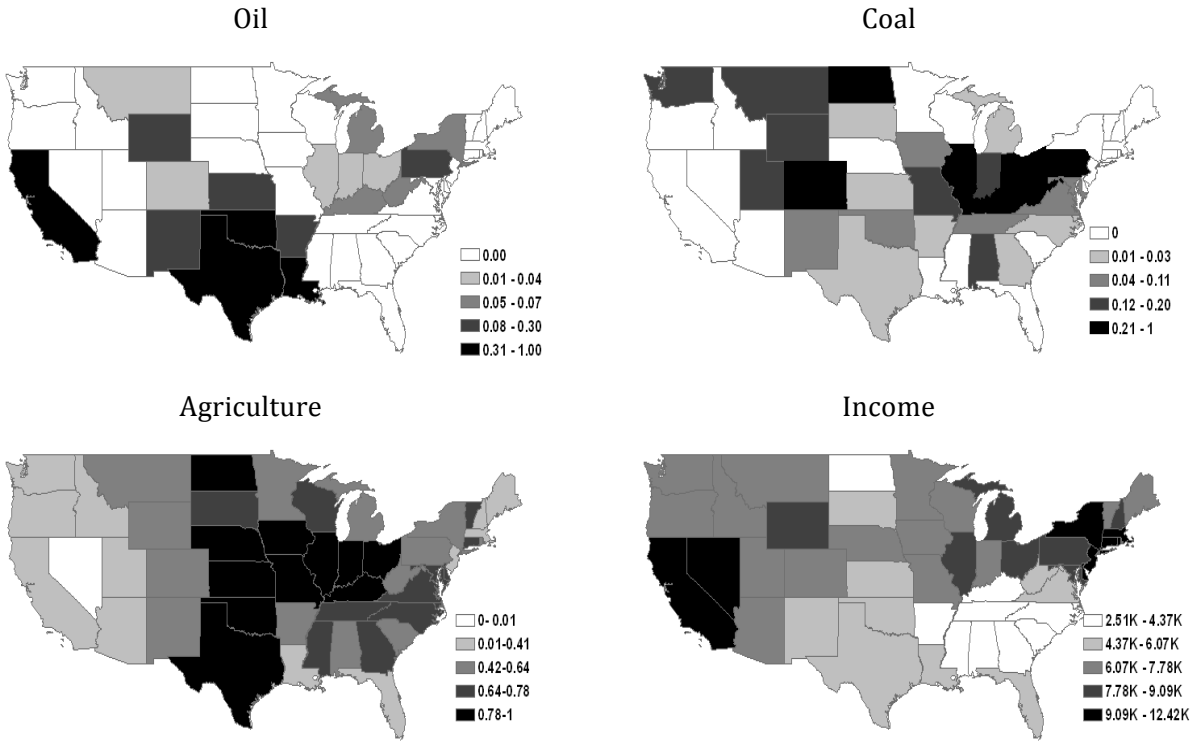
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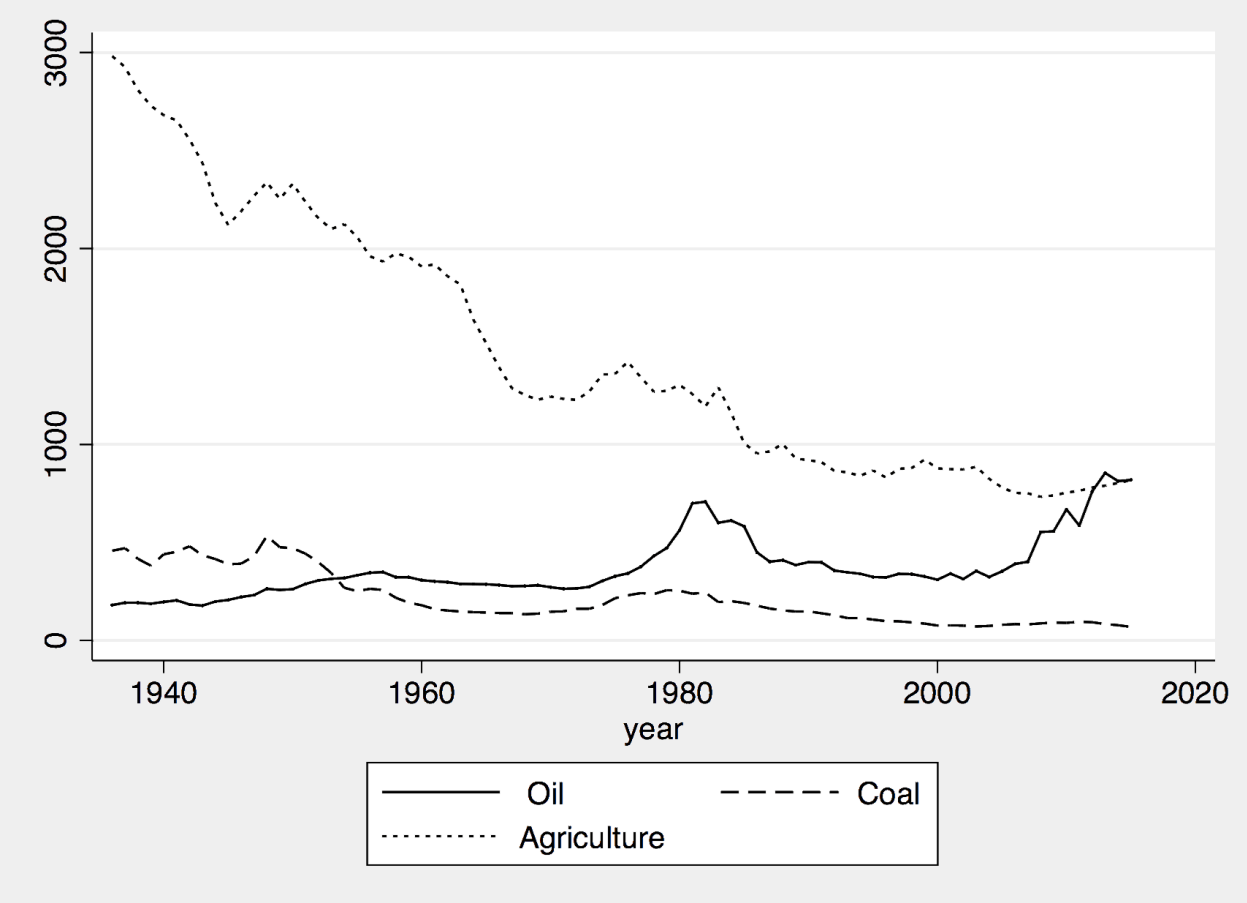
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Figure 1 - Resource Endowments in 1935



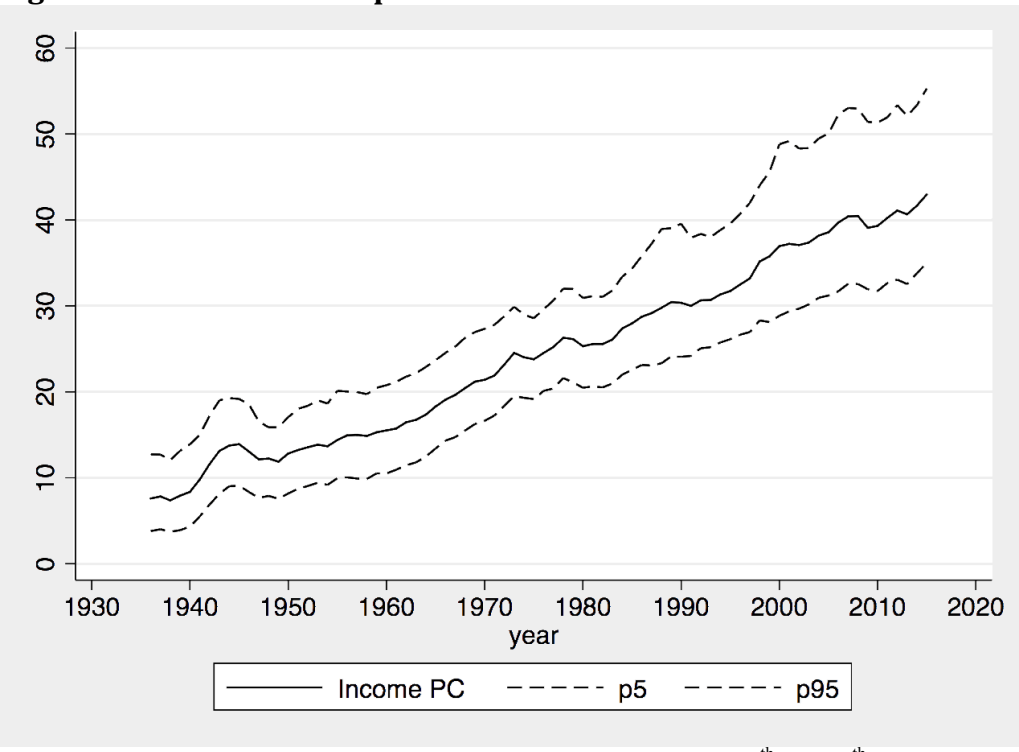
Notes: This figure maps average income per and the resource endowments as of 1935. The gradients are based on percentiles, conditional on nonzero value of resources and income ((0-25, 25-50, 50-75, 75-100)). Income PC is average income per capita in 1929-1935, in 2010 dollars. Oil map plots the dollar value of oil reserve in 1935, using 1935 oil prices. Coal map shows the dollar value of recoverable coal reserves in 1935, assuming 50% loss in production using average coal price in 1935. Agriculture map plots the value of land used in agriculture in 1935, using national farm land price in 1935.

Figure 2 – Employment: Resource Sectors



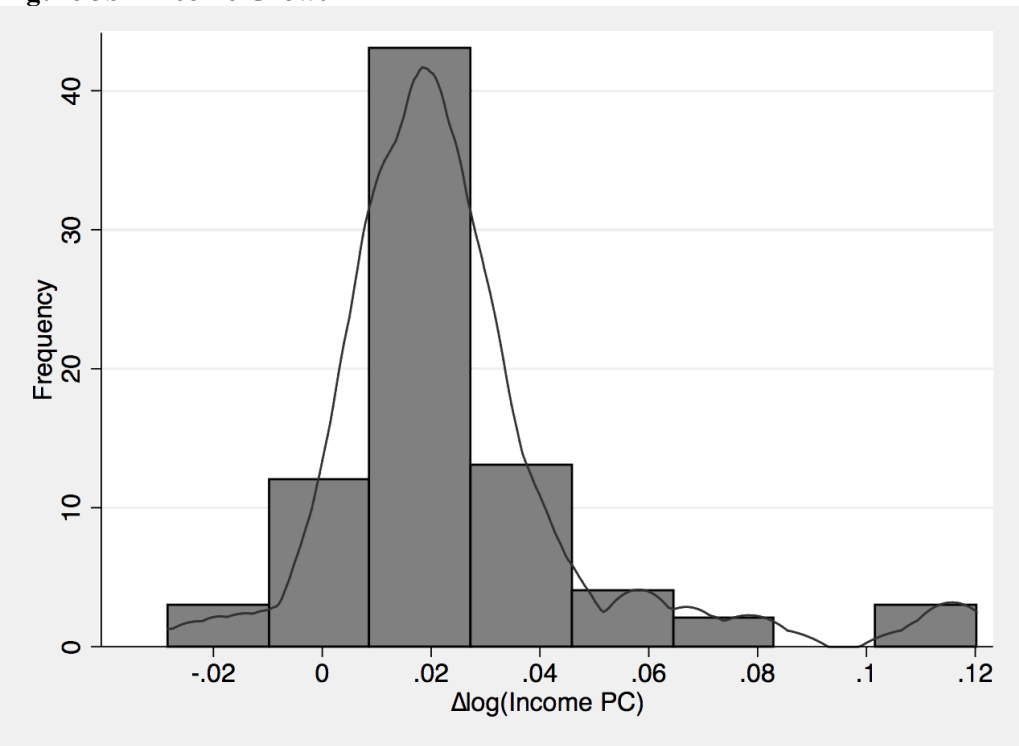
Notes: National Employment (in thousands) over time (1935-2015) in different sectors based on 1987 Standard Industrial Classification (SIC) for 1935-1998 and based on North American Industry Classification System (NAICS) for 1999-2015: Agriculture, Oil and Gas extraction. Data are taken from Bureau of Economic Analysis (BEA). Coal mining employment are taken form U.S. Bureau of Labor Statistics (BLS).

Figure 3a - Income Per Capita Over Time



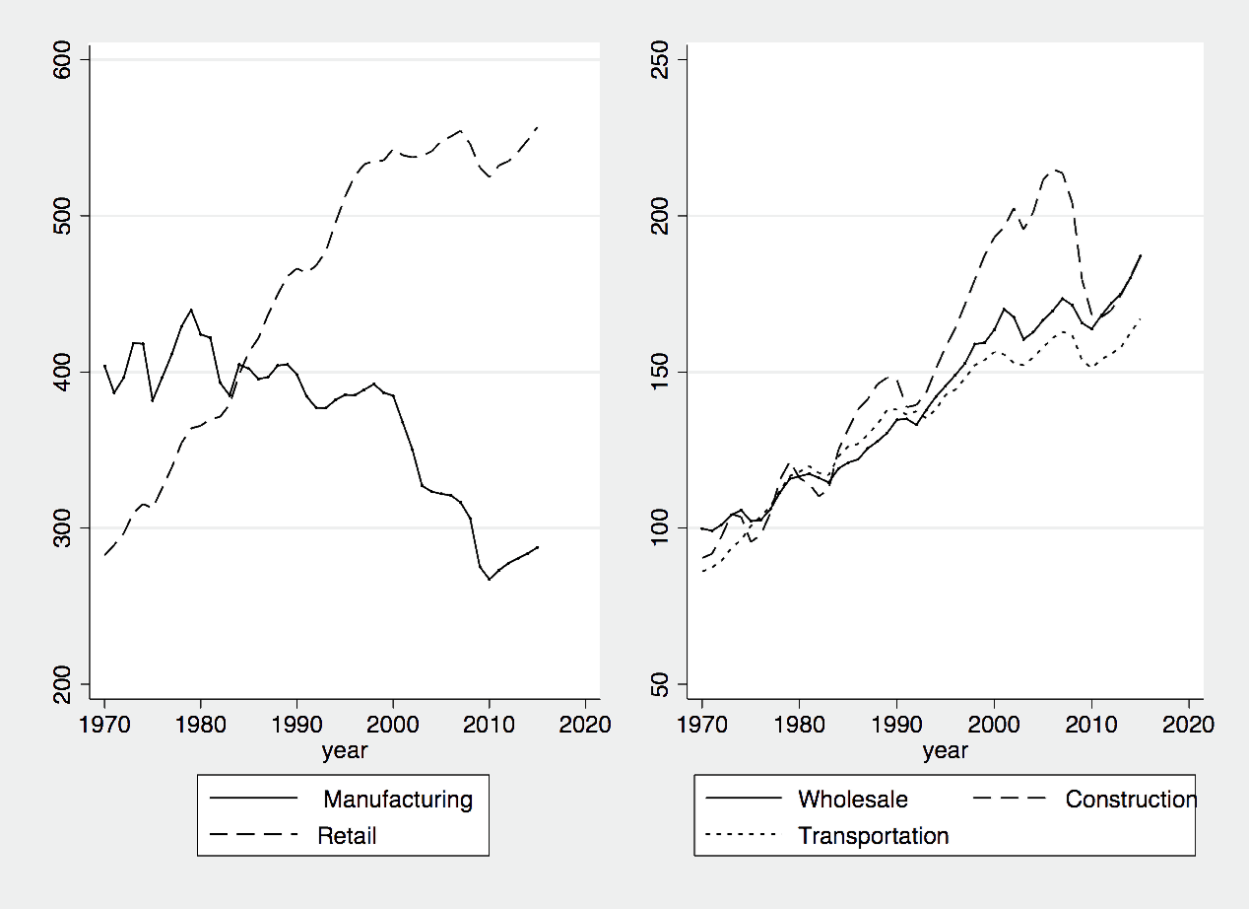
Notes: Graph plots Income Per Capita 1936-2015 in 2015 dollars and 5th and 95th percentile.

Figure 3b - Income Growth



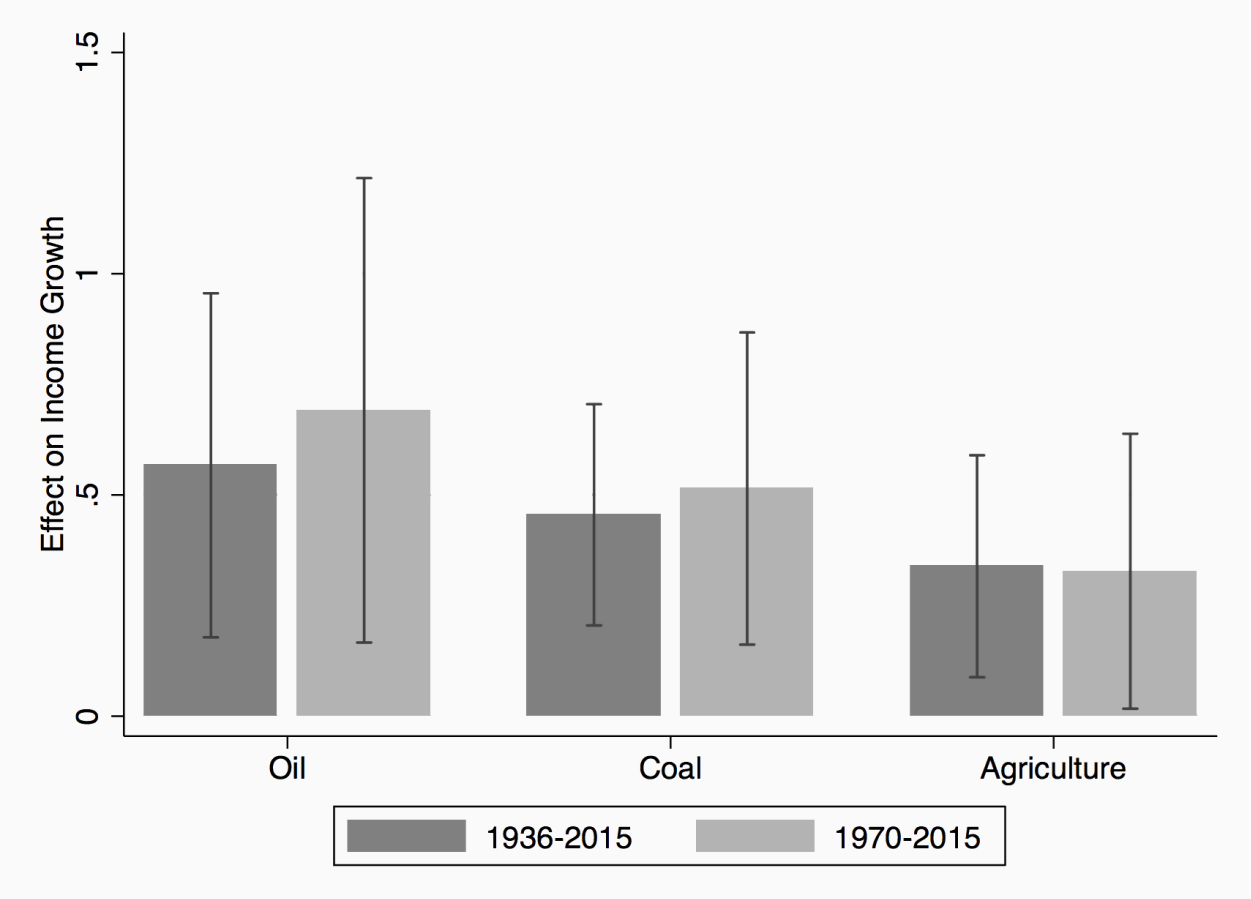
Notes: Graph plots the distribution of the main dependent variable: five-year difference in log of income per capita.

Figure 4 – Employment: Non Resource Sectors



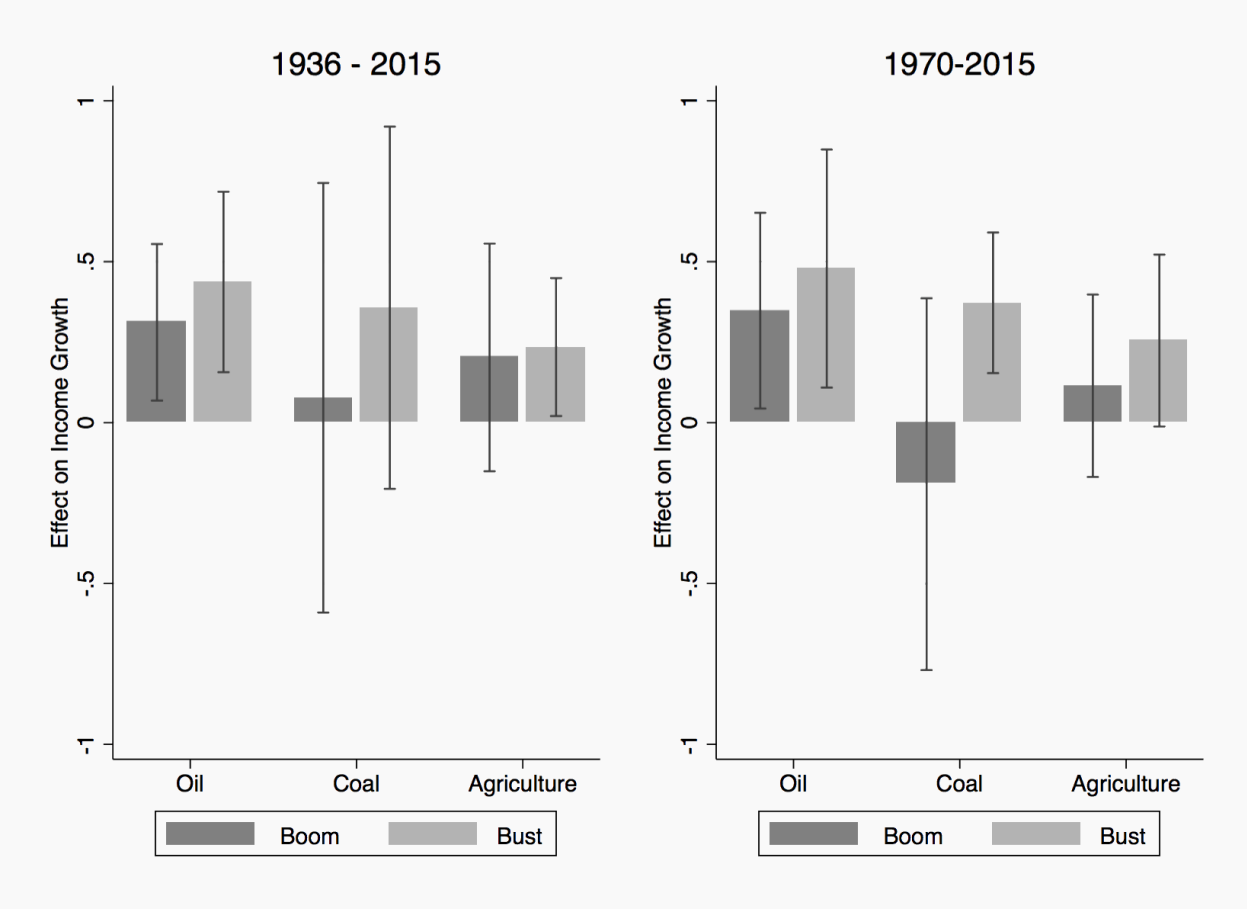
Notes: The average state employment in non resource sectors: manufacturing, construction, transportation, wholesale, and retail over 1970-2015 based on 1987 Standard Industrial Classification (SIC) for 1935-1998 and based on North American Industry Classification System (NAICS) for 1999-2015. Data are taken from Bureau of Economic Analysis (BEA).

Figure 5 – Effects of a One Standard Deviation Increase in Employment for Each Resource



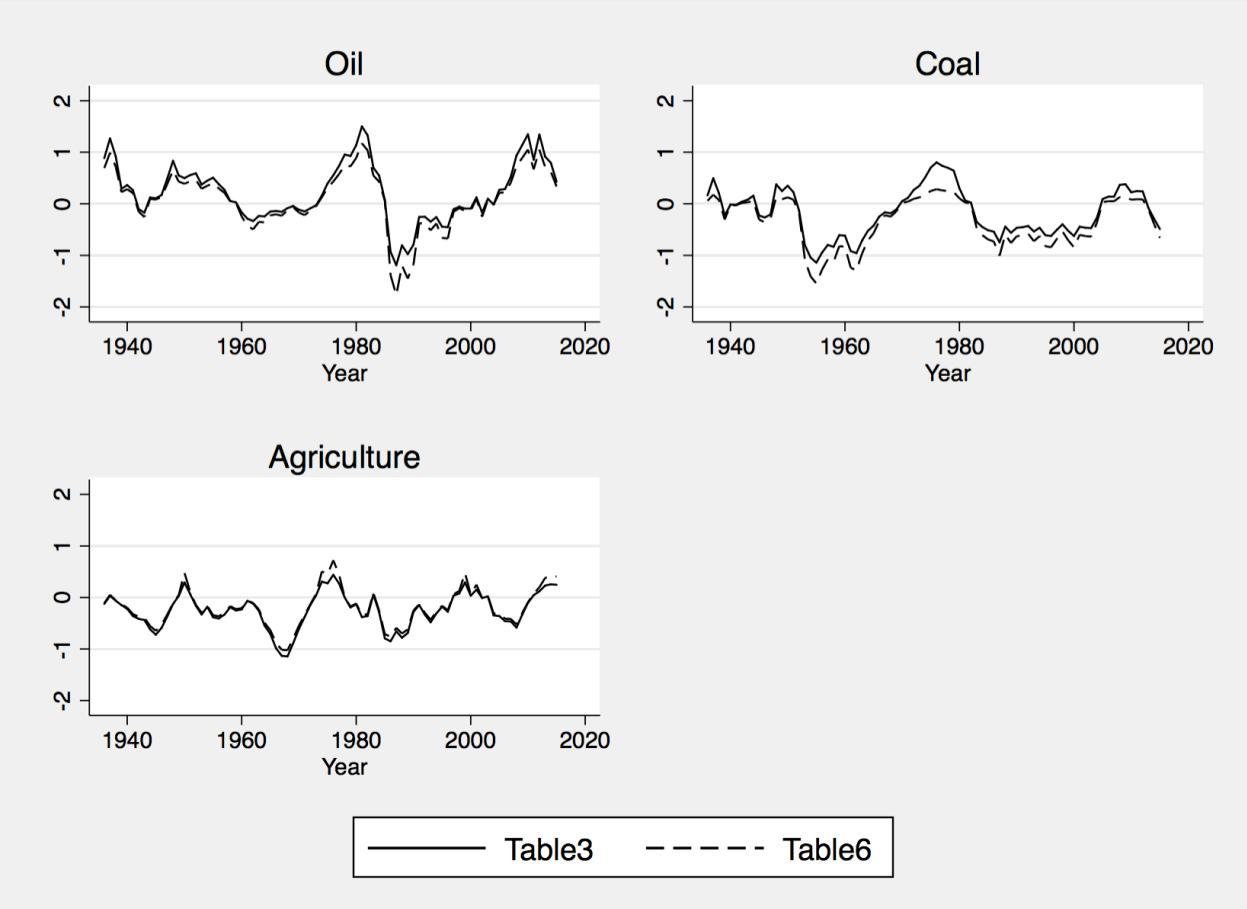
Notes: Figure based on Table 3 columns 4 and 6 and shows the effects of a one standard deviation increase in employment for each resource for two time periods: 1936-2015 and 1970-2015 with a 95% confidence intervals.

Figure 6 – Effects of Natural Resources on Income: Booms and Busts



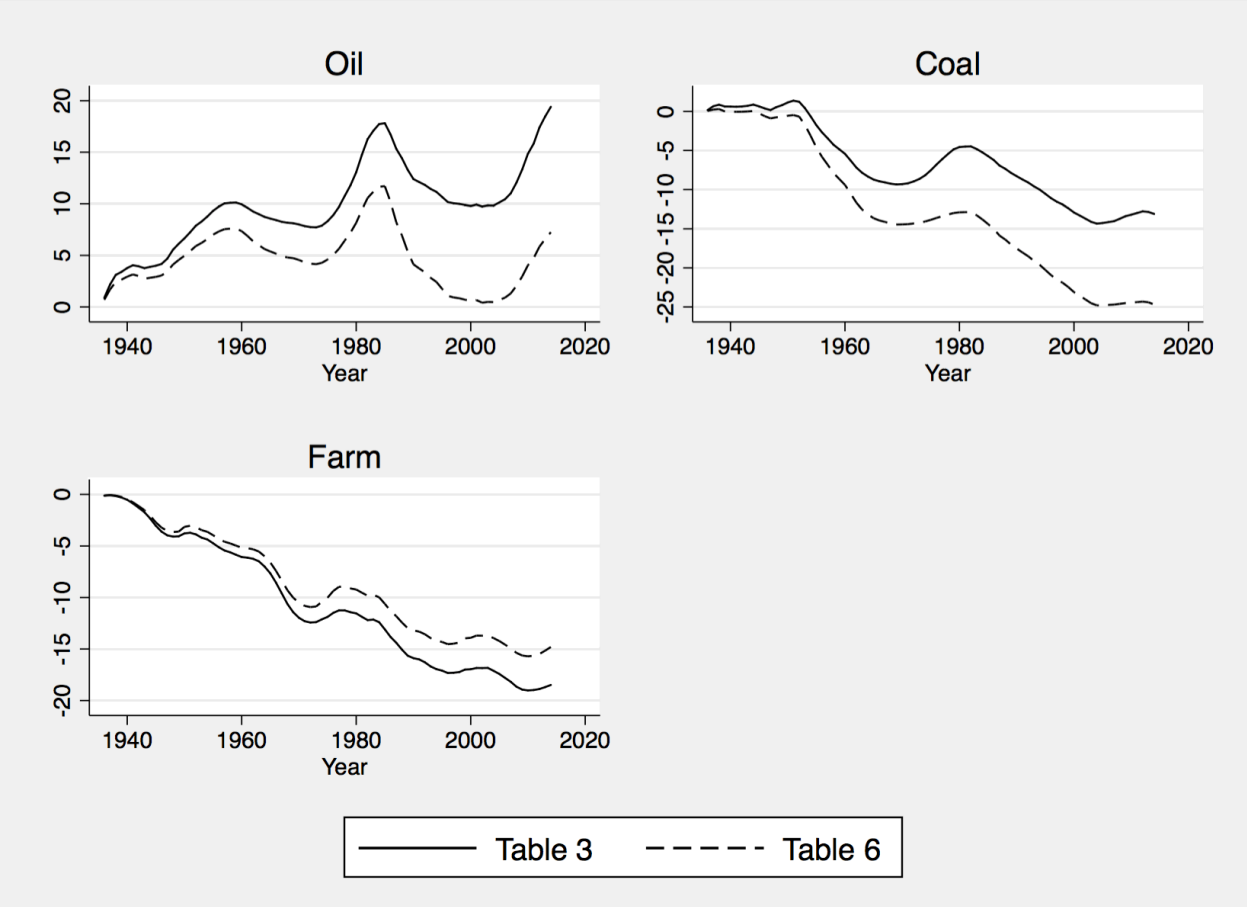
Notes: Figure based on table 6 columns 1 and 3 and shows the effect of a one standard deviation change in resource employment on income growth and 95% confidence intervals for two time periods: 1936-201 and 1970-2015.

Figure 7 – Effects of Natural Resources on Income: Booms and Busts



Notes: Figure based on table 3 column 4 and table 6 column and shows the effect of each resource on income growth over time.

Figure 8 – Cumulative Effects of Natural Resources on Income



Notes: Figure based on table 3 column 4 and table 6 column 1 and shows the cumulative effect of each resource on income growth.

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 growth pc GDP	Primary products(ag, forest, fish, mining)/exports, minerals/GDP	Country	1970-1990	Y
Boyce and Emery 2011	Cross sectional	Growth pc GSP	Mining share employment in 1970	State	1970-2001	Y growth, N income
Goldberg, Wibbles, Mvukiyehe 2008	Cross sectional	Income pc	Ln(Average Coal + oil production as a share of state income)	State	1929-2002	Y
Papyrakis and Gerlagh 2007	Cross sectional	Growth pc GSP	Primary sector share of GSP in 1986 (value added)	State	1986-2000	Y
James and Aadland 2011	Cross sectional	Growth pci	Percent of earnings in agriculture, forestry, fishing, mining in 1980	County (w state FE)	1980-1995	Y
Allcott and Keniston 2015	Time series	Employment, earnings, population	Oil and gas production	County	1969-2011	N
Black et al 2005	Time series	Employment, earnings, earnings per worker	Coal earnings/total earnings > 10%	County in 4 states	1970-1989	Asym-metric, net curse
Boyce and Emery 2011	Time series	Income pc, growth pci	Mining share employment	State	1970-2001	Y growth, N income
Feyrer et al 2016	Time series	Income, wages, employment	New value of oil and gas per capita	County, State	2005-2012	N
Goldberg, Wibbles, Wvukiyehe 2008	Time series	Growth pci	Ln(coal + oil)/state income	State	1929-2002	Y
Jacobsen and Parker 2014	Time series	Employment, income, wages	Boom increase in Oil and gas wells > 200	County in 9 states	1969-1998	Asym-metric, net curse
Michaels 2011	Time series	Income, employment, population, infrastructure	Oil reserves	County in southern states	1890-1990	N
Weber 2012		Employ-ment, earnings	Natural gas production	County in 3 states	1999-2007	N
Weber 2014	Time series	Employment, earnings per job, education	Natural gas production	County in 4 states	2000-2010	N

Table 2 - Summary Statistics

	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
	1936-2015		**1936-1969**		**1970-2015**	
Inc PC	3.065	0.530	2.567	0.382	3.434	0.246
ΔIncPC	0.025	0.029	0.036	0.038	0.016	0.013
ΔOilEmp	0.022	0.054	0.022	0.037	0.022	0.064
ΔCoalEmp	-0.020	0.050	-0.032	0.050	-0.011	0.049
ΔFarmEmp	-0.016	0.022	-0.023	0.022	-0.011	0.021
ΔMnfEmp					-0.003	0.025
ΔDurableEmp					-0.001	0.031
ΔNondurableEmp					-0.003	0.021
ΔPetroCoalEmp					0.003	0.071
ΔTransportationEmp					0.014	0.016
ΔConstructionEmp					0.015	0.039
ΔRetailEmp					0.016	0.017
ΔWholesaleEmp					0.017	0.023
ΔMinWage					0.052	0.074
ΔFarmWage					0.043	0.041
ΔMnfctWage					0.047	0.023
ΔOilEmp(Decline=1)	-0.028	0.028	-0.017	0.008	-0.034	0.033
ΔOilEmp(Decline=0)	0.057	0.038	0.043	0.029	0.069	0.040
ΔCoalEmp(Decline=1)	-0.053	0.029	-0.055	0.039	-0.052	0.014
ΔCoalEmp(Decline=0)	0.033	0.024	0.025	0.015	0.037	0.027
ΔFarmEmp(Decline=1)	-0.026	0.017	-0.027	0.020	-0.024	0.015
ΔFarmEmp(Decline=0)	0.010	0.008	0.007	0.007	0.011	0.008
Nobs	3840	3840	1,632	1,632	2,208	2,208

Notes: Summary statistics for the main variables used in the analysis for the whole sample 1936-2015 and two subsamples: 1936-1969 and 1970-2015. Δ is five-year difference in logged variables.

Table 3- Effects of Natural Resources on Per Capita Income Growth

	(1)	(2)	(3)	(4)	(5)	(6)
	1936-2015	1936-1969	1970-2015	1936-2015	1936-1969	1970-2015
	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC
VARIABLES	D1	D1	D1	D5	D5	D5
OilEnd X ΔOilEmp	0.061**	-0.078	0.083**	0.105***	0.088*	0.108**
	(0.026)	(0.152)	(0.038)	(0.036)	(0.044)	(0.041)
CoalEnd X ΔCoalEmp	0.031	0.025	0.029	0.091***	0.067	0.105***
	(0.057)	(0.047)	(0.082)	(0.025)	(0.068)	(0.036)
FarmEnd X ΔFarmEmp	0.018	0.142	-0.048	0.154***	0.175**	0.156**
	(0.052)	(0.103)	(0.049)	(0.057)	(0.079)	(0.074)
Observations	3,840	1,632	2,208	3,840	1,632	2,208
R-squared	0.776	0.775	0.741	0.915	0.926	0.779

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔInc PC is difference in log of income per capita. D1 and D5 represent one and five year differences. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, division by year and state 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 – Effects of Natural Resources on Employment and Wages

	(1)	(2)	(3)	(4)	(5)
	1970-2015	1970-2015	1970-2015	1970-2015	1970-2015
	ΔInc PC	ΔMnfct Emp	ΔMin Wage	ΔFarm Wage	ΔMnfct Wage
VARIABLES	D5	D5	D5	D5	D5
OilEnd X ΔOilEmp	0.108**	0.138*	0.727***	-0.159	-0.018
	(0.041)	(0.071)	(0.200)	(0.106)	(0.038)
CoalEnd X ΔCoalEmp	0.105***	0.096**	1.307***	-0.060	0.117**
	(0.036)	(0.043)	(0.172)	(0.125)	(0.053)
FarmEnd X ΔFarmEmp	0.156**	0.234**	0.944	1.178***	0.160*
	(0.074)	(0.091)	(0.756)	(0.342)	(0.093)
Observations	2,208	2,014	1,531	1,536	2,014
R-squared	0.779	0.843	0.669	0.682	0.945

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔInc PC is difference in log of income per capita. ΔMnfct Emp is the difference in logged manufacturing employment. ΔMinWage, ΔFarmWage and ΔMnfctWage are differences in wage in mining, agricultural and manufacturing sectors respectively. D5 represents five-year difference. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, division by year and state 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 - Employment Effects for Subsectors

	(1)	(2)	(3)	(4)
	1970-2015	1970-2015	1970-2015	1970-2015
	ΔInc PC	ΔDurableEmp	ΔNonDurableEmp	ΔPetroCoalEmp
VARIABLES	D5	D5	D5	D5
OilEnd X ΔOilEmp	0.108**	0.161	0.092**	0.308***
	(0.041)	(0.097)	(0.043)	(0.090)
CoalEnd X ΔCoalEmp	0.105***	0.167**	0.018	-0.004
	(0.036)	(0.070)	(0.042)	(0.266)
FarmEnd X ΔFarmEmp	0.156**	0.210	0.140	-0.055
	(0.074)	(0.156)	(0.097)	(0.682)
Observations	2,208	2,008	2,008	1,785
R-squared	0.779	0.802	0.847	0.317

	(5)	(6)	(7)	(8)
	1970-2015	1970-2015	1970-2015	1970-2015
	ΔTransportationEmp	ΔConstructionEmp	ΔRetailEmp	ΔWholesaleEmp
VARIABLES	D5	D5	D5	D5
OilEnd X ΔOilEmp	0.135*	0.218	0.072	0.113
	(0.076)	(0.134)	(0.046)	(0.073)
CoalEnd X ΔCoalEmp	0.082*	0.417***	0.111***	0.157**
	(0.043)	(0.086)	(0.022)	(0.064)
FarmEnd X ΔFarmEmp	0.033	0.414	0.008	0.292
	(0.127)	(0.340)	(0.082)	(0.198)
Observations	2,008	2,010	2,016	2,016
R-squared	0.738	0.749	0.892	0.790

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔIncPC is difference in log of income per capita. ΔDurableEmp, ΔNonDurableEmp, ΔPetroCoalEmp, ΔTransportationEmp, ΔConstructionEmp, ΔRetailEmp and ΔWholesaleEmp are differences in logged employment in durable, nondurable, petroleum products, transportation, construction, retail and wholesale sectors respectively. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, division by year and state 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 - Effects of Natural Resources on Income: Booms and Busts

VARIABLES	(1) 1936-2015 ΔInc PC D5	(2) 1936-1969 ΔInc PC D5	(3) 1970-2015 ΔInc PC D5	(4) 1970-2015 ΔMnfctEmp D5
(OilEmpDecline=0) X	0.082**	0.017	0.087**	0.094
OilEnd X ΔOilEmp	(0.032)	(0.055)	(0.038)	(0.098)
(OilEmpDecline=1) X	0.156***	0.407***	0.145**	0.215*
OilEnd X ΔOilEmp	(0.050)	(0.140)	(0.056)	(0.128)
(CoalEmpDecline=0) X	0.032	0.097	-0.071	0.200
CoalEnd X ΔCoalEmp	(0.139)	(0.174)	(0.107)	(0.184)
(CoalEmpDecline=1) X	0.123	0.053	0.266***	0.002
CoalEnd X ΔCoalEmp	(0.097)	(0.119)	(0.078)	(0.132)
(FarmEmpDecline=0) X	0.253	1.229*	0.143	-0.196
FarmEnd X ΔFarmEmp	(0.221)	(0.721)	(0.177)	(0.314)
(FarmEmpDecline=1) X	0.138**	0.107	0.170*	0.367**
FarmEnd X ΔFarmEmp	(0.063)	(0.087)	(0.089)	(0.160)
Observations	3,840	1,632	2,208	2,014
R-squared	0.915	0.926	0.781	0.843

Notes: Decline is a dummy variable indicating a decline in respective sectoral employment. Decline = 0 means no decline, Decline=1 means decline in employment between t to t-5. OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔIncPC is difference in log of income per capita. ΔMnfctEmp is difference in manufacturing employment. D5 represent five-year difference, i.e. the difference between t and t-5. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, and division by year and state 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 - Booms and Busts Comparisons

VARIABLES	(1) ΔIncPC D1 1969-2011	(2) ΔTotEmp D1 1969-2011	(3) ΔMinEmp D1 1969-2011	(4) ΔMnfctEmp D1 1969-2011
Panel A. Allcott and Keniston (2015)				
OilEnd X ΔOilEmp	0.158**	0.134**	-0.209	0.179**
	(0.060)	(0.062)	(0.596)	(0.088)
OilEnd X ΔOilEmp X	-0.097**	-0.035	0.175	0.032
(OilEmpDecline=1)	(0.041)	(0.041)	(0.467)	(0.097)
OilEnd X ΔOilEmp X	-0.051**	-0.102**	-0.328	-0.188***
(year>2000)	(0.021)	(0.044)	(0.668)	(0.061)
Observations	2,064	2,016	1,163	2,014
R-squared	0.744	0.823	0.540	0.832
VARIABLES	(5) ΔIncPC 1969-1998	(6) ΔTotEmp 1969-1998	(7) ΔMinEmp 1969-1998	(8) ΔMnfctEmp 1969-1998
Panel B. Jacobsen and Parker (2014)				
OilRichStateX	0.006**	0.001	-0.029	-0.005
Early Boom (1975–1979)	(0.003)	(0.004)	(0.020)	(0.005)
OilRichState X	-0.003	0.0001	-0.038	-0.010
Peak Boom(1980–1981)	(0.005)	(0.007)	(0.042)	(0.013)
OilRichState X	-0.007	-0.013*	-0.042	-0.022*
Bust(1982–1985)	(0.006)	(0.007)	(0.037)	(0.011)
OilRichState X	-0.004***	-0.008**	-0.009	-0.0001
Post Bust(1986–1998)	(0.001)	(0.004)	(0.011)	(0.004)
Observations	1,440	1,392	887	1,392
VARIABLES	(9) ΔIncPC 1970-1989	(10) ΔTotEmp 1970-1989	(11) ΔMinEmp 1970-1989	(12) ΔMnfctEmp 1970-1989
Panel C. Black et al (2005)				
CoalRichStateX	0.004*	-0.004	0.004	-0.008
Boom (1970-1977)	(0.002)	(0.002)	(0.016)	(0.007)
CoalRichState X	0.002	-0.003	-0.034	-0.017*
Peak (1978-1982)	(0.003)	(0.005)	(0.024)	(0.009)
CoalRichState X	-0.008**	-0.014***	-0.019	-0.015***
Bust (1983-1989)	(0.003)	(0.005)	(0.016)	(0.003)
Observations	960	960	666	960
R-squared	0.752	0.734	0.448	0.778

Notes: In all specifications Δ is a one-year difference, i.e. the difference between t and t- 1. Panel A. estimates specifications similar to the Allcott and Keniston (2015). Decline=1 means decline in employment between t to t-1. Panel B. estimates specifications similar to the Jacobsen and Parker (2014).

Effects are relative to pre-boom period (1969–74). Periods are defined as follows: Early boom (1975–19799), peak boom (1980–1981), bust (1982–1985) and post-bust (1986–1998). Panel C estimates specifications similar to the Black et al (2005). The relevant time periods are defined as follows: Boom (1970-1977), Peak (1978-1982), Bust (1983-1989).

Table 8 – Comparison: Cross Sectional Results

VARIABLES	(1) 1970-1999 ΔIncPC	(2) 1986-2000 ΔIncPC	(3) 2000 ΔIncPC	(4) 2000 Ln(IncPC)	(5) 2000 Ln(IncPC)
Mining Employment Share in 1970	-0.015*				
	(0.008)				
PriamrySectorProduction/GDP		-4.72**			
		(2.38)			
Ln(Total Min x 100/Income)			-0.034**		
			(0.015)		
Ln(Oil per capita)				-0.014***	
				(0.004)	
Ln(Total Min per capita)					-0.053***
					(0.013)
Initial Income	No	Yes	Yes	No	No
South	No	No	Yes	Yes	Yes
Observations	48	49	48	48	48
R-squared	0.063	0.33	0.71	0.293	0.393

Notes: Column 1 is similar to Boyce and Emery (2011) Table 3 column 1. Sample does not include Alaska, Hawaii and District of Columbia. Column 2 is similar to Papyrakis and Gerlagh (2007) Table 1 column 2. Independent variables are the primary sector's production (agriculture, forestry, fishing, and mining) in GSP and log of per capita income in 1986 (not reported). Column 2 does not include Delaware and District of Columbia. Column 3 presents a regression similar to Goldberg et al (2008), Table 1 column 1. Columns 4 -5 present results in the spirit of Alexeev and Conrad (2009).

Appendix

Table 1A – Summary Statistics

Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
	1936-2015		**1936-1969**		**1970-2015**	
ΔOilEmp	0.020	0.089	0.016	0.051	0.023	0.109
ΔCoalEmp	-0.023	0.081	-0.035	0.089	-0.015	0.074
ΔFarmEmp	-0.016	0.042	-0.025	0.036	-0.009	0.044
ΔOilInc	0.022	0.176	0.046	0.086	0.002	0.223
ΔCoalInc	-0.311	2.743	0.007	0.122	-0.575	3.688
ΔFarmInc	0.010	0.080	0.027	0.077	-0.005	0.079
Δ5_OilInc	0.026	0.072	0.049	0.039	0.007	0.086
Δ5_CoalInc	-0.310	1.196	0.009	0.055	-0.574	1.569
Δ5_FarmInc	0.011	0.045	0.032	0.048	-0.006	0.033
Obs	3,840		1,632		1,968	

Notes: Summary statistics for the variables used in the analysis for the whole sample 1936-2015 and two subsamples: 1936-1969 and 1970-2015. Δ is one-year difference in logged variables. Δ5 is five-year difference in logged variables.

Table 2A – Effects of Natural Resources: Value of Farm Land as Farm Endowment

	(1)	(2)	(3)	(4)	(5)	(6)
	1936-2015	1936-1969	1970-2015	1936-2015	1936-1969	1970-2015
	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC
VARIABLES	D1	D1	D1	D5	D5	D5
OilEnd X ΔOilEmp	0.061**	-0.072	0.083**	0.111***	0.103**	0.113***
	(0.026)	(0.150)	(0.038)	(0.037)	(0.046)	(0.042)
CoalEnd X ΔCoalEmp	0.031	0.027	0.030	0.095***	0.069	0.110***
	(0.057)	(0.047)	(0.082)	(0.024)	(0.067)	(0.036)
FarmEnd X ΔFarmEmp	0.055	0.225	-0.023	0.012	0.114	-0.042
	(0.063)	(0.165)	(0.058)	(0.079)	(0.126)	(0.082)
Observations	3,840	1,632	2,208	3,840	1,632	2,208
R-squared	0.776	0.775	0.741	0.914	0.926	0.778

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔInc PC is difference in log of income per capita. D1 and D5 represent one and five year differences. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, division by year and state 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 3A – Income: Effects of Natural Resources on Income

	(1)	(2)	(3)	(4)	(5)	(6)
	1936-2000	1936-1969	1970-2000	1936-2015	1936-1969	1970-2000
	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC	ΔInc PC
VARIABLES	D1	D1	D1	D5	D5	D5
OilEnd X ΔOilInc	0.034**	-0.038	0.043**	0.067***	0.080*	0.072**
	(0.017)	(0.046)	(0.019)	(0.022)	(0.046)	(0.028)
CoalEnd X ΔCoalInc	-0.0004	0.155***	-0.0005	-0.001	0.139	-0.001
	(0.001)	(0.044)	(0.001)	(0.001)	(0.108)	(0.001)
FarmEnd X ΔFarmInc	0.029	-0.003	0.037	0.051	0.009	0.086
	(0.041)	(0.069)	(0.036)	(0.061)	(0.083)	(0.058)
Observations	3,600	1,632	1,968	3,600	1,632	1,968
R-squared	0.777	0.776	0.749	0.915	0.927	0.773

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilInc, ΔCoalInc and ΔFarmInc are changes in the logged national income in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔInc PC is difference in log of income per capita. D1 and D5 represent one and five year differences. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, division by year and state 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 4A – Effects of Natural Resources on Employment and Wages

	(1)	(2)	(3)	(4)	(5)
	1970-2015	1970-2015	1970-2015	1970-2015	1970-2015
VARIABLES	ΔInc PC	ΔMnfct Emp	ΔMin Wage	ΔFarm Wage	ΔMnfct Wage
Panel A. D1 - Employment					
OilEnd X ΔOilEmp	0.083**	0.100*	0.608***	-0.114	-0.008
	(0.038)	(0.058)	(0.180)	(0.079)	(0.026)
CoalEnd X ΔCoalEmp	0.029	0.185***	1.334***	-0.049	0.089***
	(0.082)	(0.039)	(0.233)	(0.138)	(0.032)
FarmEnd X ΔFarmEmp	-0.048	0.105	-0.020	0.662***	0.033
	(0.049)	(0.076)	(0.362)	(0.226)	(0.033)
Observations	2,208	2,206	1,529	1,536	2,206
R-squared	0.741	0.830	0.503	0.626	0.814
Panel B. D1 - Income					
OilEnd X ΔOilInc	0.043**	0.035***	0.201**	-0.003	0.020***
	(0.019)	(0.012)	(0.078)	(0.032)	(0.005)
CoalEnd X ΔCoalInc	-0.0005	0.0004	0.337***	-0.026	0.0003
	(0.001)	(0.0005)	(0.088)	(0.098)	(0.001)
FarmEnd X ΔFarmInc	0.037	-0.020	-0.210	-0.110	0.026
	(0.036)	(0.044)	(0.230)	(0.141)	(0.026)
Observations	1,968	1,966	1,529	1,536	1,966
R-squared	0.749	0.830	0.486	0.623	0.798
Panel C. D5 - Income					
OilEnd X ΔOilInc	0.072**	0.107***	0.507***	-0.056	-0.015
	(0.028)	(0.030)	(0.149)	(0.062)	(0.030)
CoalEnd X ΔCoalInc	-0.001	-0.004***	0.701***	-0.063	-0.001
	(0.001)	(0.001)	(0.131)	(0.073)	(0.001)
FarmEnd X ΔFarmInc	0.086	0.154	-0.145	0.943***	0.102
	(0.058)	(0.094)	(0.562)	(0.248)	(0.080)
Observations	1,968	1,774	1,531	1,536	1,774
R-squared	0.773	0.848	0.654	0.684	0.937

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔInc PC is difference in log of income per capita. ΔOilInc, ΔCoalInc and ΔFarmInc are changes in the logged national income in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔInc PC is difference in log of income per capita ΔMnfctEmp is the difference in logged manufacturing employment. ΔMinWage, ΔFarmWage and ΔMnfctWage are differences in wages in mining, agricultural and manufacturing sectors respectively. D1 represent a one year year difference, i.e. the difference between t and t-1. D5 represent five-year difference, i.e. the difference between t and t-5. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, division by year and state 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 5A.1 –Employment Effects for a Variety of Subsectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔInc PC	ΔDurable Emp	ΔNonDurable Emp	ΔPetroCoal Emp	ΔTransportation Emp	ΔConstruction Emp	ΔRetail Emp	ΔWholesale Emp
VARIABLES	D1	D1	D1	D1	D1	D1	D1	D1
Panel A. D1 Employment: 1970-2015								
OilEnd X	0.083**	0.134	0.052**	0.299***	0.079	0.148*	0.053**	0.086*
ΔOilEmp	(0.038)	(0.083)	(0.024)	(0.103)	(0.048)	(0.087)	(0.026)	(0.047)
CoalEnd X	0.029	0.305***	0.037	-0.010	0.087***	0.305***	0.057***	0.100*
ΔCoalEmp	(0.082)	(0.067)	(0.033)	(0.232)	(0.030)	(0.089)	(0.017)	(0.057)
FarmEnd X	-0.048	0.139	0.020	0.098	-0.046	0.219	0.029	0.006
ΔFarmEmp	(0.049)	(0.095)	(0.055)	(0.439)	(0.036)	(0.151)	(0.034)	(0.084)
Observations	2,208	2,202	2,202	1,999	2,202	2,202	2,208	2,208
R-squared	0.741	0.786	0.757	0.269	0.741	0.714	0.837	0.695

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔInc PC is difference in log of income per capita. ΔDurableEmp, ΔNonDurableEmp, ΔPetroCoalEmp, ΔTransportationEmp, ΔConstructionEmp, ΔRetailEmp and ΔWholesaleEmp are differences in logged employment in durable, nondurable, petroleum products, transportation, construction, retail and wholesale sectors respectively. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, division by year and state 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 5A.2 – Effects for a Variety of Subsectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔInc PC	ΔDurable Emp	ΔNonDurable Emp	ΔPetroCoal Emp	ΔTransportation Emp	ΔConstruction Emp	ΔRetail Emp	ΔWholesale Emp
VARIABLES	D1	D1	D1	D1	D1	D1	D1	D1
Panel A. D1 Income: 1970-2000								
OilEnd X	0.043**	0.043***	0.018*	0.030	0.020	0.039	0.009	0.025*
ΔOilInc	(0.019)	(0.013)	(0.010)	(0.053)	(0.014)	(0.029)	(0.009)	(0.013)
CoalEnd X	-0.0005	0.0009	-0.0003	-0.007**	0.0002	0.0003	-0.0002	-0.0002
ΔCoalInc	(0.0007)	(0.0006)	(0.0004)	(0.003)	(0.0004)	(0.001)	(0.0002)	(0.0003)
FarmEnd X	0.037	-0.016	-0.041	-0.016	-0.066**	-0.171**	-0.028	-0.127***
ΔFarmInc	(0.036)	(0.053)	(0.036)	(0.236)	(0.028)	(0.084)	(0.018)	(0.043)
Observations	1,968	1,962	1,962	1,779	1,962	1,962	1,968	1,968
R-squared	0.749	0.784	0.759	0.263	0.758	0.715	0.838	0.703
Panel B. D5 Income: 1970-2000								
OilEnd X	0.072**	0.106**	0.090***	0.155*	0.079*	0.164*	0.056	0.071
ΔOilInc	(0.028)	(0.043)	(0.022)	(0.086)	(0.046)	(0.095)	(0.037)	(0.055)
CoalEnd X	-0.001	-0.004*	-0.003***	-0.005	-0.0004	-0.0004	-0.001	-0.002*
ΔCoalInc	(0.001)	(0.002)	(0.001)	(0.007)	(0.001)	(0.002)	(0.001)	(0.001)
FarmEnd X	0.086	0.220	-0.031	0.174	-0.037	0.226	0.013	0.167*
ΔFarmInc	(0.058)	(0.148)	(0.062)	(0.646)	(0.063)	(0.245)	(0.040)	(0.084)
Observations	1,968	1,768	1,768	1,571	1,768	1,770	1,776	1,776
R-squared	0.773	0.801	0.855	0.322	0.757	0.710	0.882	0.786

Notes: See notes for Table 5A.1

Table 6A.1 - Effects of Natural Resources on Income: Booms and Busts (Differential Effects of Decline relative to Increase)

VARIABLES	(1) 1936-2015 ΔInc PC D5	(2) 1936-1969 ΔInc PC D5	(3) 1970-2015 ΔInc PC D5	(4) 1970-2015 ΔMnfcEmp D5
OilEnd X ΔOilEmp	0.082**	0.017	0.087**	0.094
	(0.032)	(0.055)	(0.038)	(0.098)
(OilEmpDecline=1) X	0.075**	0.389**	0.058	0.121
OilEnd X ΔOilEmp	(0.029)	(0.166)	(0.042)	(0.173)
CoalEnd X ΔCoalEmp	0.032	0.097	-0.071	0.200
	(0.139)	(0.174)	(0.107)	(0.184)
(ColaEmpDecline=1) X	0.090	-0.044	0.337*	-0.198
CoalEnd X ΔCoalEmp	(0.232)	(0.280)	(0.172)	(0.308)
FarmEnd X ΔFarmEmp	0.253	1.229*	0.143	-0.196
	(0.221)	(0.721)	(0.177)	(0.314)
(FarmEmpDecline=1) X	-0.116	-1.121	0.027	0.563
FarmEnd X ΔFarmEmp	(0.238)	(0.745)	(0.208)	(0.437)
Observations	3,840	1,632	2,208	2,014
R-squared	0.915	0.926	0.781	0.843

Notes: Decline is a dummy variable indicating a decline in respective sectoral employment. Decline=1 means decline in employment between t to t-5. OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔIncPC is difference in log of income per capita. ΔMnfcEmp is difference in manufacturing employment. D5 represent five year difference, i.e. the difference between t and t-5. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, and division by year and state 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 6A.2– Effects of Natural Resources on Income: Booms/Busts, Low Growth and South vs Non-South

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	D5IncPC	D5IncPC	D5IncPC	D5IncPC	D5IncPC	D5IncPC	D5IncPC	D5IncPC
		Employment 1936 -2015				**Income 1936 -2015**		
OilEnd X ΔOil	0.082**	0.106***	0.113***	0.084**	0.058**	0.067**	0.076***	0.065*
	(0.032)	(0.036)	(0.036)	(0.038)	(0.022)	(0.026)	(0.026)	(0.037)
(South=1) X			-0.018	-0.017			-0.028	-0.029
OilEnd X ΔOil			(0.038)	(0.038)			(0.023)	(0.024)
(Decline_OilEmp=1)	0.075**			0.083**	0.020			0.023
X OilEnd X ΔOil	(0.029)			(0.035)	(0.023)			(0.027)
(Low Growth=1) X		-0.006		0.006		0.004		0.012
OilEnd X ΔOilEmp		(0.025)		(0.029)		(0.021)		(0.024)
CoalEnd X ΔCoal	0.032	0.088***	0.085***	0.002	-0.000	-0.001	-0.001	-0.000
	(0.139)	(0.027)	(0.026)	(0.127)	(0.001)	(0.001)	(0.001)	(0.001)
(South=1) X			-0.012	-0.007			-0.005	-0.005
CoalEnd X ΔCoal			(0.205)	(0.207)			(0.004)	(0.004)
(Decline_CoalEmp=1)	0.090			0.123	-0.001			-0.001
X CoalEnd X ΔCoal	(0.232)			(0.220)	(0.001)			(0.001)
(Low Growth=1) X		0.030		0.033		-0.045		-0.046*
CoalEnd X ΔCoal		(0.040)		(0.038)		(0.027)		(0.027)
FarmEnd X ΔFarm	0.253	0.159**	0.163**	0.311	0.085	0.039	0.052	0.072
	(0.221)	(0.059)	(0.062)	(0.229)	(0.057)	(0.064)	(0.061)	(0.059)
(South=1) X	-0.116			-0.164			-0.010	-0.011
FarmEnd X ΔFarm	(0.238)			(0.235)			(0.044)	(0.045)
(Decline_FarmEmp=1)			-0.128*	-0.139*	-0.045			-0.042
X FarmEnd X ΔFarm		`	(0.072)	(0.075)	(0.055)			(0.054)
(Low Growth=1) X		-0.121		-0.145		0.222*		0.220*
FarmEnd X ΔFarm		(0.148)		(0.145)		(0.121)		(0.120)
Observations	3,840	3,840	3,840	3,840	3,600	3,600	3,600	3,600
R-squared	0.915	0.915	0.915	0.915	0.915	0.915	0.915	0.915

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔIncPC is difference in log of income per capita. ΔMnfcEmp is difference in manufacturing employment. D5 represent five-year difference, i.e. the difference between t and t-5. Decline is a dummy variable indicating a decline in respective sectoral employment. Decline=1 means decline in employment between t to t-5. Low Growth is a dummy variable equal to one if national growth between t and t-5 is less than one percent. South is a dummy variable equal to one for former confederate states. All regressions include controls for year interacted with natural log of the average income per capita in 1929-1934, and division by year and state 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 7A – Comparison to Allcott and Keniston (2015)

	(1)	(2)	(3)	(4)	(5)
	Table 6 -Col3				Table 7 – Col 1
	All Resources	Only Oil	Only Oil	Only Oil	Only Oil
	D5	D5	D1	D1	D1
VARIABLES	1970-2015	1970-2015	1970-2015	1969-2011	1969-2011
OilEnd X ΔOilEmp	0.087**	0.089**	0.095**	0.124**	0.158**
	(0.038)	(0.039)	(0.041)	(0.053)	(0.060)
OilEnd X ΔOilEmp X	0.058	0.081*	-0.032	-0.068*	-0.097**
(OilEmpDecline=1)	(0.042)	(0.044)	(0.035)	(0.034)	(0.041)
OilEnd X ΔOilEmp X					-0.051**
(year>2000)					(0.021)
CoalEnd X ΔCoalEmp	-0.071				
	(0.107)				
CoalEnd X ΔCoalEmp X	0.337*				
(CoalEmpDecline=1)	(0.172)				
CoalEnd X ΔCoalEmp	0.143				
	(0.177)				
FarmEnd X ΔFarmEmp X	0.027				
(FarmEmpDecline=1)	(0.208)				
Observations	2,208	2,208	2,208	2,064	2,064
R-squared	0.781	0.773	0.741	0.744	0.744

Notes: OilEnd, CoalEnd and FarmEnd are oil, coal and farmland endowments in 1935 constructed as described in the data section. ΔOilEmp, ΔCoalEmp and ΔFarmEmp are changes in the logged national employment in the oil and gas extraction, coal mining and agriculture sectors respectively. ΔIncPC is difference in log of income per capita. OilEmpDecline, CoallEmpDecline and FarmEmpDecline are dummy variables equal to 1 if respective sectoral employment declines during that time period. Columns 1 and 2 present the result for a five-year difference, columns 3,4 and 5 show the result for a one year difference, Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1