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THE SHORT-RUN AND LONG-RUN EFFECTS OF RESOURCES ON ECONOMIC OUTCOMES: EVIDENCE FROM THE UNITED STATES 1936-2015

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ABSTRACT

This paper draws on a new state-level panel dataset and a model of domestic Dutch disease to examine the short-run and long-run effects of oil & natural gas, coal, and agricultural land endowments on state economies during 1936-2015. Using a flexible shift-share estimation approach, where the shift is national resource employment and the share is state resource endowment, we find that different resources had different short-run effects in different time periods, across increases and decreases in resource employment, and across different outcomes. Using long differences, we find that long-run population growth was an important margin of adjustment over 1936-2015. States with larger coal and agricultural endowments per square mile experienced significantly slower population growth than states with smaller endowments per square mile. Resource endowments had no effect on long-run growth in per capita income.

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1. Introduction

What are the short-run and long-run effects of resources on economic outcomes? The effects of resources on outcomes are widely debated, because many countries, states, and counties have substantial endowments of natural resources. The salience of the relationship between resources and outcomes has led to a large amount of research. Despite the large literature, there is relatively little consensus regarding the answer to the question. In both the U.S. and the international contexts, different papers reach different conclusions about the effects of resources on outcomes.[1]

To address this question for the United States, we use a new state-level panel dataset and a model of domestic Dutch disease. The data set spans 1936-2015 and covers the three most valuable natural resources – oil & natural gas, coal, and agricultural land. The model, which is from Allcott and Keniston (2018), provides short-run and long-run predictions regarding the effects of resources on population, wages and employment. Our empirical analysis examines the extent to which these predictions hold for state population, wages and employment. Because some papers in the literature focus on per capita income, the empirical analysis also examines per capita income. The long time period allows us to examine the effects of resources over different time periods. The use of three resources facilitates comparisons across coal and agriculture, which had declining employment, and oil & natural gas, which had increasing employment. It also facilitates comparisons across oil & natural gas and coal, which are non-renewable, and

[1] In the international context, Sachs and Warner (1995, 1997), Sala-i-Martin and Subramanian (2003), Papyrakis and Gerlagh (2004) and other papers find a negative relationship between resources and outcomes, but Alexeev and Conrad (2009) and Cavalcanti, Mohaddes and Raissi (2011) do not. In 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 a negative relationship between resources and outcomes, but Boyce and Emery (2011), Michaels (2011), Weber (2012, 2014), Feyrer et al (2017) and Allcott and Keniston (2018) do not.

agricultural land, which is renewable and can be used to produce different products at different times.

To examine the short-run relationships between resources and outcomes, we use a flexible shift-share approach, where the shift is changes in national employment for that resource and the share is state endowment of a resource per square mile. Our primary measure of endowment is state endowment in 1935 per square mile based on 1935 knowledge of reserves, but we present results for alternative measures of endowment including endowment in 1935 per square mile based on 2015 knowledge of reserves and endowment per capita based on population in 1929. Our estimation approach is flexible in that it allows for different effects across increases and decreases in resource employment. Our main results focus on short-run effects over 5-year time intervals, rather than the 1-year time intervals that are more common in the literature, to allow time for spillovers to develop.

The paper has two main findings. First, the paper finds that different resources had different short-run effects in different time periods, across increases and decreases in resource employment, and across different outcomes. For growth in population and for growth in per capita income, the coefficients for a given resource in a given time period were not necessarily the same in sign or significance. This is relevant, because growth in population and growth in per capita income are frequently used as proxies for welfare. Across a hypothetical boom-bust cycle for a given resource, states in many cases could be worse off after the cycle than before the cycle.

Second, the paper finds that the primary margin of long run adjustment has been larger long-run relative population declines in states with larger coal and agricultural endowments. States with larger coal endowments had larger relative population declines for the full sample period and for the 1936-1974 and 1975-2015 sub-periods. States with larger agricultural endowments had larger relative population declines in the later period. As a result of population adjustments, resources had no effect on growth in state per capita income in any of the periods. Employment in coal and agriculture peaked in the early twentieth century. To evaluate whether the long-run effects were different when employment in coal and agriculture was rising, we examine the long-run relationships between resource endowments in 1935 and population growth during 1880-1935. During this earlier period, states with larger coal endowments had larger relative population increases.

This paper contributes to the U.S. literature on the relationship between resources and economic outcomes by examining effects of multiple resource sectors on multiple outcomes over an 80-year time period and using a flexible estimation approach that allows increases and decreases in resource employment to have different effects. Our findings on the effects of increases and decreases in resource employment are related to Black et al (2005) and Jacobsen and Parker (2015), who find negative effects of boom-bust cycles for coal and non-coal counties in Appalachia over the period 1970-1989 and for oil and non-oil counties in the Western U.S. over the period 1969-1998. Our analysis is also related to Allcott and Keniston (2018), which examines the effects of oil & natural gas on county outcomes from 1969-2014. They find over the boom-bust cycle of the 1970s and 1980s that there is no long-term effect of oil & natural gas endowment on a range of county outcomes, which is similar to what we find. Finally, our work is related to Hornbeck and Keskin (2015), who look at spillovers generated by agriculture by comparing agricultural counties that differ in their access to the Ogallala aquifer. Our analysis complements time series work by other scholars at the U.S. county level, which tends to focus on individual resources, shorter time periods, and 1-year time intervals over which resources affect outcomes.

The paper also contributes to the literature in American economic history that examines the long-run role of resources on economic outcomes during the mid- and late twentieth century. Our finding that there were no long-run effects of resources on per capita income and that population was the primary margin of adjustment are most closely related to Mitchener and McLean (2003), Michaels (2011), Hornbeck (2012), and Matheis (2016). Mitchener and McLean (2003) find that state resources, as measured by the share of the workforce in mining, were related to worker productivity through 1940, but not in 1960 or 1980. Michaels (2011) examines southern counties with and without oil in Texas, Louisiana, Oklahoma, and nearby states using data from 1940-1990. He finds population increases in oil counties relative to counties without oil and higher, but declining, differences in per capita income and median family income. Hornbeck (2012) finds that population loss was the primary margin of adjustment to erosion in Dust Bowl counties from 1930 to 1940 and that population declines continued through the 1950s. Matheis (2016) studies the short- and long-run effects of coal production on county population and manufacturing. He finds large positive effects of coal production in the previous decade on population pre-1930 and smaller effects in later periods.

Our results speak indirectly to the economic history literature on the importance of resources during the nineteenth and early twentieth centuries. We find that the long-run effects of state endowment of coal on state population during 1880-1935 were positive. This is consistent with Habakkuk (1962), Wright (1990), and Wright and Czelusta (2004), who argue that mineral resources had important benefits for the American economy during the nineteenth and early twentieth centuries.[2] And it is consistent with the European literature on coal and economic development (Pomeranz 2001, Allen 2009, and Fernihough and O'Rourke 2014).

2. Resources

This section briefly discusses the literature on the relationship between natural resources and outcomes in the United States, measures of resources used by different authors, and the measures of resources used in this paper.

Resources and Economic Outcomes in the United States

A large number of papers have examined the effects of resources on outcomes. Nearly all papers that apply cross sectional analysis find that resources had a negative effect on outcomes, including Boyce and Emery (2011), Goldberg, Wibbles, and Mvukiyehe (2008) James and Aadland (2011), and Papyrakis and Gerlagh (2007). An important exception is Mitchener and McLean (2003), which examines earlier time periods and focuses on price adjusted income per worker. They find resources were positively related to outcomes in 1880, 1900, 1920 and 1940 and had no effect in 1960 and 1980.

The results are somewhat mixed for papers that use time series analysis. These papers predominatly focus on the short run. Using state data, Goldberg, Wibbles, and Mvukiyehe (2008) find resources are negatively related to growth. Boyce and Emery (2011) find resources are negatively related to growth, but positively related to income. Using county data, Hornbeck and Keskin (2015) show that having access to the Oglalla Aquifer, which was used for irrigation after World War II, is positively related to a range of outcomes. Hornbeck (2012) shows that counties with larger land erosion during the Dust Bowl experienced larger population outflows.

[2] The Canadian literature also emphasizes the importance of resources (Chambers and Gordon 1966, Lewis 1975, and Keay 2007).

Matheis (2016) finds that coal is positively related to a population and manufacturing. Allcott and Keniston (2018) and Michaels (2011) find that oil & natural gas are positively related to a range of outcomes. Feyrer et al (2017) 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 & natural gas counties worse off after the boom-bust cycle than before.

A strand within U.S. and European economic history argues that natural resources were important drivers of long-run growth. Some examples include Habakkuk (1962), Wright (1990), Pomeranz (2001), Wright and Czelusta (2004), Mitchener and McLean (2003), Keay (2007), Allen (2009), and Fernihough and O'Rourke (2014). Other authors such as Mokyr (1976, 1992), 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 broader literature, however, they generally do not argue that resources had a negative effect on outcomes.

Measures of Resources in the Literature

The definition of resources varies considerably across papers in the U.S. literature. For example, Papyrakis and Gerlagh (2007) define resources as "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) use percent earnings from agriculture, forestry, fisheries, and mining as their measure of resources. Other papers focus primarily on fossil fuels. The dependent variables are mining (which includes oil, coal and other minerals) in Mitchener and McLean (2003); coal in Black et al (2005); oil and coal in Goldberg et al (2008); oil and natural gas in Michaels (2011); mining in Boyce and Emery (2011); natural gas in Weber (2012, 2014);

oil and natural gas in Jacobsen and Parker (2014); coal in Matheis (2016); natural gas in Feyrer et al (2017); and oil and natural gas in Allcott and Keniston (2018).

Measures of resource intensity also vary. Some use the value of resources produced or employment divided by income or population or workforce. Others classify geographic units based on reserves (Michaels 2011) or reserves per square mile (Allcott and Keniston 2018) or use cutoffs to identify high and low coal counties (Black et al 2005), or high and low oil and natural gas counties (Jacobsen and Parker 2014).

Measures of Resources in this Paper

This paper examines three resources: oil & natural gas, coal, and agriculture. Why do we focus on these three resources? Table 1 shows the value in constant 2010 dollars of renewable and non-renewable resources produced in the U.S. in 1936 and 2015, the first and last years of our sample.[3] Oil & natural gas and coal were the largest nonrenewable sectors in 1936 and in 2015, and agriculture was the largest renewable sector in those years. We treat oil & natural gas as a single resource, because disaggregated employment is not available for every year. Examining these three resources facilitates comparisons along two dimensions: i) sectors with declining vs. increasing employment and ii) non-renewable vs. renewable resources. Coal and agriculture had declining employment over the sample period, while oil & natural gas had increasing employment. Coal and oil & natural gas deposits can only produce coal or oil & natural gas. In contrast, agricultural land is renewable and thus can be used to produce different agricultural products at different times in response to changing market conditions.

[3] 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 economic activity in the District of Columbia. Data were adjusted to 2010 dollars using the US CPI data from Officer and Samuelson's website Measuring Worth.

State endowments of oil & natural gas, coal, and agriculture are measured in 1935. For oil & natural gas and coal, endowments are reserves from the *Minerals Yearbooks*.[4] For agricultural, endowment is the state value of farmland from the *1935 Census of Agriculture*.[5]

Why do we use 1935 and not an earlier measure of endowments? One issue is the low frequency of data on outcomes for earlier periods. The other issue is endogeneity.[6] Reserves for oil & natural gas and coal and land values for agriculture are used because they are more exogenous than production or employment. During much of the nineteenth century, estimated oil & natural gas and coal reserves are likely to be related to the timing of settlement of states and state investments in discovery of resources. By 1935, the location and characteristics of oil & natural gas and coal deposits in the United States were relatively well understood, so this is much less important than it might have been earlier.[7]

We construct α_{ir}, as a scaled measure of endowment per square mile in 1935 in state *i* for resource *r*.[8] Specifically, 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.

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

[5] We use 1935 average *state* value of farmland multiplied by the number of acres to measure endowment. An alternative approach is to use 1935 average *national* value of farmland multiplied by the number of acres to measure endowment. This treats all acres as having equal value, wherever they are located. As a robustness check, we present specifications in which each acre has equal value.

[6] See Wright 1990, David and Wright 1997, Mitchener and McLean 2003, and Clay 2011.

[7] Mitchener and McLean 2003 argue that state level mining can be considered exogenous in 1880. "There were no barriers to the flow of capital and technology across state boundaries, and firms and individuals could take their investment and talents wherever they saw the opportunity for the highest potential return."

[8] This approach is similar to Allcott and Keniston (2018), which also uses endowment per square mile. Reserves are divided by area to address variation across geographic units in area. Some studies examine counties that are roughly similar in size and so simply use reserves. Reserves are not divided by employment or income, because these are likely to change in response to increases in production.

The endowments are then rescaled so that the state with the highest endowment of resource *r* per square mile has α = 1. States with zero endowment have α = 0. The lowest endowment is zero for oil & natural gas and coal. The lowest endowment is positive for agriculture. The first three panels of Figure 1 present the distribution of agriculture, oil & natural gas, and coal across states in 1935 (based on available knowledge in 1935). There is considerable variation in resource endowments. Louisiana, Texas, and Oklahoma have the largest oil & natural gas endowments. North Dakota, West Virginia and Colorado have the largest coal endowments. Connecticut, Iowa, and Illinois have the largest agricultural endowments.

We construct two additional measures of endowment. Because there continued to be resource discoveries and changes in understanding of known deposits that would occur between 1935 and 2015, we construct a measure of 1935 endowment based on knowledge available in 2015.[9] *Shares* of resources held by different states were generally stable and so can be treated as the endowment in 1935. The *level* of economically recoverable reserves would change, of course, with national changes in technology and economic conditions. If these changes in levels caused shares to shift between 1935 and 2015, the relationship between 1935 endowment shares interacted with changes in national employment and outcomes may become more attenuated over time. For the second measure, we construct per capita endowment in 1935 based on knowledge available in 1935 using population in 1929.[10]

[9] For oil & natural gas and coal, we take reserves in 2015 and add back production (in constant 2010 dollars) of oil & natural gas and quantities of coal (in short tons) produced between 1935 and 2015. For agriculture, the alternative measure of endowment is based on the land value in 2015. The correlation between endowment per square mile in 1935 (based on available knowledge in 2015) and endowment per square mile in 1935 (based on available knowledge in 1935) is 0.94 for oil & natural gas, 0.55 for coal, and 0.78 for agriculture. We present specifications using this measure as a robustness check.

[10] The correlation between endowment per square mile in 1935 (based on available knowledge in 2015) and endowment per capita (using population in 1929 as a denominator) is 0.57 for oil & natural gas, 0.72 for coal, and 0.27 for agriculture. We present specifications using this measure as a robustness check.

Figure 2 plots the national employment by resource sector over time.[11] We see a general decline in the agricultural employment and in coal mining employment over time. Oil & natural gas employment was increasing through the early 1980s, declined into the mid-2000s, but has been increasing since then. For most of the time period, agriculture had the highest employment and coal had the lowest. Appendix Figure A1 plots resource income in constant 2010 dollars over time. Agriculture had the highest income and coal had the lowest.[12]

We examine two sub-periods: 1936-1974 and 1975-2015. The first sub-period, 1936-1974, is a period of relative income stability for all three sectors. There is a short boom in the very early period for agricultural income. Employment is also changing relatively smoothly, particularly for oil & natural gas and coal. The second sub-period, 1975-2015, is much more volatile in terms of income. The boom-bust-boom cycle in income is evident for all three sectors. Employment changes more smoothly than income, but the boom-bust-boom cycle is clear, especially for oil & natural gas employment.

3. Conceptual Framework

To understand the effects of resource booms, we draw on Allcott and Keniston's (2018) model of domestic Dutch disease. In this section, we discuss some key aspects of their model.

Allcott and Keniston (2018) use a Moretti (2010) version of the Rosen–Roback spatial equilibrium framework to investigate the local welfare effects of resource booms. The model compares two geographic units, one with a resource endowment and one without, across three

[11] According to BEA (2015), wage and salary jobs and proprietors' jobs are counted when constructing employment, but unpaid family workers and volunteers are not.

[12] An important factor in the divergence of resource employment and resource income has been improvements in efficiency driven largely by technology and mechanization. Efficiency improvements are discussed later in the paper.

periods.[13] In period 0, the geographic units are symmetric and neither produces resources. In period 1, the unit with the endowment experiences a (temporary) resource boom, in which production is positive. In period 2, the boom is over and neither produces resources. In addition to the resource sector, there are two other sectors that require local labor – a tradable sector and a non-tradable sector. There is also a housing sector that does not require local labor.

In equilibrium, firms and consumers optimize and markets clear. Firms maximize profits and demand labor. There are two possible types of spillovers across firms over time – learning by doing spillovers and agglomeration spillovers. Learning by doing spillovers mean that current productivity is influenced by prior sectoral employment. Agglomeration spillovers mean that past population influences current productivity. In every period, individuals decide where to live, supply one unit of labor, and make consumption decisions about housing, tradable goods, and non-tradable (local) goods subject to the budget constraint.

The model generates predictions regarding the contemporaneous and long-run effects of a resource boom. *Contemporaneously, the model predicts that the resource boom will increase population and wages.* The boom will also increase local sector employment, decrease tradable sector employment, and increase local sector prices.

Allcott and Keniston (2018) examine the long-run relative welfare effects. They first ask whether the boom increases cumulative social welfare in geographic unit A vs. geographic unit B. *In the long run, the model predicts that the relative welfare effects can be signed by examining relative population.* They state: “Intuitively, people vote with their feet by migrating to the county with higher welfare. This equation will be useful empirically, as it will allow us to sign the relative welfare effect even without a direct estimate of how the resource boom affects

[13] In their online appendix, Allcott and Keniston (2018) show the results hold for many geographic units. In their context the geographic units are counties; in our context the geographic units are states.

local prices and amenities. … If there are no productivity spillovers … then the two counties have equal productivity, population, and wages after t=1, and a resource boom unambiguously increases relative welfare. If there are productivity spillovers, then local sector relative productivity will increase, and the signs of both tradable sector relative productivity and relative welfare will depend on the relative strengths of the learning-by-doing versus agglomeration spillovers." [14]

While the model considers a single resource sector, empirically one might expect the relationship between individual resources and outcomes to be heterogeneous across a variety of dimensions. For example, resources may have different effects across increases and decreases because of differences in spillovers. Relationships might change over time due to changing production technology, transportation costs, capital markets and other factors.[15][16][17] If there are adjustment costs, the effects over a one-year period may differ from the effects over a five-year period.

4. Data on Outcomes

[14] Allcott and Keniston (2018) p. 11, 13. They also examine the long-run absolute welfare effects (i.e. whether the boom increases cumulative social welfare in geographic unit A relative to the counterfactual in which A has but does not produce resources). The relative and absolute effects differ, because the general equilibrium effects differ.

[15] Recessions could affect these relationships. 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 (2011, 2012) and Kilian and Vigfusson (2014). Kilian and Vigfusson (2014) discuss nonlinearity of the relationships. In unreported regressions, we did not find statistically significant differential effects during periods of recession.

[16] Political institutions could also affect these relationships. 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. In unreported regressions, we did not find statistically significant differential effects for the South.

[17] High rates of federal land ownership in western states could affect these relationships. In unreported regressions, we did not find statistically significant differential effects for states with high rates of federal land ownership.

The data on resource endowments, resource employment and resource income were discussed in Section 2. This section considers data on outcomes including per capita income, population and employment in various sectors. Appendix Figure A2 shows the evolution of population and per capita income in constant 2010 dollars over time. Data on state personal income are available annually beginning in 1929 from the Bureau of Economic Analysis. One can see the effects of major events including the Great Depression, WWII, and the Great Recession. Appendix Figures A3 and A4 plot average wages, total employment, and employment in specific sectors. Population, employment and wage data are from the Bureau of Economic Analysis (BEA).[18]

Figure 3 plots the distribution of the five-year annualized income per capita and population growth rate. The average income per capita growth rate is around 2.5% per year. The average population growth rate is 1.2% per year.

Tables 2a and 2b present the summary statistics for the main variables used in the analysis. Summary statistics for other variables are available in the Appendix Table A1.

5. Identification

The Allcott and Keniston (2018) model has implications for states with higher and lower endowments if there is variation over time in resource employment such as we observe in Figure 2. The relative effects are denoted τ_r, where τ_r is the effect of an increase in resource employment on the average difference in outcomes between states with higher and lower endowments. τ_r captures spillovers from learning by doing and agglomeration and any other general equilibrium effects.[19]

[18] State specific employment by sectors is not available prior to 1969.

[19] Allcott and Keniston (2018) also estimate τ_a, the treatment on the treated. This is possible, because they use county data and so can measure spillovers. Empirically they find that $\tau_r > \tau_a$.

To investigate the empirical relationship between resources and various economic outcomes we estimate the following reduced form equation:[20]

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

Y_{it} is an outcome in state i in year t. α_{ir} is endowment of resource r in the baseline period. E_{rt} is national employment or income for resource r in time t. Y_{i0} is a baseline value of the outcome for state i.[21] φ_{dt} are census region-year fixed effects. Economic outcomes may be moving for reasons other than shifts in resources. To address this, we interact baseline values with year fixed effects, as well as control for census region by year fixed effects. We use robust standard errors that are clustered by state.[22]

The variables Y and E are logged, so ΔlnY_{it} is approximately equal to the growth rate in the outcome variable, and ΔlnE_{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 variable $\alpha_{ir}\Delta lnE_{rt}$ is similar to the shift-share approach used in Allcott and Keniston (2018). Here the share comes from the cross-sectional variation in the resource endowment per square mile in 1935, α_{ir}. The shift comes from changes in national resource employment, ΔlnE_{rt}. The estimated τ_r is similar to elasticity, where τ_r is the differential effect of a one percent increase in national resource employment in the state with the largest resource endowment per square mile.

If increases and decreases in resource employment are uncorrelated with unobserved economic trends, conditional on baseline outcomes interacted with year and census region year

[20] The regression could also be estimated using fixed effects, but differencing is more efficient if errors are serially correlated.

[21] Per capita income or population in 1929 is included as a control in specifications where the outcome is per capita income or population respectively. In unreported regressions, the estimated effects are similar if the average value in 1929-1934 is included as a baseline instead of the variable in 1929.

[22] In unreported regressions, we bootstrapped the standard errors for some specifications. Bootstrapping does not change the statistical significance of the results.

fixed effects, Equation (1) will produce unbiased estimates of τ_r. Figure 2 shows that the three resources follow different time paths. Any confounder would have to follow one of the three time trends and differentially affect states with higher endowments of that resource.

One limitation of equation (1) is that it restricts the effects to be similar for increases and decreases in resource employment. A number of papers including Black et al (2005), and Jacobsen and Parker (2014) suggest that there may be differential effects of increases and decreases in resources. To allow the effects to differ during booms and busts, we estimate the following equation:

$$\Delta lnY_{it} = \tau_r^{-} \alpha_{ir} 1(\Delta lnE_{rt} < 0)\Delta lnE_{rt} + \tau_r^{+} \alpha_{ir} 1(\Delta lnE_{rt} \geq 0)\Delta lnE_{rt} + \omega_t lnY_{i0} + \varphi_{dt} + \varepsilon_{it} \quad (2)$$

where $1(\Delta lnE_{rt} < 0)$ and $1(\Delta lnE_{rt} \geq 0)$ are dummy variables indicating a decline and an increase in sectoral r employment E_{rt} between *t* and *t-5*, respectively. The coefficients of interest τ_r^{-} and τ_r^{+} show the differential effects of resources during boom and bust periods respectively.

6. Short-Run Effects

Short-Run Effects of Resources on Population and Growth in Per Capita Income

Table 3 presents estimates of the relationship between resources and growth in population. Columns 1 and 2 of Table 3 report the estimates of equation (1) for 1-year and 5-year time intervals, assuming the effect is symmetric across increases and decreases in resource employment. The 1-year difference specification (column 1) assumes that changes in resource employment immediately translate into growth in population in states with higher resource endowments, while 5-year differences (column 2) allow the effects to develop over a longer time period. In columns 1 and 2, the coefficients are similar in sign and significance, but the magnitudes are larger over the 5-year period. National increases in oil & natural gas employment are positively but not significantly related to growth in population in states with higher endowments. National increases in coal employment are positively and statistically significantly related to growth in population in states with higher endowments. National increases in agricultural employment are negatively and statistically significantly related to growth in population in states with higher endowments. That is, increases in agricultural employment are associated with relative declines in overall population. Columns 3-5 of Table 3 present the results for the more flexible boom-bust specification from equation (2) and examine the effects across three time periods: 1936-2015, 1936-1974, and 1975-2015.

Compared to the results in column 2 of Table 3, the results in columns 3-5 tell a different and more nuanced story. In column 3, the coefficient on oil & natural gas for *increases* and *decreases* in resource employment are both positive but not statistically significant. The coefficient on coal for *increases* in resource employment, which was positive and significant in column 2, is now negative and statistically significant. The coefficient on coal for *decreases* in resource employment is positive and statistically significant. States with high coal endowments face population declines during both increases and decreases in national coal employment. The coefficient on *increases* in agricultural employment is negative and statistically significant, while the coefficient on *decreases* is negative and not significant. States with high agricultural endowments face population declines during increases in national agricultural employment. In columns 4 and 5 some coefficients for a given resource and direction of change in employment differ in magnitudes, significance, and for agriculture during periods of decline in both sign and significance.

Table 4 presents the coefficients for the same specifications, where the dependent variable is growth in per capita income. We are interested in growth in per capita income, because in parts of the literature it is used implicitly or explicitly as a measure of welfare. As in Table 3, the symmetric results in columns 1 and 2 and the asymmetric results in the columns 3-5 have different implications.

Tables A2 and A3 in the appendix present the specifications for population and per capita income comparing 1935 endowments per square based on 1935 knowledge to the following alternatives: i) 1935 endowments based on 2015 knowledge; ii) 1935 endowment per capita based on 1929 population; iii) agricultural land per square mile in 1935 instead of land value; iv) changes in national resource income instead of employment. The results are qualitatively similar for oil and coal. For agriculture, the results are sensitive to the specification.

Figure 4 plots by resource the effects implied by estimates in Tables 3 and 4 of a one standard deviation increase in employment for the state with the highest endowment. Recall that the endowment of the state with the largest endowment is equal to 1, so a state with X% the endowment per square mile of the state with the largest endowment would experience an effect that is X% of that of that state. It is worth noting that declines have been multiplied by a negative number because employment fell and so have effects that are opposite in sign to the coefficients on declines in Tables 3 and 4.

Figure 4 highlights four points. First, there is no one relationship between resources and outcomes. Different resources have different short-run effects in different time periods, across increases and decreases in resource employment, and across different outcomes. To get a sense of the differences across resources and outcomes, for example, one can examine increases in resource employment during 1935-1974. Increases in national oil & natural gas employment have no effect on population growth or income per capita in states with higher endowments, while increases in national coal employment have a negative and statistically significant effect on population growth and a positive and statistically significant effect on income. Increases in national agricultural employment have a statistically significant negative effect on population growth but no effect on per capita income.

Second, to the extent that growth in population responds to changes in resource employment, it is primarily responsive to declines – rather than increases – in resource employment.[23] The model predicts that population would increase during increases in resource employment. Two of the six effects (oil) are not statistically significant and the remaining four (coal and agriculture) are negative and statistically significant. Overall employment in coal and agriculture was declining over the period 1936-2015. Even during periods of increases in employment in these sectors, population continued to fall, possibly because individuals were forecasting further declines. The model predicts that population would typically decrease during decreases in resource employment, although the magnitude would depend on the extent of the spillovers. Consistent with this four of the six effects are negative and statistically significant, one is negative and not significant (oil for 1936-1974), and one is positive and statistically significant (agriculture for 1936-1974).

Third, the coefficients for growth in population and for growth in per capita income for an increase or decrease resource in a given time period are not necessarily the same in sign or significance. For oil, two of the four pairs of coefficients differ in significance. For coal, all four pairs differ in sign or significance. And for agriculture, all four pairs differ in sign or significance. This is important, because growth in population and growth in per capita income are frequently used as proxies for welfare in the literature. In the model, population is a proxy for

[23] In unreported regressions, the coefficients from the specification with 1-year differences are qualitatively similar, do this is not being driven by the use of 5-year differences.

welfare. All but one of the coefficients on population are either insignificant or negative and significant.

Fourth, for oil & natural gas and coal across a hypothetical boom-bust cycle, states could be worse off in relative terms after the cycle than before the cycle. Although the differences are not always statistically significant, the coefficient on the decline is always bigger in magnitude than the coefficient on increase in resource employment. In the model, this could occur if in the short run learning by doing spillovers were larger than agglomeration spillovers.

Short-Run Effects of Resources on Wages and Employment

Table 5 explores the effects of resources on mining (all resource extraction), agricultural, and manufacturing wages for 1975-2015.[24] As predicted by the model, in Panel B, increases in oil employment and coal employment are associated with increases in wages in both mining and manufacturing in states with higher endowments. Similarly, increases in agricultural employment are positively related to agricultural wages and positively and significantly related to manufacturing wages in states with higher endowments.

Table 6 explores employment effects for total employment, retail, manufacturing, transportation, and construction for the same period. In Panel B column 1 shows the effects for total employment. For increases in resource employment, the coefficients are positive and significant for oil & natural gas, negative and not significant for coal, and negative and significant for agriculture. For decreases in resource employment, all three coefficients are positive and significant. During declines in resource employment, total employment falls more in states with larger resource endowments. These results for oil & natural gas, coal, and agriculture are similar to the effects on population shown in Table 3 and Figure 4. The effects on retail and

[24] Over this period, separate series are not available for oil & natural gas and coal.

manufacturing employment are broadly similar to the effects on total employment for all three resources. The effects on transportation and construction vary by resource.

7. Long-run Effects of Resources

Table 7 examines the long-run relationship between resource endowments and growth in population in Panel A and between resource endowments and growth in per capita income in Panel B over the periods 1936-2015, 1936-1974, and 1975-2015.[25] All columns include controls for initial levels of the outcome, either population in 1929 or income per capita in 1929, and region fixed effects.[26]

Figure 5 plots the coefficients from Table 7 by resource for population growth and growth in per capita income. States with higher coal endowments and agricultural endowments experienced slower long-run relative population growth. The coefficients on coal endowments in all time periods and the coefficient on agriculture in 1975-2015 are negative and statistically significant. Strikingly, endowments have little long-run relationship to per capita income. The coefficients on endowments are small, positive, and not statistically significant.

Population growth was a key margin of adjustment for states with large endowments of coal and agriculture. To provide a sense of the magnitudes, consider West Virginia, which had a large coal endowment, and Illinois, which had a large agricultural endowment. The estimates from Table 7 column 1 imply that if it did not have any coal, West Virginia's population in 2015 would have been about 1.3 million higher.[27] This is very large effect, given the population of West Virginia in 2015 was 1.8 million. The estimates from Table 7 column 3 imply that if it did

[25] Tables A4 and A5 in the appendix present results for alternative measures of endowment.
[26] In unreported regressions, the estimated effects are similar if controls for the former Confederate states or/and federal land are included.
[27] For West Virginia, 1.3 million higher equals (1.8*(exp(80*0.0125*0.54)-1)). For Illinois, 3 million higher equals (12.9*(exp(40*0.0077*0.668)-1)).

not have any agricultural land, Illinois' population in 2015 would have been 3 million higher. This is also a large effect, given the population of Illinois in 2015 was 12.9 million.

The model tells us that a boom-bust cycle can be welfare enhancing if the geographic unit sees an increase in population and then returns to its original population. The question is, of course, over what time frame. The short-run and long-run results for 1936-2015 suggest that states with larger coal or agricultural endowments had slower relative population growth during one or both time periods. Was having larger coal or agricultural endowments associated with faster population growth prior to 1936? If so, then viewed from the perspective of the nineteenth century, having coal or agricultural resources may have been welfare enhancing.

Coal and agricultural employment peaked before the start of our sample period. Thus, it is possible that these states experienced faster population growth during the period in which employment was rising. Figure A5 shows the trajectory for coal employment, which peaked in 1923, and the trajectory for farm population, which peaked in 1935.

Why did employment decline? The decline in coal and agricultural employment was not a function of output, which continued to increase over time, but rather a function of technological and organizational improvements that reduced the labor inputs necessary to achieve a unit of output. Figure A6 plots workers per BTU for coal and workers per acre for agriculture. Both fell dramatically over time. For coal, Darmstadter and Kropp (1997) and Ellerman, Stoker, and Berndt (2001) describe the changes in mining technology such as the adoption of and improvements in long wall mining and the development of highly productive large-scale mines in the Powder River Basin. For agriculture, Olmstead and Rhode (2000) demonstrate that improvements were partly driven by the replacement of horses and mules by tractors, which freed up land, and by improvements in the price and quality of tractors and farm equipment, which reduced the labor input. In their book, *Creating Abundance: Biological Innovation and American Agricultural Development*, Olmstead and Rhode (2008) document the stream of biological innovations that improved crops and livestock and in many cases resulted in greater labor productivity.

Transportation costs were falling as well, making it easier for areas to specialize in specific products and ship them to other markets, thereby realizing the gains from trade. Redding and Turner (2014) show that rail costs in the U.S. were secularly declining from the late nineteenth century onward and transportation costs as a share of GDP have fallen since the early twentieth century. The importance of rail for the U.S. economy has been an active area of research since Fogel (1964). Recent work by Donaldson and Hornbeck (2016) finds that effects of the railroad on the U.S. economy in 1890 were larger than originally suggested by Fogel (1964).[28] Further, Costinot and Donaldson (2016) find that there were substantial gains to economic integration for agriculture between 1880 and 1997. These are all relevant, because they may have impacted spillovers from resources.

Did states with large coal and agricultural endowments experience faster population growth prior to 1936? In Appendix Table A6, we explore this using our main 1935 measure of endowment and the alternative measures of endowment from Appendix Table A2. Over 1880-1935, seven of the eight coefficients on coal and agricultural endowments are positive. Further, the coefficient on coal is positive and statistically significant in the main specification and in two of the three alternative specifications. In sum, although having a larger coal endowment was associated with statistically significant negative short-run and long-run effects on population during 1936-2015, it was associated with statistically significant positive long-run effects during

[28] See also related work on the effects of railroads on a variety of earlier outcomes including Atack et al (2010) and Haines and Margo (2008).

1880-1935. The effects of having a larger agricultural endowment were qualitatively similar to the effects of having a larger coal endowment, although the coefficients were less frequently statistically significant and are somewhat sensitive to how the endowment is measured. It is worth noting that states with larger agricultural endowments may have experienced faster population growth prior to 1880.

In contrast to coal and agriculture, oil & natural gas employment is currently at or near an all time high. Like agriculture and coal, there have been significant improvements in productivity in oil & natural gas. Bohi (1998) discusses the factors driving productivity in oil discovery and development. Figure A6 shows that employees per BTU fell into the early 1970s and then increased during the mid to late 1970s, when oil prices rose. The early period was characterized by discovery of many of the largest oil & natural gas fields, while the later period was characterized by the need to focus on efficient extraction of smaller or more difficult to access fields. We find limited short-run effects and no long-run effects of oil & natural gas endowment on population during 1936-2015 or during 1880-1935.

In sum, over the long run, the evidence is mixed. Having a larger coal endowment appears to have been associated with an initial relative population increase during 1880-1935 followed by relative population decline during 1936-2015. Having a larger agricultural endowment was associated with relative population decline during 1975-2015. Having a larger oil endowment never had a significant effect on long-run population. When viewed from the perspective of the nineteenth century, resource endowments may have been welfare neutral or welfare enhancing.

Our results speak indirectly to the economic history literature on the importance of resources during the nineteenth and early twentieth centuries. States with larger coal endowments experienced statistically significantly larger population increases during 1880-1935. This is consistent with welfare increases in states with larger coal endowments and with Habakkuk (1962), Wright (1990), and Wright and Czelusta (2004), who argue that mineral resources had important benefits for the American economy during the nineteenth and early twentieth centuries. And it is consistent with the European literature on coal and economic development (Pomeranz 2001, Allen 2009, and Fernihough and O'Rourke 2014).

8. Conclusion

What are the short-run and long-run effects of resources on economic outcomes? To answer this question, the paper drew on a model of domestic Dutch disease and new state-level panel datasets spanning 1936-2015 covering oil & natural gas, coal, and agricultural land. The analysis used a flexible shift-share estimation approach, where the shift was changes in national employment for that resource and the share was state endowment of a resource per square mile. In the short run, the paper found that different resources had different short-run effects in different time periods, across increases and decreases in resource employment, and across different economic outcomes. These findings suggest that researchers should be cautious about making general statements regarding the effects of resources on outcomes.

In the long run, the primary effect of resources has been on population growth for some resources in some time periods. States with larger coal and agricultural endowments experienced slower long-run growth in population than states with smaller endowments. This held for states with larger coal endowments for 1936-2015, 1936-1974, and 1975-2015 and for states with larger agricultural endowments in the later period. As a result of differential population growth across states, resources had no effect on growth in state per capita income. Even in the long run, however, one needs to be cautious when making general statements regarding the effects of resources on outcomes. The robust negative relationship between state coal endowments and state population in the long run might suggest that the effect of coal had only ever been negative, and yet when we look back to 1880-1935, the relationship between state coal endowments and state population was positive.

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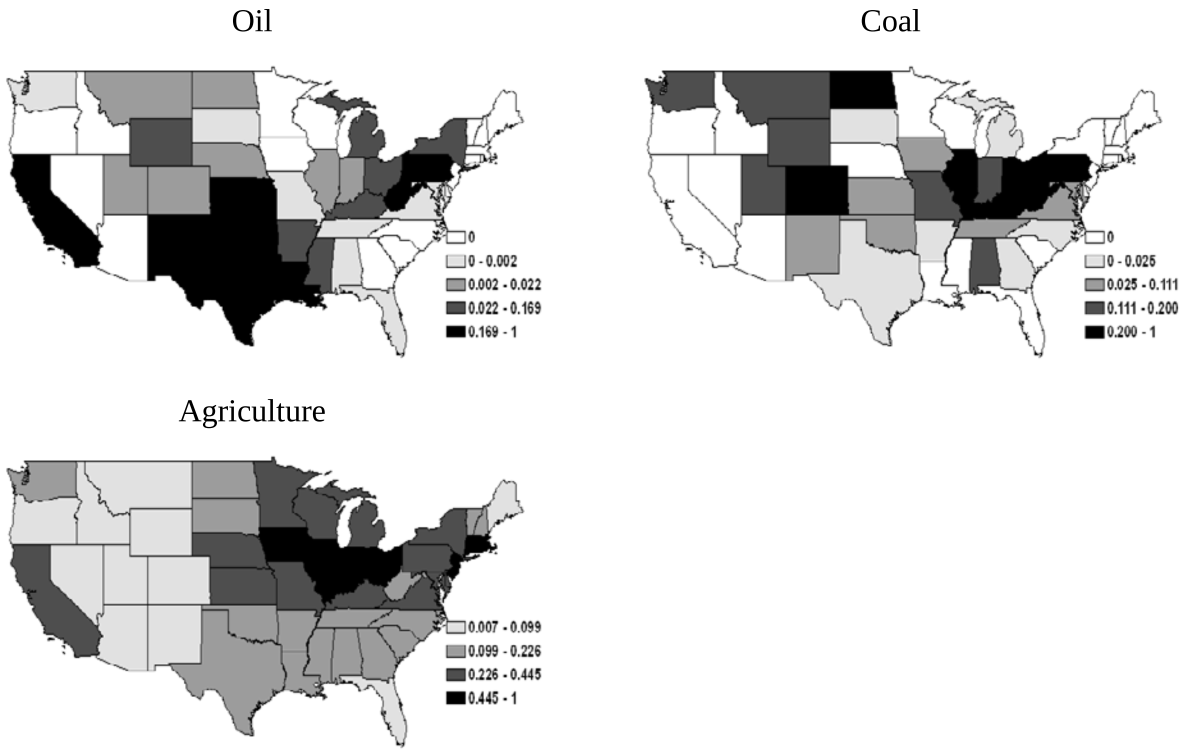
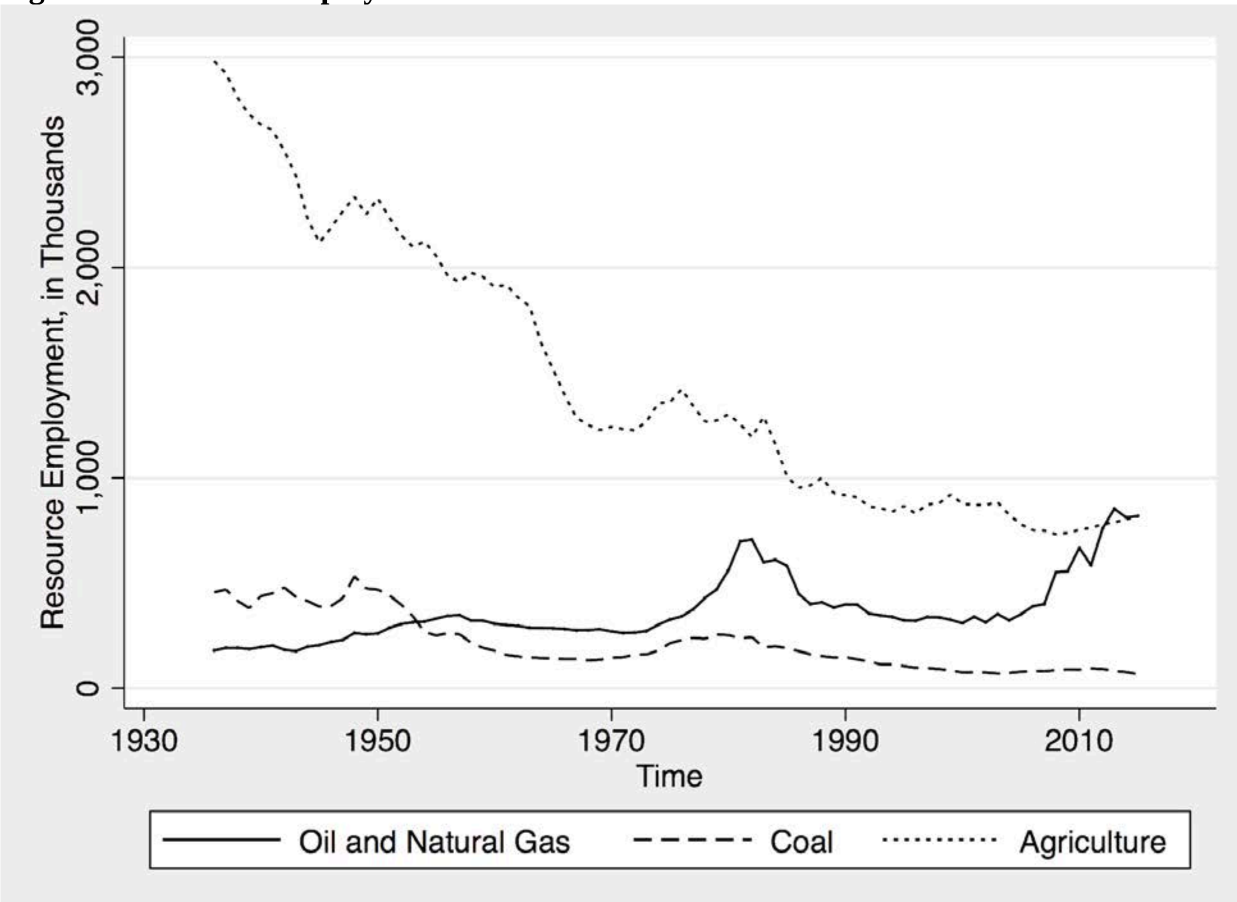
Figure 1 - Resource Endowments in 1935



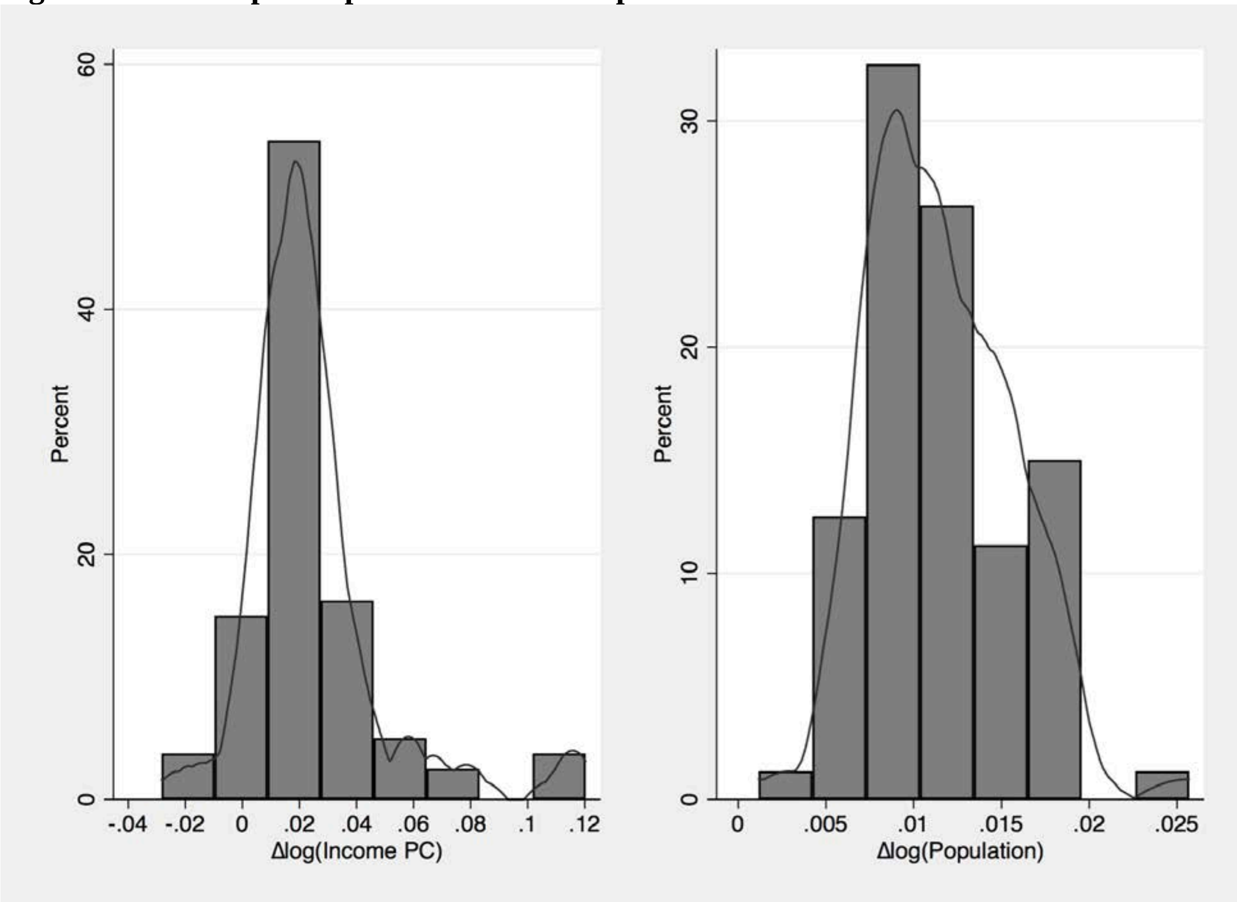
Notes: This figure maps the resource endowments as of 1935. The gradients are based on percentiles, conditional on nonzero value of resources ((0-25, 25-50, 50-75, 75-100)). Oil & natural gas map plots the dollar value of oil & natural gas reserve in 1935, using 1935 oil and natural gas prices. Coal map shows the dollar value of recoverable coal reserves in 1935 using average coal price in 1935. Agriculture map plots the farm value (value of land and buildings in farms) used in agriculture in 1935. Oil & natural gas and coal data are from Minerals Yearbooks. Agriculture data are from United States Department of Agriculture (USDA), Census of Agriculture.

Figure 2 – National Employment: Resource Sectors



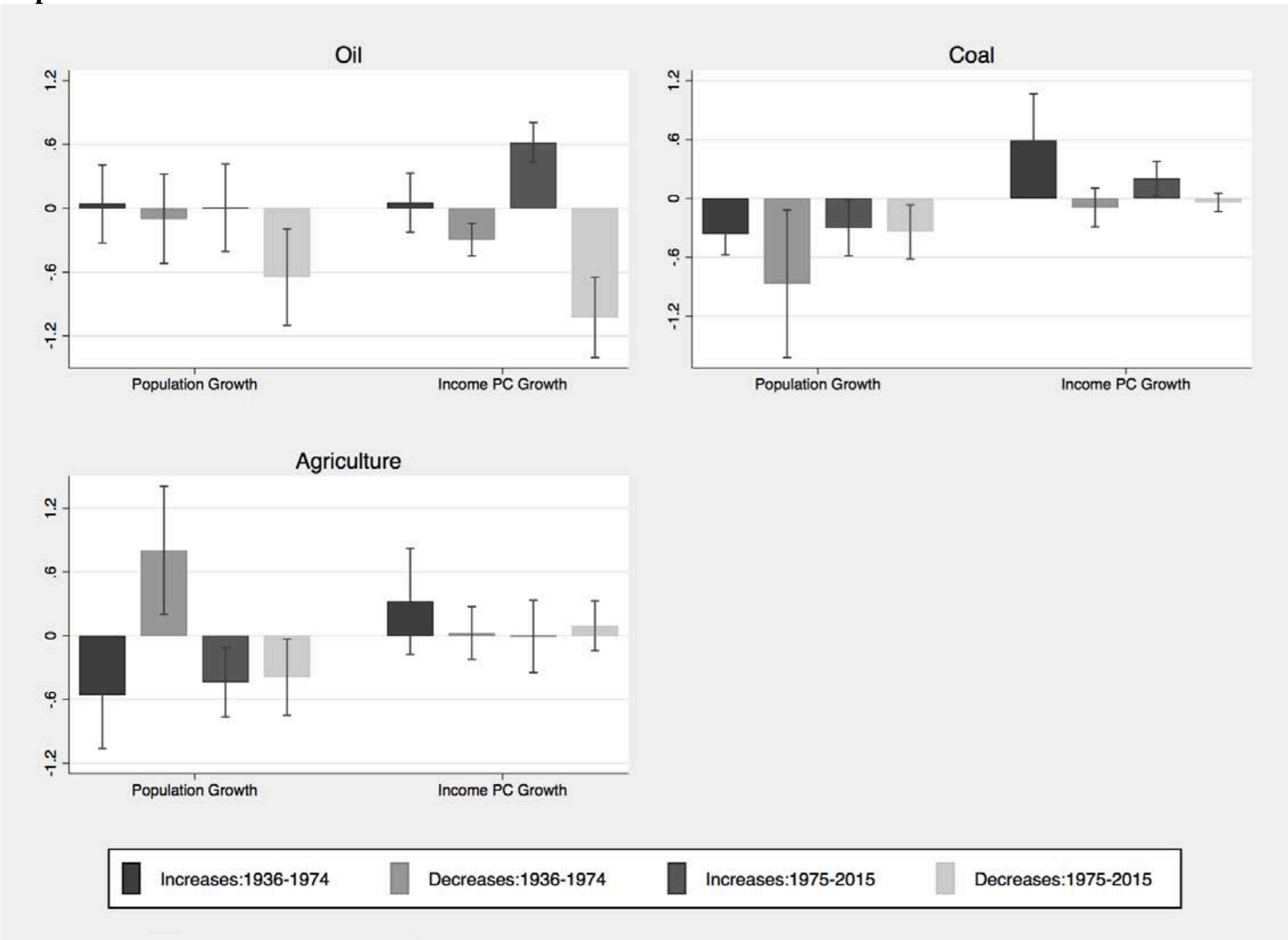
Notes: National Employment (in thousands) over time (1935-2015) in different sectors based on 1987 Standard Industrial Classification (SIC) for 1935-2001 and based on North American Industry Classification System (NAICS) for 2002-2015: Agriculture, Oil & natural gas extraction. National employment statistics for oil & natural gas and agriculture sectors for 1935-2015 are taken from the Bureau of Economic Analysis. National coal mining employment is taken from U.S. Bureau of Labor Statistics.

Figure 3 - Income per Capita Growth and Population Growth



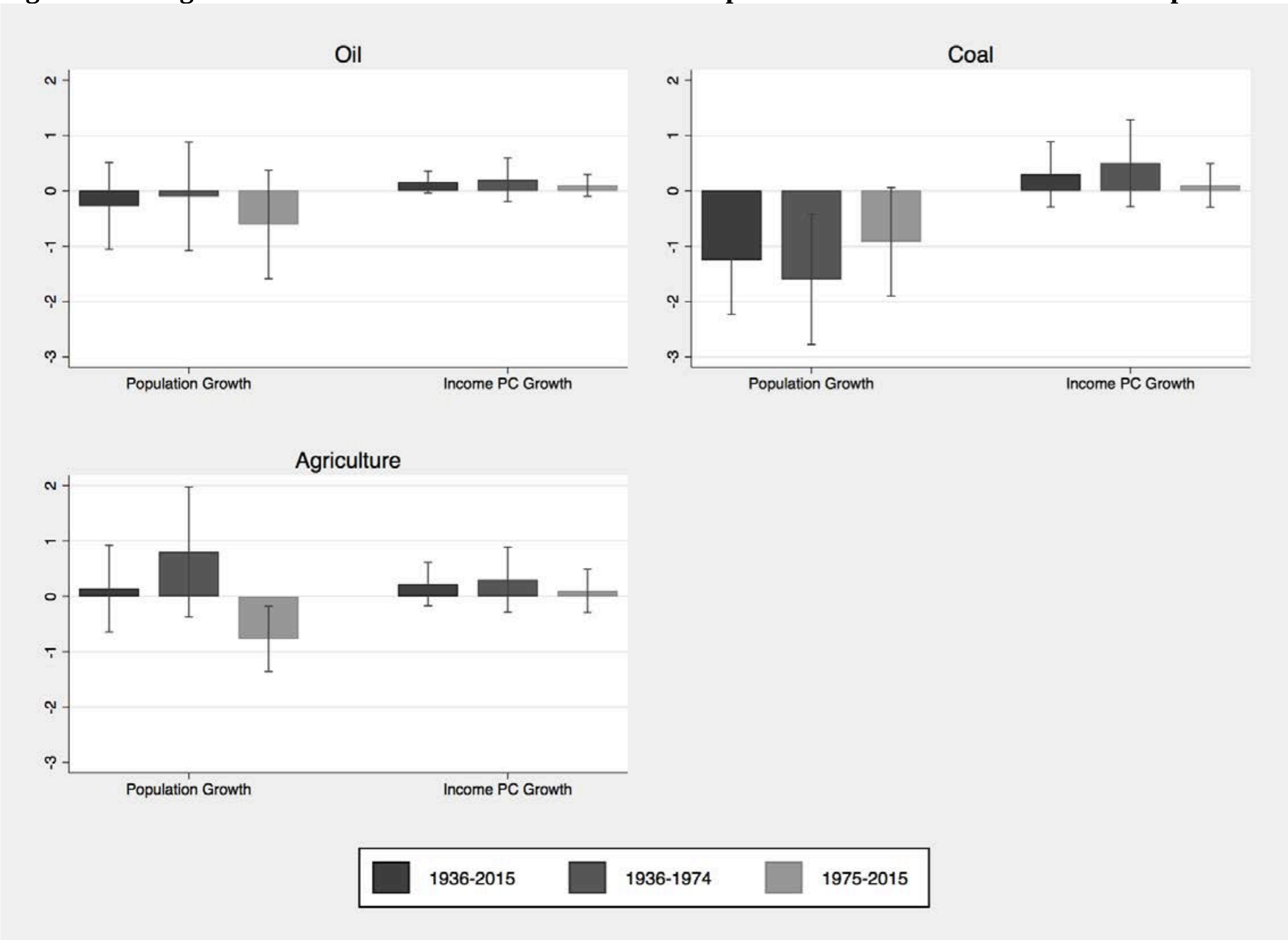
Notes: Graph plots the distribution of the main dependent variables: annualized five-year difference in log of income per capita and annualized five-year difference in log of population.

Figure 4 – Effects of a One Standard Deviation Increase in Resource Employment on Population Growth and Income Per Capita Growth



Notes: The figure is based on Tables 3 and 4 and shows the effects of a one standard deviation increase in oil, coal and agriculture employment on population growth and income per capita growth. Vertical bars show the 95% confidence intervals.

Figure 5 – Long-Run Effect of Resource Endowments on Population Growth and Income Per Capita Growth



Notes: Figure plots the coefficients and the 95% confidence intervals from the Table 7.

Table 1 - Resource Production in 1936 and 2015

	1936	2015
Agricultural Output	**132**	**345**
Fossil Fuels Total	**36**	**211**
Coal (Bituminous, Lignite and Anthracite)	16	26
Oil and Natural Gas	21	185
Total Metals	**9**	**24**
Iron Ore	2	4
Copper	2	7
Lead	0.6	0.7
Zinc	0.8	1.6
Gold	2	7
Silver	0.8	0.5
Molybdenum	0.2	0.9
Total Nonmetal Minerals	**9**	**48**
Cement	3	9
Clay Products	1	1
Lime	0.4	2
Sand and Gravel	1	7
Crushed Stone (including Slate)	2	12
Phosphate Rock	0.2	2
Salt	0.4	2
Sulfur	0.6	0.86
Forest Products		
Timber	0.04	0.15

Notes: Value of production/sales in 2010 dollars (in billion). Data for 1936 are from U.S. Bureau of Mines, Mineral Resources of the United, U.S. Bureau of Mines, Minerals Yearbooks U.S. Geological Survey, Minerals Yearbooks (U.S. Department of the Interior). Data for 2015 are from U.S. Department of the Interior, U.S. Geological Survey, Mineral Commodity Summaries. Forest product values are from the U.S. Forest Service, Agricultural Statistics (U.S. Department of Agriculture, 1944 and 2017).

Table 2a –Summary Statistics: Resource Endowments and Employment

Variable	Obs.	Mean	Std. Dev.
Panel A: State Resource Endowments in 1935			
Oil Endowment	3,840	0.082	0.191
Coal Endowment	3,840	0.095	0.178
Ag Endowment	3,840	0.257	0.209
Panel B: Changes in National Resource Employments 1936-2015			
∆OilEmp	3840	0.022	0.054
∆CoalEmp	3840	-0.020	0.050
∆AgEmp	3840	-0.016	0.022
Panel C: Changes in National Resource Employments 1936-1974			
∆OilEmp	1872	0.019	0.036
∆CoalEmp	1872	-0.024	0.051
∆AgEmp	1872	-0.021	0.022
Panel D: Changes in National Resource Employments 1975-2015			
∆OilEmp	1,968	0.025	0.067
∆CoalEmp	1,968	-0.016	0.049
∆AgEmp	1,968	-0.011	0.021

Notes: Panel A reports summary statistics for state level variables used in the analysis. OilEnd, CoalEnd and AgEnd are oil, coal and farm endowments in 1935 scaled so that the state with largest endowment is coded as 1. Oil & natural gas endowment is the dollar value of oil & natural gas reserves in 1935, using 1935 oil and natural gas prices. Coal endowment is the dollar value of recoverable coal reserves in 1935 using average coal price in 1935. Agriculture endowment is the farm value (value of land and buildings) used in agriculture in 1935. Oil & natural gas and coal data are from Minerals Yearbooks. Agriculture data are from United States Department of Agriculture (USDA), Census of Agriculture. Panels B - D report the summary statistic for national changes in resource employments for the whole sample 1936-2015 (Panel B) and two subsamples: 1936-1974 (in Panel C) and 1975-2015 (in Panel D). ∆OilEmp, ∆CoalEmp and ∆AgEmp are changes in the logged national employment in the oil & natural gas extraction, coal mining and agriculture sectors respectively.

Table 2b - Summary Statistics: Outcome Variables

	Obs.	Mean	Std. Dev.
Panel A: 1936-2015			
ΔIncPC	3,840	0.025	0.029
ΔPop	3,840	0.012	0.012
Panel B: 1936-1974			
ΔIncPC	1,872	0.036	0.036
ΔPop	1,872	0.013	0.014
Panel C: 1975-2015			
ΔIncPC	1,968	0.014	0.012
ΔPop	1,968	0.010	0.010
ΔTotEmp	1,968	0.017	0.014
ΔMnfEmp	1,966	0.046	0.023
ΔTransportationEmp	1,960	0.014	0.016
ΔConstructionEmp	1,962	0.015	0.039
ΔRetailEmp	1,968	0.016	0.017
ΔWholesaleEmp	1,968	0.016	0.023

Notes: Summary statistics for the main outcome variables used in the analysis for the whole sample 1936-2015 and two subsamples: 1936-1974 and 1975-2015. Δ is five-year difference in logged variables. Data are from BEA.

Table 3- Effects of Natural Resources on Population Growth

VARIABLES	(1) 1936-2015 ΔPop D1	(2) 1936-2015 ΔPop D5	(3) 1936-2015 ΔPop D5	(4) 1936-1974 ΔPop D5	(5) 1975-2015 ΔPop D5
OilEnd X ΔOilEmp	0.017	0.039			
	(0.013)	(0.025)			
CoalEnd X ΔCoalEmp	0.059*	0.153**			
	(0.035)	(0.066)			
AgEnd X ΔAgEmp	-0.121**	-0.234**			
	(0.055)	(0.112)			
(OilEmpDecline=0) X OilEnd X ΔOilEmp			0.018	0.014	0.001
			(0.049)	(0.065)	(0.053)
(OilEmpDecline=1) X OilEnd X ΔOilEmp			0.126	0.129	0.188***
			(0.089)	(0.276)	(0.067)
(CoalEmpDecline=0) X CoalEnd X ΔCoalEmp			-0.127***	-0.229***	-0.106**
			(0.044)	(0.068)	(0.051)
(CoalEmpDecline=1) X CoalEnd X ΔCoalEmp			0.234**	0.225**	0.242**
			(0.094)	(0.099)	(0.099)
(AgEmpDecline=0) X AgEnd X ΔAgEmp			-0.521**	-0.703**	-0.551**
			(0.199)	(0.324)	(0.209)
(AgEmpDecline=1) X AgEnd X ΔAgEmp			-0.203	-0.420**	0.261**
			(0.122)	(0.161)	(0.122)
Observations	3,840	3,840	3,840	1,872	1,968
R-squared	0.399	0.429	0.444	0.394	0.550

Notes: This table presents estimates of equation (1) in columns 1 and 2 and equation (2) in columns 3-5. OilEnd, CoalEnd and AgEnd are oil, coal and farm endowments in 1935, based on available knowledge in 1935, constructed as described in the resources section. ΔOilEmp, ΔCoalEmp and ΔAgEmp are changes in the logged national employment in the oil & natural gas extraction, coal mining and agriculture sectors respectively. ΔPop is difference in log of population. D1 and D5 represent one and five year differences. Decline is a dummy variable indicating a decline in respective sectoral employment. Estimated effects in columns 3-5 are relative to zero. Decline = 0 means no decline, Decline=1 means decline in employment between t to t-5. All regressions include controls for census region by year fixed effects. Columns 1-4 also include controls for year interacted with natural log of population in 1929, column 5 includes controls for year interacted with natural log of the population in 1969. The effect of oil during the employment decreases is statistically different from the effect during employment increases over the period 1975-2015. The effect of coal during the employment decreases is statistically different from the effect of coal during employment increases across two sub-periods, but not for the whole time period. The effect of agriculture during the employment decreases is statistically different from the effect during employment increases over the whole time period as well as two sub-periods. 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 Per Capita Income Growth

VARIABLES	(1) 1936-2015 ΔInc PC D1	(2) 1936-2015 ΔInc PC D5	(3) 1936-2015 ΔInc PC D5	(4) 1936-1974 ΔInc PC D5	(5) 1975-2015 ΔInc PC D5
OilEnd X ΔOilEmp	0.123***	0.162***			
	(0.023)	(0.030)			
CoalEnd X ΔCoalEmp	0.025	0.059***			
	(0.050)	(0.019)			
AgEnd X ΔAgEmp	0.066	-0.061			
	(0.060)	(0.059)			
(OilEmpDecline=0) X OilEnd X ΔOilEmp			0.127***	0.018	0.156***
			(0.024)	(0.049)	(0.024)
(OilEmpDecline=1) X OilEnd X ΔOilEmp			0.306***	0.382***	0.298***
			(0.053)	(0.101)	(0.056)
(CoalEmpDecline=0) X CoalEnd X ΔCoalEmp			0.164***	0.371**	0.071**
			(0.033)	(0.152)	(0.031)
(CoalEmpDecline=1) X CoalEnd X ΔCoalEmp			0.028	0.024	0.029
			(0.018)	(0.026)	(0.034)
(AgEmpDecline=0) X AgEnd X ΔAgEmp			0.089	0.406	-0.010
			(0.187)	(0.320)	(0.219)
(AgEmpDecline=1) X AgEnd X ΔAgEmp			-0.054	-0.013	-0.063
			(0.057)	(0.066)	(0.080)
Observations	3,840	3,840	3,840	1,872	1,968
R-squared	0.727	0.890	0.891	0.900	0.668

Notes: This table presents estimates of equation (1) in columns 1 and 2 and equation (2) in columns 3-5. OilEnd, CoalEnd and AgEnd are oil, coal and farm endowments in 1935, based on available knowledge in 1935, constructed as described in the resources section. ΔOilEmp, ΔCoalEmp and ΔAgEmp are changes in the logged national employment in the oil & natural 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. Decline is a dummy variable indicating a decline in respective sectoral employment. Estimated effects in columns 3-5 are relative to zero. Decline = 0 means no decline, Decline=1 means decline in employment between t to t-5. All regressions include controls for census region by year fixed effects. Columns 1-4 also include controls for year interacted with natural log of income per capita in 1929, column 5 includes controls for year interacted with natural log of income per capita in 1969.The effect of oil during the employment decreases is statistically different from the effect during employment increases over the period 1975-2015. The effect of coal during the employment decreases is statistically different from the effect of coal during employment increases across two sub-periods, but not for the whole time period. 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 - Effects of Natural Resources on Wages: 1975-2015

VARIABLES	(1) 1975-2015 ΔMinWage D5	(2) 1975-2015 ΔAgWage D5	(3) 1975-2015 ΔMnfctrWage D5
Panel A. Symmetric Effect			
OilEnd X ΔOilEmp	0.343**	0.035	0.104***
	(0.128)	(0.075)	(0.018)
CoalEnd X ΔCoalEmp	0.368***	0.106*	0.126**
	(0.097)	(0.059)	(0.051)
AgEnd X ΔAgEmp	0.787*	0.107	-0.050
	(0.449)	(0.159)	(0.098)
Observations	1,928	1,968	1,966
R-squared	0.552	0.489	0.927
Panel B. Boom-Bust			
(OilEmpDecline=0) X OilEnd X ΔOilEmp	0.376**	0.018	0.100***
	(0.142)	(0.072)	(0.014)
(OilEmpDecline=1) X OilEnd X ΔOilEmp	0.247*	0.098	0.133**
	(0.138)	(0.120)	(0.054)
(CoalEmpDecline=0) X CoalEnd X ΔCoalEmp	0.905***	-0.154	0.116***
	(0.149)	(0.199)	(0.033)
(CoalEmpDecline=1) X CoalEnd X ΔCoalEmp	0.078	0.244*	0.131*
	(0.112)	(0.140)	(0.069)
(AgEmpDecline=0) X AgEnd X ΔAgEmp	0.123	0.423	0.495***
	(0.909)	(0.406)	(0.183)
(AgEmpDecline=1) X AgEnd X ΔAgEmp	0.840*	0.070	-0.112
	(0.427)	(0.179)	(0.118)
Observations	1,928	1,968	1,966
R-squared	0.559	0.493	0.928

Notes: This table presents the estimates of equation (1) in Panel A and equation (2) in Panel B. ΔMinWage is the difference in log mining wages, ΔAgWage is the difference in logged wage in agriculture, ΔMnfctWage is the difference in logged manufacturing wages. OilEnd, CoalEnd and AgEnd are oil, coal and farm endowments in 1935, based on available knowledge in 1935, constructed as described in the resources section. ΔOilEmp, ΔCoalEmp and ΔAgEmp are changes in the logged national employment in the oil & natural gas extraction, coal mining and agriculture sectors respectively. Estimated effects in Panel B are relative to zero. Decline = 0 means no decline, Decline=1 means decline in employment between t to t-5. All regressions include controls for year interacted with the respective dependent variable in 1969 and census region by year fixed effects. Number of observations is smaller in column 3 because manufacturing wages are not available for Wyoming in 2002. 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 Employment Growth: 1975-2015

	(1)	(2)	(3)	(4)	(5)
	1975-2015	1975-2015	1975-2015	1975-2015	1975-2015
	ΔTotal Emp	Δ Retail Emp	Δ Mnfct Emp	Δ Transportation Emp	Δ Construction Emp
VARIABLES	D5	D5	D5	D5	D5
Panel A. Symmetric Effects					
OilEnd X ΔOilEmp	0.175***	0.129***	0.193***	0.188***	0.529***
	(0.042)	(0.031)	(0.063)	(0.034)	(0.083)
CoalEnd X ΔCoalEmp	0.122***	0.128***	0.066	0.101*	0.333***
	(0.035)	(0.026)	(0.054)	(0.056)	(0.075)
AgEnd X ΔAgEmp	0.158	0.268**	0.397**	0.016	-0.083
	(0.104)	(0.101)	(0.173)	(0.110)	(0.224)
Observations	1,968	1,968	1,966	1,960	1,962
R-squared	0.638	0.772	0.729	0.531	0.645
Panel B. Boom-Bust					
(OilEmpDecline=0) X	0.106*	0.035	0.157*	0.076	0.379***
OilEnd X ΔOilEmp	(0.061)	(0.042)	(0.088)	(0.054)	(0.077)
(OilEmpDecline=1) X	0.393***	0.421***	0.298***	0.551***	1.001***
OilEnd X ΔOilEmp	(0.061)	(0.056)	(0.061)	(0.097)	(0.131)
(CoalEmpDecline=0) X	-0.028	-0.005	-0.083	-0.018	0.337**
CoalEnd X ΔCoalEmp	(0.081)	(0.071)	(0.200)	(0.144)	(0.166)
(CoalEmpDecline=1) X	0.197**	0.193***	0.143	0.159	0.321***
CoalEnd X ΔCoalEmp	(0.084)	(0.057)	(0.155)	(0.140)	(0.065)
(AgEmpDecline=0) X	-0.553*	-0.716**	-0.801	-0.460	-1.282**
AgEnd X ΔAgEmp	(0.281)	(0.290)	(0.487)	(0.349)	(0.505)
(AgEmpDecline=1) X	0.299**	0.465***	0.569**	0.167	0.183
AgEnd X ΔAgEmp	(0.129)	(0.132)	(0.245)	(0.150)	(0.172)
Observations	1,968	1,968	1,966	1,960	1,962
R-squared	0.660	0.794	0.735	0.560	0.654

Notes: This table presents estimates of equation (1) in Panel A and equation (2) in Panel B. ΔTotal Emp, ΔRetailEmp, ΔMnfctrEmp ΔTransportationEmp and ΔConstructionEmp are differences in logged total employment, employment in retail, manufacturing employment, transportation and construction employment sectors respectively. OilEnd, CoalEnd and AgEnd are oil, coal and farm endowments in 1935, based on available knowledge in 1935, constructed as described in the resources section. ΔOilEmp, ΔCoalEmp and ΔAgEmp are changes in the logged national employment in the oil & natural gas extraction, coal mining and agriculture sectors respectively. Estimated effects in Panel B are relative to zero. Decline = 0 means no decline, Decline=1 means decline in employment between t to t-5. All regressions include controls for year interacted with the respective dependent variable in 1969 and census region by year fixed effects. Number of observations is smaller in columns 3, 4 and 5 because BEA employment data are not available for all states in all years to avoid disclosure of confidential information. Specifically, manufacturing employment is not available for Wyoming in 2002, transportation employment is not available for Rhode Island and Wyoming in 2001 and 2002, employment in the construction sector is not available for Rhode Island and Wyoming in 2002 and for Delaware in 2005. Standard errors are clustered at the state level and are in parentheses. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

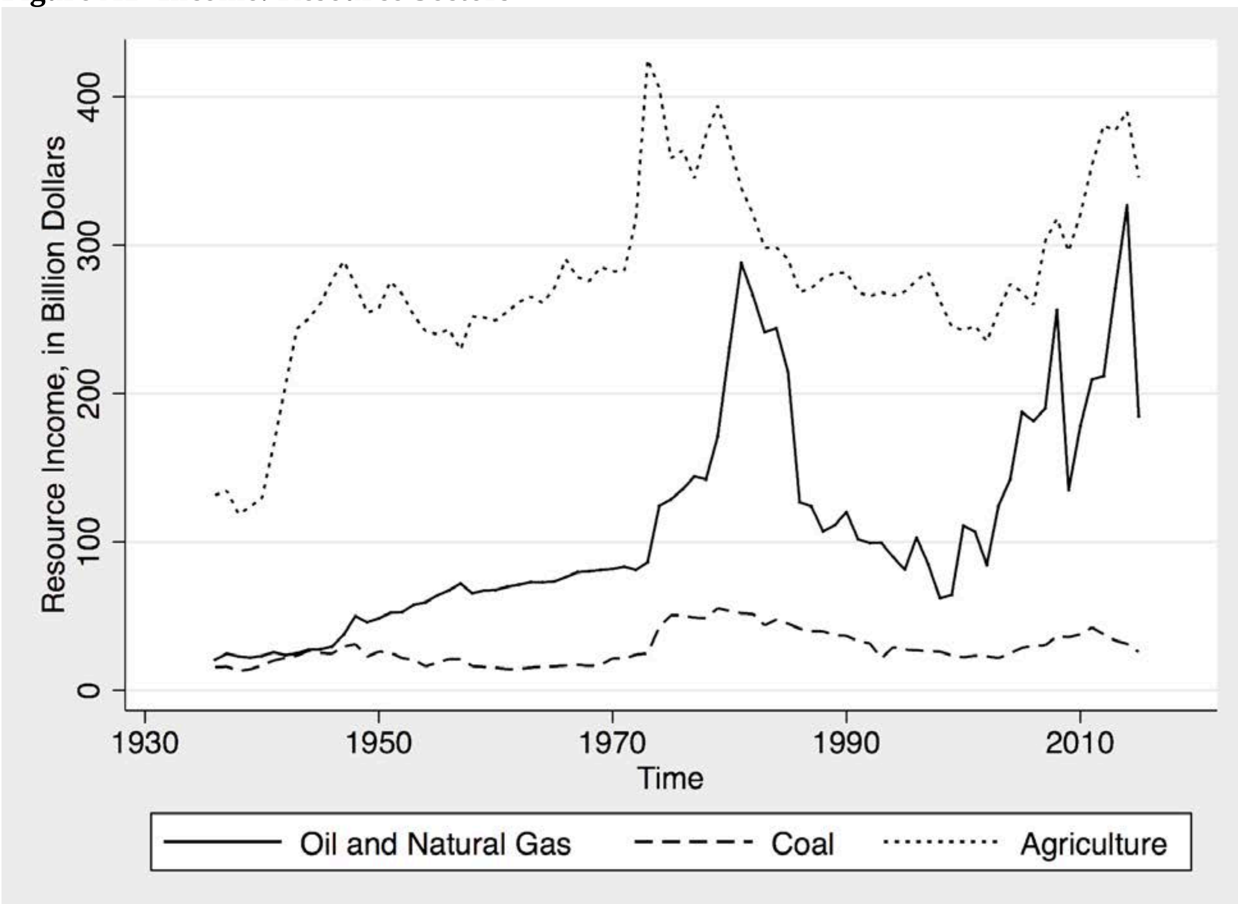
Table 7 - Long-Run Effects of Resource Endowments

	(1)	(2)	(3)
VARIABLES	1936-2015	1936-1975	1975-2015
Panel A. Population			
Oil Endowment	-0.0027	-0.001	-0.0061
	(0.004)	(0.005)	(0.005)
Coal Endowment	-0.0125**	-0.016***	-0.0092*
	(0.005)	(0.006)	(0.005)
Ag Endowment	0.0014	0.008	-0.0077**
	(0.004)	(0.006)	(0.003)
Observations	48	48	48
R-squared	0.5235	0.428	0.5915
	(4)	(5)	(6)
VARIABLES	1936-2015	1936-1975	1975-2015
Panel B. Income Per Capita			
Oil Endowment	0.0016	0.002	0.0010
	(0.001)	(0.002)	(0.001)
Coal Endowment	0.0030	0.005	0.0010
	(0.003)	(0.004)	(0.002)
Ag Endowment	0.0022	0.003	0.0010
	(0.002)	(0.003)	(0.002)
Observations	48	48	48
R-squared	0.7978	0.881	0.5408

Notes: This table presents the estimated long-run effects of resource endowments on average annualized population and income per capita growth for the whole time period: 1936-2015 as well as for the two sub-periods: 1936-1974 and 1975-2915. All columns include controls for the initial conditions: population or income per capita in 1929 and census region 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.

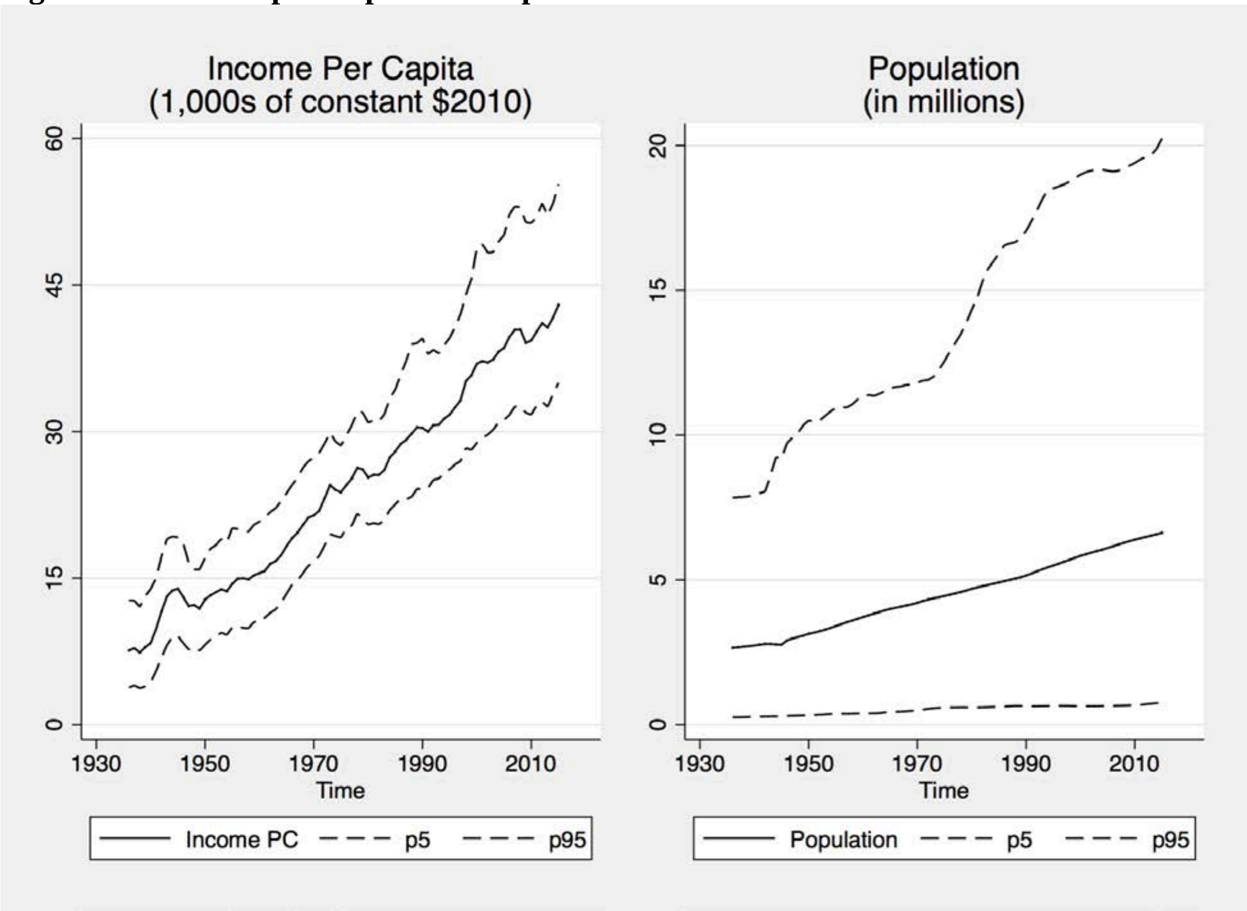
Appendix

Figure A1- Income: Resource Sectors



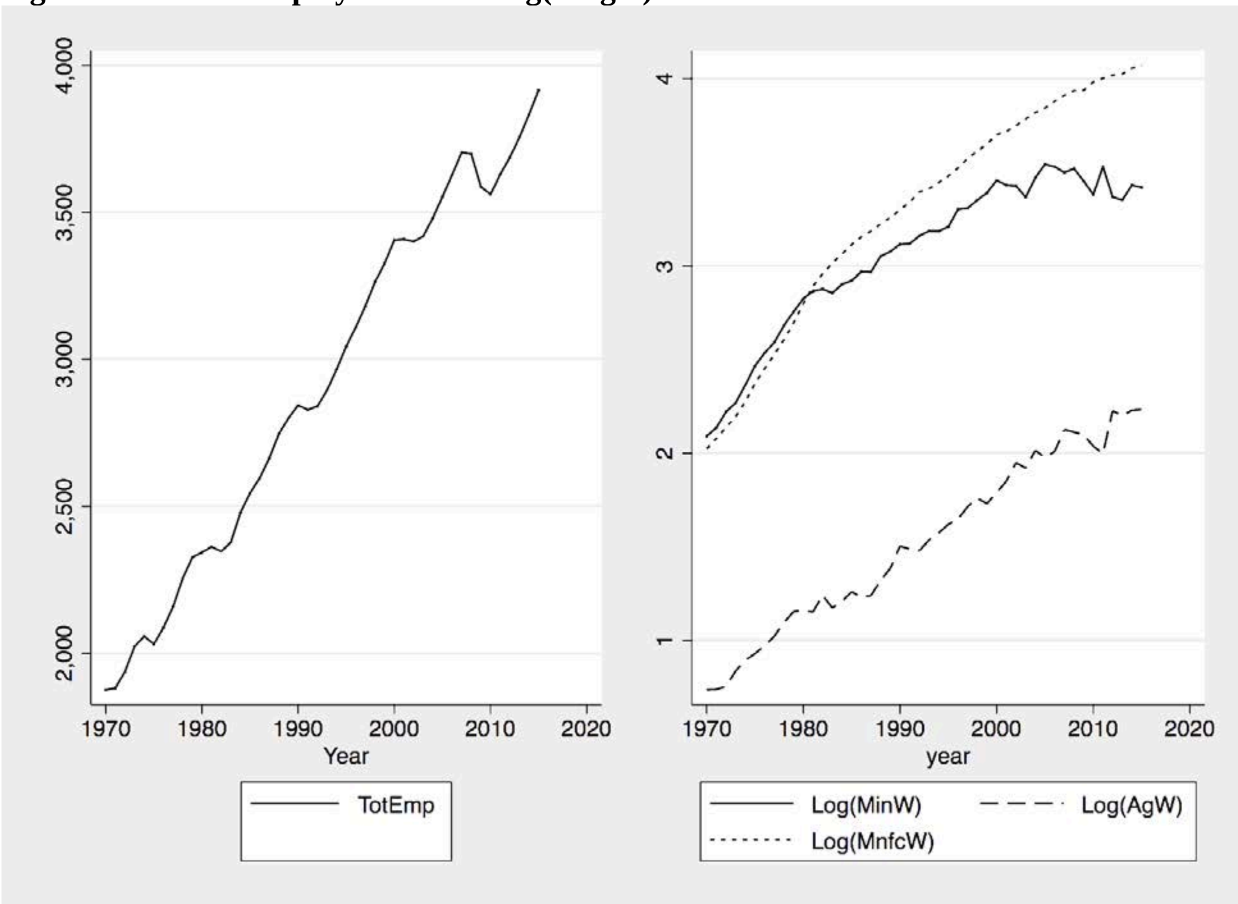
Notes: Income (in millions) from resource sectors, in 2010 dollars. Oil& natural gas from Alaska excluded from oil & natural gas income. Coal and oil & natural gas income data are from the U.S. Bureau of Mines, Minerals Yearbooks and U.S. Energy Information Administration (EIA), Annual Energy Review. Agriculture income data are taken from the United States Department of Agriculture (USDA).

Figure A2 –Income per Capita and Population over Time



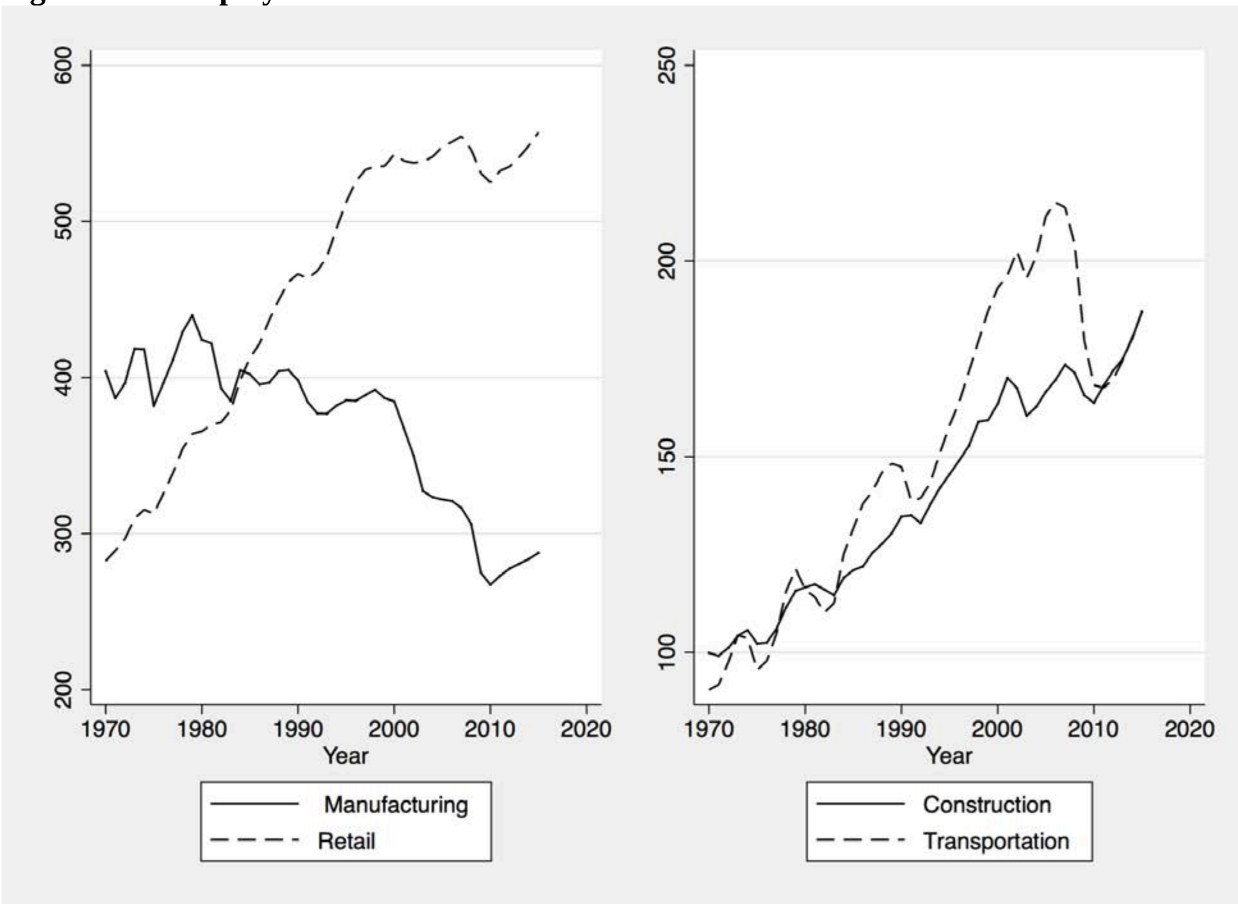
Notes: Graph plots income per capita in 2010 dollars and population over time and 5th and 95th percentile. Data are taken from the Bureau of Economic Analysis (BEA).

Figure A3 –Total Employment and Log(Wages)



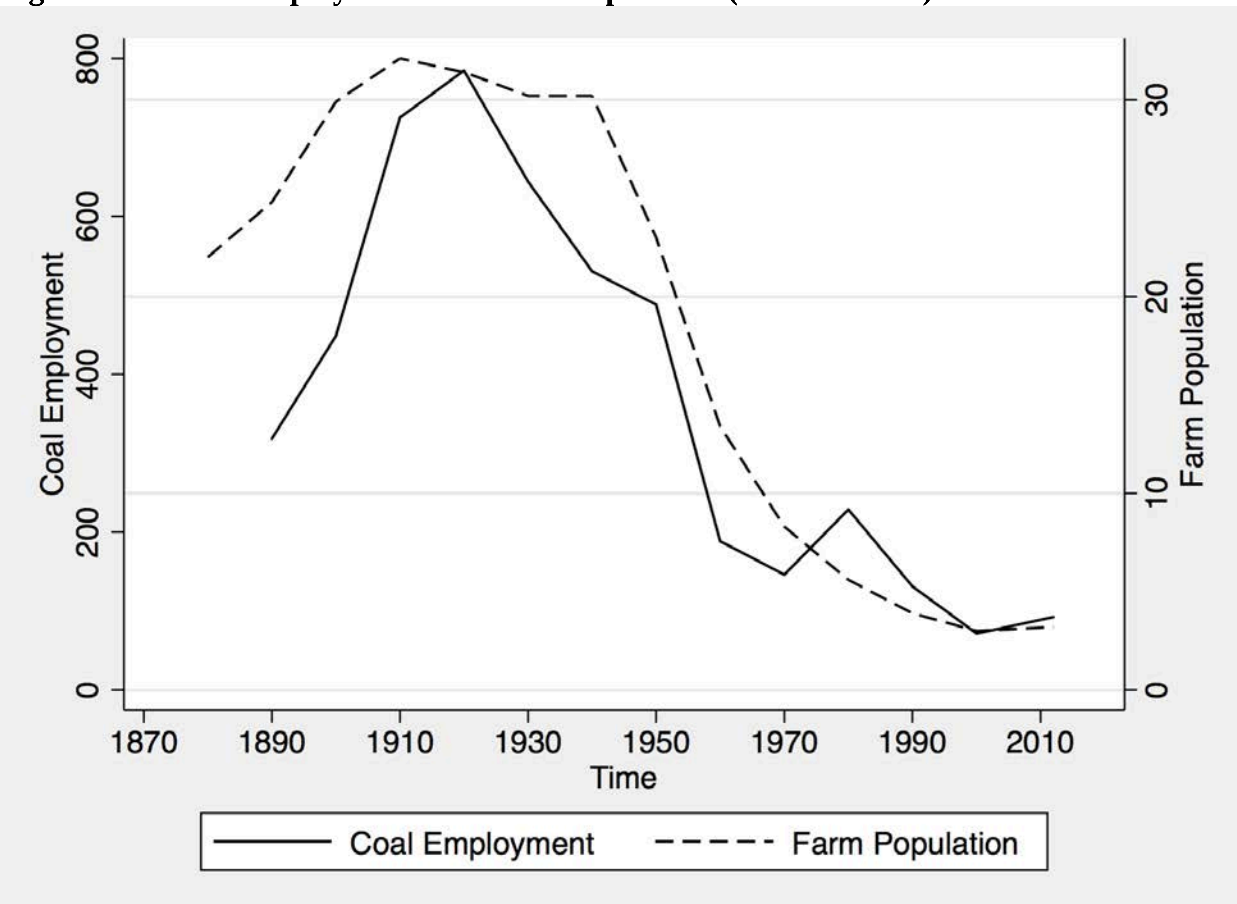
Notes: Figure shows total employment per 1,000 and wages in log for mining(MinW), manufacturing(MnfcW), and agriculture(AgW) sectors over time. Data are taken from Bureau of Economic Analysis (BEA).

Figure A4 – Employment: Non-Resource Sectors



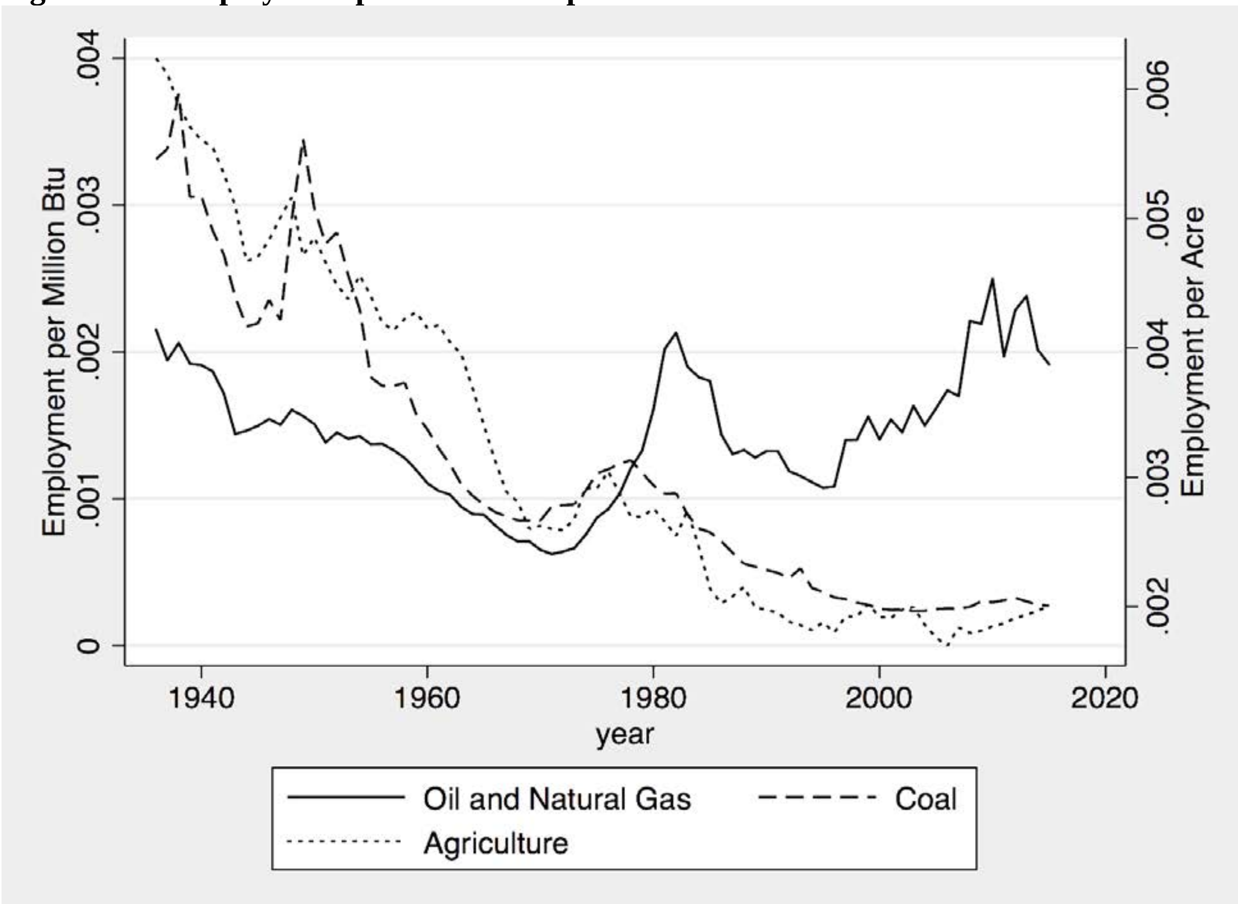
Notes: The average state employment in non resource sectors: manufacturing, construction, transportation, and retail over 1970-2015. Employment is based on 1987 Standard Industrial Classification (SIC) for 1970-2001 and is based on North American Industry Classification System (NAICS) for 2002-2015. Data are taken from Bureau of Economic Analysis (BEA).

Figure A5 – Coal Employment and Farm Population (in Thousands): 1880-2012



Notes: This figure shows the coal employment and farm population over the period 1880-2012. Data on coal employment are taken from U.S. Bureau of Mines, Mineral Resources of the United States. 1932–1970: U.S. Bureau of Mines, Minerals Yearbooks. 1971–1993: U.S. Energy Information Administration, Coal Data. 1994–2000: Coal Industry Annual. Data on farm population are taken from U.S. Census Bureau, decennial census publications, Leon E. Truesdell (1960), "Farm Population:1880 to 1950, "U.S. Bureau of the Census, Technical Paper No.3 and Census of Agriculture 2012.

Figure A6 – Employment per Unit of Output: 1935-2015



Notes: Figure shows the employment per unit of output. Oil & natural gas and Coal are employments in oil & natural gas and coal sectors per million Btu respectively. Agriculture is the employment in agricultural sector per acre.

Table A1 – Summary Statistics

Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: D1 - One year difference						
	1936-2015		**1936-1969**		**1970-2015**	
ΔOilEmp	0.02	0.089	0.016	0.051	0.023	0.109
ΔCoalEmp	-0.023	0.081	-0.035	0.089	-0.015	0.074
ΔAgEmp	-0.016	0.042	-0.025	0.036	-0.009	0.044
Panel B: D5 - Five years difference						
	1936-2015		**1936-1969**		**1970-2015**	
ΔOilEmp(Decline=1)	-0.028	0.028	-0.015	0.008	-0.04	0.034
ΔOilEmp(Decline=0)	0.057	0.038	0.042	0.029	0.071	0.039
ΔCoalEmp(Decline=1)	-0.053	0.029	-0.055	0.039	-0.052	0.014
ΔCoalEmp(Decline=0)	0.033	0.024	0.026	0.016	0.04	0.028
ΔAgEmp(Decline=1)	-0.026	0.017	-0.027	0.02	-0.024	0.015
ΔAgEmp(Decline=0)	0.01	0.008	0.008	0.008	0.011	0.008
ΔOilInc	0.026	0.072	0.049	0.039	0.007	0.086
ΔCoalInc	-0.31	1.196	0.009	0.055	-0.574	1.569
ΔAgInc	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.

Table A2 – Effects of Natural Resources on Population Growth: Alternative Measures

VARIABLES	(1) 1936-1974 1936 Knowledge	(2) 1936-1974 2015 Knowledge	(3) 1936-1974 Per Capita	(4) 1936-1974 Land	(5) 1936-1974 Income
Panel A. 1936-1974					
(OilEmpDecline=0) x	0.014	-0.032	0.094*	0.004	0.009
OilEnd x ΔOilX	(0.065)	(0.072)	(0.051)	(0.064)	(0.050)
(OilEmpDecline=1) x	0.129	0.173	0.267	0.234	-0.216
OilEnd x ΔOilX	(0.276)	(0.251)	(0.339)	(0.281)	(0.276)
(CoalEmpDecline=0) x	-0.229***	-0.098	-0.277***	-0.183***	-0.176***
CoalEnd x ΔCoalX	(0.068)	(0.074)	(0.094)	(0.054)	(0.049)
(CoalEmpDecline=1) x	0.225**	0.168*	0.215*	0.186**	0.044
CoalEnd x ΔCoalX	(0.099)	(0.085)	(0.123)	(0.085)	(0.044)
(AgEmpDecline=0) x	-0.703**	-0.717*	-0.183	-0.459	-0.052
AgEnd x ΔAgX	(0.324)	(0.402)	(0.317)	(0.413)	(0.043)
(AgEmpDecline=1) x	-0.420**	-0.619***	0.637***	0.697**	0.221***
AgEnd x ΔAgX	(0.161)	(0.137)	(0.167)	(0.274)	(0.080)
Observations	1,872	1,872	1,872	1,872	1,872
R-squared	0.394	0.423	0.429	0.423	0.378
VARIABLES	1975-2015 1936 Knowledge	1975-2015 2015 Knowledge	1975-2015 Per Capita	1975-2015 Land	1975-2015 Income
Panel B. 1975-2015					
(OilEmpDecline=0) x	0.001	0.012	0.022	0.010	-0.006
OilEnd x ΔOilX	(0.053)	(0.047)	(0.061)	(0.065)	(0.042)
(OilEmpDecline=1) x	0.188***	0.226***	0.119	0.169*	0.077***
OilEnd x ΔOilX	(0.067)	(0.061)	(0.101)	(0.087)	(0.028)
(CoalEmpDecline=0) x	-0.106**	-0.089	-0.103	-0.070	-0.058*
CoalEnd x ΔCoalX	(0.051)	(0.057)	(0.080)	(0.049)	(0.031)
(CoalEmpDecline=1) x	0.242**	0.229**	0.269*	0.201**	0.225**
CoalEnd x ΔCoalX	(0.099)	(0.086)	(0.147)	(0.096)	(0.099)
(AgEmpDecline=0) x	-0.551**	-0.305*	0.222	-0.639*	-0.085**
AgEnd x ΔAgX	(0.209)	(0.169)	(0.251)	(0.350)	(0.042)
(AgEmpDecline=1) x	0.261**	0.089	0.043	0.411*	0.168**
	(0.122)	(0.100)	(0.152)	(0.216)	(0.066)
Observations	1,968	1,968	1,968	1,968	1,968
R-squared	0.550	0.563	0.537	0.564	0.525

Notes: This table presents estimates of equation (2). Panel A and Panel B present the results for 1936-1974 and for 1975-2015 respectively. Endowment measures based on 1935 used in column 1 (same specifications as in Table 3 columns 4 and 5), 2015 knowledge of endowments are used in column 2. In column 3 resource endowments are measured per population in 1929, land area in acres used in agricultural sector per square mile, and 1935 knowledge about coal and oil & natural gas used as endowments in column 4, and, in column 5, the national sectoral income used instead of national sectoral employment. The construction of the variables is described in the resources section. All differences are five year differences. 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. Estimated effects are relative to zero. All regressions include controls for census region by year. Panel A also includes controls for year interacted with natural log of population in 1929, Panel B includes controls for year interacted with natural log of population in 1969. 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 A3 – Effects of Natural Resources on Income Per Capita Growth: Alternative Measures

VARIABLES	(1) 1936-1974 1936 Knowledge	(2) 1936-1974 2015 Knowledge	(3) 1936-1974 Per Capita	(4) 1936-1974 Land	(5) 1936-1974 Income
Panel A. 1936-1974					
(OilEmpDecline=0) x	0.018	0.063	0.084*	0.016	0.025
OilEnd x ΔOilX	(0.049)	(0.062)	(0.042)	(0.046)	(0.031)
(OilEmpDecline=1) x	0.382***	0.400***	0.531***	0.384***	-0.323***
OilEnd x ΔOilX	(0.101)	(0.097)	(0.079)	(0.099)	(0.099)
(CoalEmpDecline=0) x	0.371**	0.124	0.548***	0.342**	0.116
CoalEnd x ΔCoalX	(0.152)	(0.087)	(0.065)	(0.159)	(0.100)
(CoalEmpDecline=1) x	0.024	0.020	0.076**	0.025	0.213**
CoalEnd x ΔCoalX	(0.026)	(0.028)	(0.029)	(0.026)	(0.081)
(AgEmpDecline=0) x	0.406	0.208	0.893***	0.797**	0.088
AgEnd x ΔAgX	(0.320)	(0.243)	(0.191)	(0.322)	(0.079)
(AgEmpDecline=1) x	-0.013	0.028	-0.050	-0.014	-0.026
AgEnd x ΔAgX	(0.066)	(0.072)	(0.050)	(0.062)	(0.084)
Observations	1,872	1,872	1,872	1,872	1,872
R-squared	0.900	0.899	0.903	0.900	0.901
VARIABLES	1975-2015 1936 Knowledge	1975-2015 2015 Knowledge	1975-2015 Per Capita	1975-2015 Land	1975-2015 Income
Panel B. 1975-2015					
(OilEmpDecline=0) x	0.156***	0.186***	0.143**	0.156***	0.102***
OilEnd x ΔOilX	(0.024)	(0.037)	(0.057)	(0.021)	(0.018)
(OilEmpDecline=1) x	0.298***	0.336***	0.236**	0.299***	0.144***
OilEnd x ΔOilX	(0.056)	(0.068)	(0.114)	(0.056)	(0.029)
(CoalEmpDecline=0) x	0.071**	0.052	0.082	0.051*	0.071***
CoalEnd x ΔCoalX	(0.031)	(0.039)	(0.081)	(0.028)	(0.024)
(CoalEmpDecline=1) x	0.029	0.055**	0.022	0.036	-0.024
CoalEnd x ΔCoalX	(0.034)	(0.024)	(0.030)	(0.034)	(0.027)
(AgEmpDecline=0) x	-0.010	-0.097	0.557**	0.575***	0.067
AgEnd x ΔAgX	(0.219)	(0.161)	(0.230)	(0.179)	(0.090)
(AgEmpDecline=1) x	-0.063	-0.054	-0.038	-0.001	0.155
AgEnd x ΔAgX	(0.080)	(0.061)	(0.060)	(0.066)	(0.097)
Observations	1,968	1,968	1,968	1,968	1,968
R-squared	0.668	0.684	0.662	0.671	0.659

Notes: This table presents estimates of equation (2). Panel A and Panel B present the results for 1936-1974 and for 1975-2015 respectively. Endowment measures based on 1935 used in column 1, 2015 knowledge of endowments are used in column 2. In column 3 resource endowments are measured per population in 1929, land area in acres used in agricultural sector per square mile used as endowments in column 4, and, in column 5, the national sectoral income used instead of national sectoral employment. All differences are five year differences. 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. Estimated effects are relative to zero. All regressions include controls for census region by year. Panel A also includes controls for year interacted with natural log of per capita income in 1929, Panel B includes controls for year interacted with natural log of per capita income in 1969. 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 A4 – Lon-Run Effects of Resource Endowments on Population Growth: Alternative Endowments Measures

	(1)	(2)	(3)	(4)
	1936-2015	1936-2015	1936-2015	1936-2015
VARIABLES	1936 knowledge	2015 knowledge	Per Capita	Land
Panel A. 1936-2015				
Oil Endowment	-0.0027	-0.0038	-0.0020	-0.0032
	(0.004)	(0.004)	(0.005)	(0.006)
Coal Endowment	-0.0125**	-0.0098**	-0.0124*	-0.0088**
	(0.005)	(0.005)	(0.007)	(0.004)
Ag Endowment	0.0014	0.0063*	-0.0089**	-0.0164**
	(0.004)	(0.004)	(0.004)	(0.008)
Observations	48	48	48	48
R-squared	0.5235	0.5461	0.5724	0.6026
	(5)	(6)	(7)	(8)
VARIABLES	1936 knowledge	2015 knowledge	Per Capita	Land
Panel B. 1936-1974				
Oil Endowment	-0.001	-0.002	-0.001	-0.003
	(0.005)	(0.005)	(0.006)	(0.006)
Coal Endowment	-0.016***	-0.011**	-0.015*	-0.011**
	(0.006)	(0.005)	(0.008)	(0.005)
Ag Endowment	0.008	0.015***	-0.017***	-0.023**
	(0.006)	(0.005)	(0.005)	(0.011)
Observations	48	48	48	48
R-squared	0.428	0.460	0.506	0.519
	(9)	(10)	(11)	(12)
VARIABLES	1936 knowledge	2015 knowledge	Per Capita	Land
Panel C. 1975-2015				
Oil Endowment	-0.0061	-0.0063	-0.0049	-0.0041
	(0.005)	(0.004)	(0.006)	(0.005)
Coal Endowment	-0.0092*	-0.0098**	-0.0066	-0.0092
	(0.005)	(0.004)	(0.005)	(0.006)
Ag Endowment	-0.0077**	-0.0036	-0.0109	0.0015
	(0.003)	(0.003)	(0.007)	(0.005)
Observations	48	48	48	48
R-squared	0.5915	0.6168	0.6139	0.5597

Notes: This table presents the estimated long-run effects of resource endowments on population growth for the whole time period in Panel A: 1936-2015 as well as for the two sub-periods in: 1936-1975 and 1975-2915 in Panel B and C respectively. In column 1 the endowments of resources are measured per square mile based on 1936 knowledge about the endowments, as in Table 7, in column 2 the endowments of resources are measured per square mile based on 2015 knowledge about the endowments, in column 3 land area in acres used in agricultural sector per square mile, rather than value of that land as a measure of agricultural endowment and 1935 knowledge about coal and oil & natural gas endowments, and in column 4 endowments are measured by population in 1929. All columns include controls for the initial conditions: population or income per capita in 1929 and census region 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 A5 – Long-Run Effects of Resource Endowments on Income Per Capita Growth: Alternative Endowments Measures

	(1)	(2)	(3)	(4)
	1936-2015	1936-2015	1936-2015	1936-2015
VARIABLES	1936 knowledge	2015 knowledge	Land	Per Capita
Panel A. 1936-2015				
Oil Endowment	0.0016	0.0030	0.0009	0.0013
	(0.001)	(0.002)	(0.001)	(0.001)
Coal Endowment	0.0030	-0.0011	0.0037***	0.0020
	(0.003)	(0.001)	(0.001)	(0.003)
Ag Endowment	0.0022	0.0005	0.0050***	0.0043**
	(0.002)	(0.002)	(0.001)	(0.002)
Observations	48	48	48	48
R-squared	0.7978	0.7905	0.8657	0.8185
	(5)	(6)	(7)	(8)
VARIABLES	1936 knowledge	2015 knowledge	Land	Per Capita
Panel B. 1936-1974				
Oil Endowment	0.002	0.003	0.000	0.001
	(0.002)	(0.003)	(0.001)	(0.001)
Coal Endowment	0.005	-0.001	0.004**	0.004
	(0.004)	(0.002)	(0.002)	(0.004)
Ag Endowment	0.003	-0.000	0.008***	0.006**
	(0.003)	(0.003)	(0.002)	(0.002)
Observations	48	48	48	48
R-squared	0.881	0.871	0.925	0.893
	(9)	(10)	(11)	(12)
VARIABLES	1936 knowledge	2015 knowledge	Land	Per Capita
Panel C. 1975-2015				
Oil Endowment	0.0010	0.0022**	0.0009	0.0013
	(0.001)	(0.001)	(0.001)	(0.001)
Coal Endowment	0.0010	-0.0019*	0.0004	0.0029***
	(0.002)	(0.001)	(0.002)	(0.001)
Ag Endowment	0.0010	0.0007	0.0026	0.0020*
	(0.002)	(0.002)	(0.002)	(0.001)
Observations	48	48	48	48
R-squared	0.5408	0.5752	0.5641	0.6234

Notes: This table presents the estimated long-run effects of resource endowments on income per capita growth for the whole time period in Panel A: 1936-2015 as well as for the two sub-periods in: 1936-1975 and 1975-2915 in Panel B and C respectively. In column 1 the endowments of resources are measured per square mile based on 1936 knowledge about the endowments, as in Table 7, in column 2 the endowments of resources are measured per square mile based on 2015 knowledge about the endowments, in column 3 endowments are measured by population in 1929, and in column 4 land area in acres used in agricultural sector per square mile, rather than value of that land as a measure of agricultural endowment and 1935 knowledge about coal and oil & natural gas endowments. All columns include controls for the initial conditions: population or income per capita in 1929 and census region 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 A6 – Long-Run Effects of Resource Endowments on Population Growth: 1880-1935

VARIABLES	(1) 1880-1935 1936 knowledge	(2) 1880-1935 2015 knowledge	(3) 1880-1935 Per Capita	(4) 1880-1935 Land
Oil Endowment	0.0086	0.0137	-0.0029	0.0079
	(0.006)	(0.009)	(0.008)	(0.006)
Coal Endowment	0.0149**	0.0038	0.0192**	0.0157**
	(0.007)	(0.003)	(0.009)	(0.007)
Ag Endowment	0.0046	0.0087	0.0032	-0.0030
	(0.007)	(0.009)	(0.008)	(0.012)
Observations	47	47	47	47
R-squared	0.6043	0.5955	0.6011	0.6025

Notes: This table presents the effects of resource endowments on annualized population growth over the period 1880-1935. In column 1 the endowments of resources are measured per square mile based on 1936 knowledge about the endowments, in column 2 the endowments of resources are measured per square mile based on 2015 knowledge about the endowments, in column 3 endowments are measured by population in 1929, and in column 4 land area in acres used in agricultural sector per square mile, rather than value of that land as a measure of agricultural endowment and 1935 knowledge about coal and oil & natural gas endowments. All columns include controls for the initial conditions: population in 1880 and census region 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. Oklahoma is not in the sample.