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The curse of natural resources: An empirical investigation of U.S. counties☆

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ABSTRACT

Research consistently shows that natural resource dependence tends to be associated with lower economic growth. However, the studies typically focus on differences across nations or states. We fill a gap in the literature by testing the so-called resource curse at a more disaggregated county level. Our results show clear evidence that resource-dependent counties exhibit more anemic economic growth, even after controlling for state-specific effects, socio-demographic differences, initial income, and spatial correlation. A case study analysis of Maine and Wyoming, and the counties within, highlight the growth effects of specializing in natural resource extraction.

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> *Resource economics can be viewed as a sequence of thought experiments or models and organized empirical observations directed at a common set of questions about economic scarcity and thus choice*. Tom Crocker, 2002

1. Introduction

The *curse of natural resources* is one of the most intriguing puzzles in economics and a great example of how organized empirical observations can guide economic theory and inform policy. Contrary to basic intuition, studies consistently find that higher national or regional resource dependence tends to be associated with lower economic growth.[1] Seminal research by Sachs and

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[1] Examples of studies that find empirical support for the resource curse include Ding and Field (2005) and Bulte et al. (2005). We note that a few studies find evidence contradicting the resource curse (e.g., Sala-i-Martin et al., 2004; Wright and Czelusta, 2004). See Ross (1999), Auty (2001), and Barbier (2005) for comprehensive surveys of the resource-based growth literature.

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Warner (1995, 1999, 2001) show that nations with more natural resources exhibit lower growth even after controlling for geographical, demographic, political, or economic differences. Papyrakis and Gerlagh (2007) have recently extended this research to the U.S. and show that the resource curse also holds at the state level. We add to this literature by testing whether the resource curse exists at an even more disaggregated county level. Testing the resource curse at the county level has several advantages. First, there are over 3000 counties in the U.S. which greatly increases the sample size and the reliability of the econometric estimates. Second, there is less need to control for institutional or political differences at the county or state level. Third, a county-level analysis avoids the need to look at the resource curse through an aggregation lens. Since economic policies are set by local or county planners, a more micro-level analysis allows researchers to explore *how* the resource curse operates and *why* decision makers choose to specialize in resource industries associated with lower economic growth.

We find strong evidence that the curse of natural resources holds at the county level. The coefficient on natural resource earnings is consistently negative and statistically significant. A main advantage of looking for the resource curse at the county level is a reduced need to control for confounding effects such as differences in institutions, spoken language, currencies and government corruption. However, we do control for possible county-level effects such as state-specific fixed factors, demographic variation in age, race and education, population density, initial income, and spatial correlation. Furthermore, to analyze the stability of the resource curse over time, we consider five separate sample periods starting in the base year of 1980 (first year of consistently available data from the Census Bureau) and ending in the years 1985, 1990, 1995, 2000 and 2005. The curse is always statistically significant and remarkably robust to changes in the sample period, control variables and estimation techniques.

We close with a brief case study analysis of Maine and Wyoming – two states separated by 2400 miles and are different in nearly every regard with the exception that they are both called home by Tom Crocker. Wyoming, with 23 counties, is a resource-abundant state and a leading producer of coal, natural gas and several other minerals. In 1980, over 25% of Wyoming's earnings were derived from the resource sectors of agriculture, fishing, forestry and mining. On the other end of the spectrum, less than 2% of the earnings from the 16 counties in Maine were generated through natural resource extraction (primarily fishing). During the period 1980–1995, Maine's economy clearly outperformed Wyoming's. Real personal income per capita in Maine grew at a rate of 1.8%, while over the same period Wyoming experienced an economic contraction at the rate of −0.2%. Maine and Wyoming, and the counties within, appear to be classic examples of the natural resource curse.

2. Data and econometric model

Our dataset covers 3092 counties in the United States. The U.S. consists of 3144 counties, but 52 counties were omitted because of missing data. All data were downloaded from the U.S. Census Bureau's website (www.census.gov/support/DataDownload.htm). The base year for the growth analysis is 1980 because this was the first year of consistently available data for all counties. All prices are in 1980 dollars. The dependent variable is the annual growth in per capita personal income between 1980 and 1995.[2] The resource variable is measured as percent earnings from agriculture, fishing, forestry and mining industries. Table 1 presents the definitions and descriptive statistics for all the variables. (Additional details of the data collection and preparation procedure can be found in the attached Data Appendix.)

Across the 3092 counties, the average growth in annual per capita personal income growth is 1.3%, while the average fraction of earnings from the resource sectors is 5.1%. There is substantial variation in resource specialization across U.S. counties – on the low end, many counties effectively extracted no natural resources in 1980 while other counties had over 50% of earnings derived from natural resources extraction. One county (Loving, TX) in 1980 had a remarkable 90% of county revenues coming from the natural resource sector.

[2] For our baseline regression, we choose a 15-year window but also report results for windows of 5, 10, 20 and 25 years. Papyrakis and Gerlagh (2007) choose a 14-year window (1986–2000); Sachs and Warner (1995) choose a 19-year window (1970–1989); and Higgins et al. (2006) choose a 29-year window (1969–1998).

Table 1
Variable definitions and descriptive statistics.

Variable	Definition	Mean	Min	Max
G	Annual growth in per capita personal income (1980–1995)	0.013	−0.049	0.076
Resources	Percent of earnings in agriculture, forestry, fishing, mining in 1980	0.051	>0	0.905
Y_{80}	Personal income per capita in 1980	8187	2435	21,366
High School	Percent of county population that graduated high school in 1980	0.204	0.059	0.346
College	Percent of county population with a college degree in 1980	0.066	0.015	0.300
Young	Percent of population that is less than 19 years old in 1980	0.294	0.134	0.481
Old	Percent of population that is at least 65 years old in 1980	0.131	0.008	0.334
Poverty	Percent of population at or below the poverty line in 1980	0.017	0.003	0.061
White	Percent of population Caucasian in 1980	0.880	0.063	<1
Metro	= 1 if population per square mile in 1980 exceeds 300, else zero	0.078	0	1

Notes. All data are from the U.S. Census Bureau. ">0" indicates a negligible percentage, which is censored to zero. Similarly, "<1" indicates a fraction censored at one.

We build upon traditional neoclassical models of cross-country income convergence (Mankiw et al., 1992; Barro and Sala-i-Martin, 1992) to test the curse of natural resources. The empirical model takes the following form:

$$G_i = \beta_1 \ln Y_{0,i} + \beta_2 R_{0,i} + \gamma' X_{0,i} + \alpha_S + \varepsilon_i, \tag{1}$$

where $G_i = (1/T)\ln(Y_{T,i}/Y_{0,i})$ is the growth rate between 1980 and 1995; $\ln Y_{0,i}$ is the natural log of per capita personal income in 1980; $R_{0,i}$ is the share of earnings in resource-extraction industries in 1980; $X_{0,i}$ is a set of socio-economic control variables measured in 1980; α_S is a state-specific fixed effect for $S=1, \ldots, 50$; and $i=1, \ldots, 3092$ indexes U.S. counties. We test the curse of natural resources by contrasting the null hypothesis H_0: $\beta_2 \geq 0$ against the alternative H_A: $\beta_2 < 0$. Rejection of the null hypothesis provides evidence that, all else equal, resource abundant U.S. counties exhibit conditionally slower economic growth.

Counties neighboring each other are likely to be similarly impacted by regional economic factors. To account for this possible spatial correlation, we follow Rappaport and Sachs (2003) and Higgins et al. (2006) by allowing a non-zero error covariance between nearby counties. The covariance of the errors between counties i and j is given by

$$\text{cov}(\varepsilon_i, \varepsilon_j) = \sigma_{ij}\alpha\left[1 - \left(\frac{d_{ij}}{200}\right)^2\right] \tag{2}$$

if d_{ij} (the Euclidean distance between the centers of county i and j) is less than 200 km; zero otherwise. As a result, we impose that the covariance between errors in county i and j are quadratically declining for counties with 200 km of one another. The scale parameter α captures the intensity of the spatial correlation.

The model is estimated with two-stage generalized least squares (GLS). In the first stage, we estimate (1) using OLS and save the residuals (e_i). We then form the following estimate of σ_{ij}, $\hat{\sigma}_{ij} = e_i e_j$, for $i \neq j$. In stage two, we form the estimated error variance–covariance matrix and apply the standard GLS estimator. All estimation results are performed using Gauss version 8.0.

3. Theories of the resource curse and justification for the covariates

Before discussing the empirical results, we briefly review theories for the resource curse and provide justification for the choice of covariates. There are numerous explanations for the resource curse. A leading explanation is the "Dutch Disease" theory (Matsuyama, 1992). This theory states that specialization in resource production and the appreciation of the exchange rate will result in a decline in manufacturing, a sector that is more conducive to growth via increasing returns and positive production externalities. In addition to the Dutch Disease, Auty (1994) argues Latin America may have suffered from resource-induced trade restrictions. Regions endowed with plentiful stocks of natural resources may consider trade liberalization unnecessary and become entrenched in a pro-autarky philosophy. Similarly, Gylfason (2001) argues that excessive social confidence created from resource endowments may lead to under investments in human capital. Sachs and Warner (2001) have also argued that the sudden exploitation of a natural resource stock may create social and economic turmoil. Countries or regions with institutions to protect against civil conflict are, therefore, less likely to be impacted by the natural resource curse (Mehlum et al., 2006; Bulte and Damania, 2008). For example, Acemoglu et al. (2003) argue that the African nation of Botswana has effectively escaped the resource curse by providing property rights, political checks and balances, health care, education and investments in infrastructure. By comparison, neighboring countries such as the Democratic Republic of Congo and Sierra Leone with weaker institutions and high resource extraction have had stagnant or shrinking economies.

The main advantage of looking for the resource curse at the county level is a reduced need to control for confounding effects such as differences in institutions, spoken language, currencies and corruption. Theories that rely on trade restrictions, economic turmoil, or civil conflict are unlikely to be the cause of the resource curse across relatively homogeneous U.S. states and counties. However, we do control for possible county-level effects such as state-specific fixed factors, demographic variation in age, race and education, population density, initial income, and spatial correlation. The choice of these covariates is driven by previous research on the causes of economic growth and the availability of county data.

Our control variables are commonly used in growth regressions. For example, Zak and Knack (2001) present a model in which social homogeneity, through its impact on trust, decreases transaction costs and thus facilitates higher levels of productivity. They measure social homogeneity by the percent of the population in the largest ethnic class. We use the percent of the county population considered Caucasian as a proxy for social homogeneity.

Population demographics have also been shown to be an important determinant of economic growth. Bloom et al. (2000) argue that higher percentages of young and old individuals tend to decrease income per capita as they are either excluded from the labor force or are less productive. Malmberg (1994) argues that because young and elderly individuals tend to save less, per capita economic growth will be lower in countries with relatively large young and elderly populations. We use the proportion of the county population less than 6 years old and greater than 64 years old as proxies for differences in the initial age distribution.

Human capital has long been considered an important channel for economic growth (Lucas, 1988; Mankiw et al., 1992). We control for human capital in three ways. First, we include the percent of the county population with *at least* a bachelor's degree. Second, we include the percent of the population that earned only a high school degree. Third, we include the percent of the population that is below the poverty line. High poverty rates tend to be associated with a less productive labor force and lower levels of human capital. These proxies for human capital are consistent with those used in the economic growth literature (Mankiw et al., 1992; Higgins et al., 2006).

Lastly, we control for population density by including a dummy variable for "metro" if the population per square mile is greater than 300. The economic growth literature provides several explanations why cities may exhibit higher growth. For example, cities may benefit from economies of scale (Dixit, 1973) or lower transaction costs (Acemoglu, 1996). See Quigley (1998) for a more complete literature review of the relationship between population density and economic growth.

4. Discussion of the econometric results

The primary econometric results are displayed in Table 2. The coefficient on the resource variable for the baseline sample period 1980–1995 is negative and statistically significant at the 1% level, supporting the resource curse hypothesis at a county level. We estimate seven different models that control for initial income, education, age, poverty, race, and population density. All seven regressions include state-specific fixed effects (estimated coefficients not shown) and a correction for spatial correlation of the errors. The resource coefficient is consistently around -0.02, implying that a one percentage point increase in natural resource specialization reduces real income per capita by two

Table 2
Spatially-weighted GLS estimates.

Dependent variable: *G*, annual per capita personal income growth (1980–1995) $N=3092$							
Variable	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)
Resources	−0.021*** (0.002)	−0.025*** (0.002)	−0.018*** (0.001)	−0.019*** (0.002)	−0.020*** (0.002)	−0.022*** (0.002)	−0.012*** (0.002)
$\ln(Y_{80})$		−0.006*** (0.0008)	−0.007*** (0.0008)	−0.005*** (0.0008)	−0.002** (0.0008)	−0.0002 (0.0008)	−0.011*** (0.0008)
High School			−0.029*** (0.005)	−0.038*** (0.005)	0.009* (0.005)	0.021*** (0.007)	−0.049*** (0.007)
College			0.053*** (0.006)	0.088*** (0.007)	0.089*** (0.007)	0.088*** (0.007)	0.090*** (0.008)
Young				0.044*** (0.007)	0.023*** (0.007)	0.018** (0.008)	0.042*** (0.007)
Old				0.039*** (0.006)	0.013** (0.006)	0.005 (0.006)	0.047*** (0.007)
Poverty					0.023*** (0.003)	0.028*** (0.004)	0.001 (0.004)
White						−0.001 (0.001)	−0.001 (0.001)
Metro							−0.0008 (0.0007)
F statistic for state FEs	21.09***	21.62***	12.79***	19.81***	15.85***	26.43***	17.83***
R^2	0.337	0.355	0.375	0.390	0.393	0.393	0.394

Notes. Superscripts *, **, *** denote statistical significance at the 10%, 5% and 1%, respectively. Standard errors (Std Err) are in parentheses. Estimates for state fixed-effects are not shown. The *F* statistic refers to the joint significance of the state fixed effects. FE = fixed effects. The R^2 values are for OLS estimation, given the well known problems with GLS goodness-of-fit measures (Greene, 2008). To ensure a positive definite variance–covariance matrix for the errors, we found it necessary to set $a=0.1$.

hundredths of a percentage point, all else equal. This implies that an increase in the percent of natural resource earnings from 1% (think ME counties) to 25% (think WY counties) would lower income per capita growth from 1.3% to 0.8%, all else equal. On an annual basis this seems like a small difference but assuming this can be compounded over generations, the differences become substantial. For example, imagine two counties in 1980 with personal income per capita of $20,000 that are similar in every way except for resource abundance. If the heavily resource-dependent county grows at 0.8%, personal income per capita in the year 2050 will be approximately $34,950 (in 1980 dollars). Assuming the less resource-dependent county grows at 1.3%, personal income per capita in the year 2050 will be $49,400 (again, in 1980 dollars). Standards of living are nearly 50% higher in the county that chose not to invest so heavily in natural resource extraction.

The estimates in Table 2 are consistent with conditional income convergence at the county level (Higgins et al., 2006). The coefficient on the log of initial per capita income is consistently negative and statistically significant at the 1% level for the majority of the regressions. This implies that two counties similar in all respects but have different initial income per capita will tend to converge over time. Each of the regressions in Table 2 includes controls for state-specific fixed effects (the coefficient estimates are not reported but are available upon request). An *F* test for the equality of the 50 state effects strongly rejects the null hypothesis, suggesting that economic, social and political policies at the state level play a significant role in economic growth.

In Table 3 we report estimates for five different growth horizons. The coefficient on resource earnings is negative and significant for all time periods. However, the resource curse tends to dissipate as the time horizon lengthens (although not uniformly). One explanation for the decay of the resource curse is that counties relying heavily on resource earnings in 1980 became less resource dependent over time. The data support this hypothesis. Fig. 5 shows an unconditional scatter plot of growth (1980–2005) in resource dependence versus resource dependence in 1980. Counties with a greater dependence on natural resources in 1980 tended to experience slower growth in resource dependence from 1980 to 2005. In fact, counties with the highest initial resource dependence tended to experience *negative* growth in the resource sector, causing the magnitude of the resource curse coefficient to decrease over the sample period.

In Table 4 we separate counties into those with the lowest and highest levels of natural resource dependence. The first three columns display a random sample of 20 non-resource-dependent counties taken from the 195 counties reported by the U.S. Census Bureau to have negligible resource earnings. The second set of columns displays the most resource-dependent counties in the U.S., which are over-represented by counties in Kentucky and West Virginia. This dichotomy shows the effect of reliance on natural resources: from 1980 to 1995 incomes in the most resource-dependent counties shrank at a −0.4% rate while income in the 195 least resource-dependent counties grew at 1.6%.

As a final robustness check, we consider a variation of (1) that allows the resource coefficient to vary by state:

$$G_i = \beta_1 \ln Y_{0,i} + \beta_{2,s} R_{0,i} + \gamma' X_{0,i} + \alpha_s + \varepsilon_i, \quad (3)$$

where $\beta_{2,s}$ captures the impact of the resource curse by state for $s = 1, \ldots, 50$. Allowing the resource coefficient to vary by state will let us investigate whether the resource curse is driven by a small set of counties or robust across states. Although we do not report the estimates for all the coefficients (full set of results are available upon request), Fig. 1 shows a scatter plot of the estimated resource coefficients against percent of earnings derived from the resource sector. The scatter plot shows a clear negative state-level relationship between economic growth and resource abundance – the resource curse is a robust phenomenon across U.S. states. This finding is consistent with the research of Papyrakis and Gerlagh (2007). There are also a couple of other notable features of Fig. 1. First, all twelve states with more than 5% of state earnings derived from the resource sector experienced negative economic growth during the 1980–1995 period. Second, there is substantial variation in economic growth for non-resource dependent states. Low-resource states such as Connecticut, Nebraska, Oregon, Massachusetts and Rhode Island have all exhibited economic growth per capita above 5% per annum, while Vermont and Wisconsin experienced an annual decline of more than 5% in personal income per capita.

Table 3
Spatially-weighted GLS estimates over various sample periods.

Dependent variable: G, annual per capita personal income growth N=3092					
Variable	Sample period				
	1980–1985	1980–1990	1980–1995	1980–2000	1980–2005
	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)
Resources	−0.046*** (0.009)	−0.029*** (0.002)	−0.012*** (0.002)	−0.019*** (0.001)	−0.007*** (0.001)
ln(Y_{80})	−0.082*** (0.005)	−0.006*** (0.001)	−0.011*** (0.0008)	−0.003*** (0.0007)	−0.003*** (0.0006)
High School	−0.003 (0.035)	−0.037*** (0.009)	−0.049*** (0.007)	0.002 (0.006)	−0.004 (0.005)
College	0.292*** (0.040)	0.120*** (0.011)	0.090*** (0.008)	0.095*** (0.007)	0.057*** (0.006)
Young	0.132*** (0.037)	0.055*** (0.011)	0.042*** (0.007)	0.034*** (0.006)	−0.003 (0.006)
Old	0.225*** (0.034)	0.094*** (0.009)	0.047*** (0.007)	0.032*** (0.005)	0.005 (0.005)
Poverty	0.002 (0.019)	−0.001 (0.005)	0.001 (0.004)	0.011*** (0.003)	0.018*** (0.003)
White	0.038*** (0.005)	0.001 (0.001)	−0.001 (0.001)	−0.002*** (0.0007)	−0.0004 (0.0007)
Metro	0.004 (0.003)	−3.403e−5 (0.0009)	−0.0008 (0.0007)	−0.0007 (0.0005)	−0.0003 (0.0005)
F statistic for state FEs	4.19	17.55***	17.83***	20.63***	12.83***
R^2	0.365	0.365	0.394	0.374	0.337
G Average	0.023	0.017	0.013	0.015	0.014

Notes. Superscripts *, **, *** denote statistical significance at the 10%, 5% and 1%, respectively. Standard errors (Std Err) are in parentheses. Estimates for state fixed-effects are not shown. The F statistic refers to the joint significance of the state fixed effects. FE = fixed effects. The R^2 values are for OLS estimation, given the well known problems with GLS goodness-of-fit measures (Greene, 2008). To ensure a positive definite variance–covariance matrix for the errors, we found it necessary to set a=0.1.

Table 4
Highest and lowest resource abundant counties in the U.S.

Lowest resource abundance counties			Highest resource abundance counties		
State/County	Resource earnings (% income in 1980)	Annual per capita income growth (1980–95)	State/County	Resource earnings (% income in 1980)	Annual per capita income growth (1980–95)
Buffalo, SD	>0	0.0228	Loving, TX	0.9051	−0.0038
Rich, UT	>0	0.0052	Martin, KY	0.8542	−0.0080
Hardin, TN	>0	0.0193	Dickenson, VA	0.8079	−0.0277
Hart, GA	>0	0.0181	Lake, CO	0.7896	−0.0122
Grand Isle, VT	>0	0.0215	Boone, WV	0.7489	−0.0026
Aitkin, MN	>0	0.0202	Buchanan, VA	0.7450	−0.0095
Clinton, MO	>0	0.0132	Billings, ND	0.6947	−0.0304
Jefferson Davis, MS	>0	0.0172	McDowell, WV	0.6894	−0.0057
Grant, AR	>0	0.0110	San Juan, CO	0.6793	0.0088
Hamilton, NY	>0	0.0211	Rio Blanco, CO	0.6697	−0.0221
Gilpin, CO	>0	0.0150	Wyoming, WV	0.6545	0.0028
Hidalgo, NM	>0	0.0086	Greenlee, AZ	0.6405	0.0060
Garrard, KY	>0	0.0129	Union, KY	0.6102	0.0065
Miller, GA	>0	0.0483	Gallatin, IL	0.6095	0.0072
Jackson, GA	>0	0.0274	Pike, KY	0.6027	−0.0017
Appomattox, VA	>0	0.0171	Reynolds, MO	0.5880	0.01045
Baxter, AR	>0	0.0152	Letcher, KY	0.5865	0.0096
Northampton, NC	>0	0.0209	Magoffin, KY	0.5748	0.0060
Taylor, FL	>0	0.0131	Perry, KY	0.5670	−0.0097
Lewis, TN	>0	0.0384	Barbour, WV	0.5662	0.0019
Average	>0	0.0193	Average	0.6792	−0.0037
Average of 195 least resource abundant counties				>0	0.0159
Average of counties with resource earnings less than 1% of income				0.0051	0.0150
Average of all 3092 counties				0.0510	0.0133

Notes. ">0" indicates that resource earnings are censored to zero. The twenty "lowest resource abundant counties" are a random sample from the 195 counties reporting zero resource earnings.

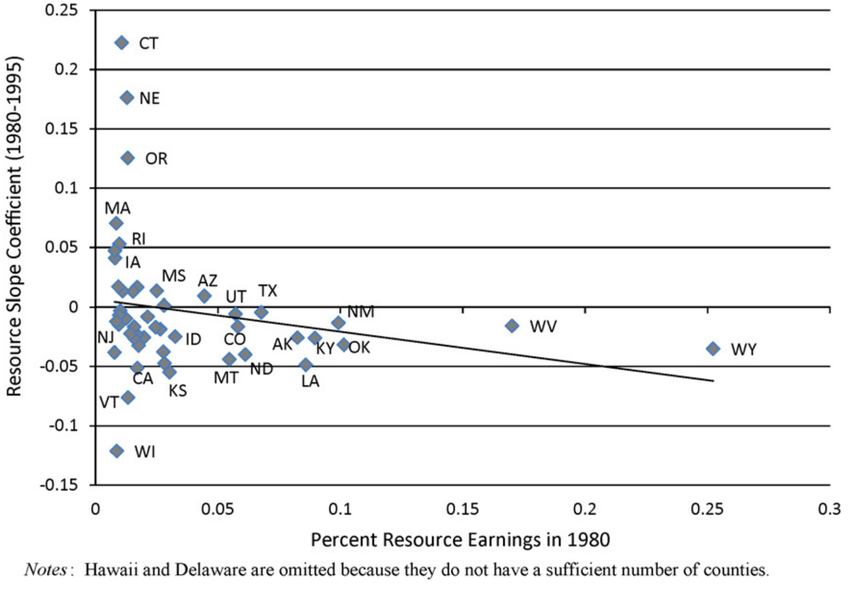


Fig. 1. State-level resource curse coefficients versus resource dependence. *Notes.* Hawaii and Delaware are omitted because they do not have a sufficient number of counties.

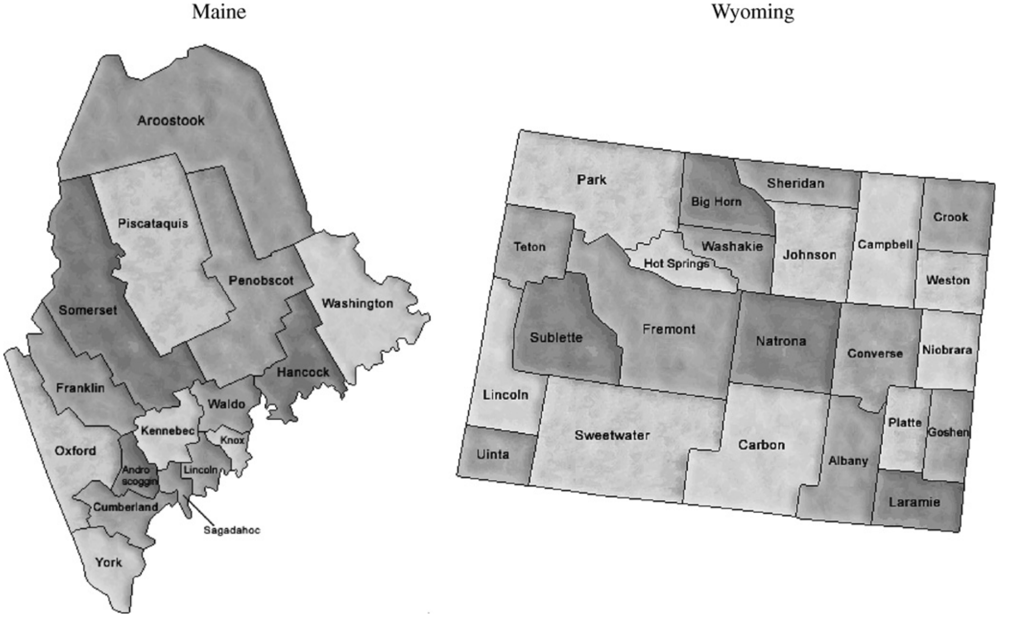


Fig. 2. Maine and Wyoming counties.

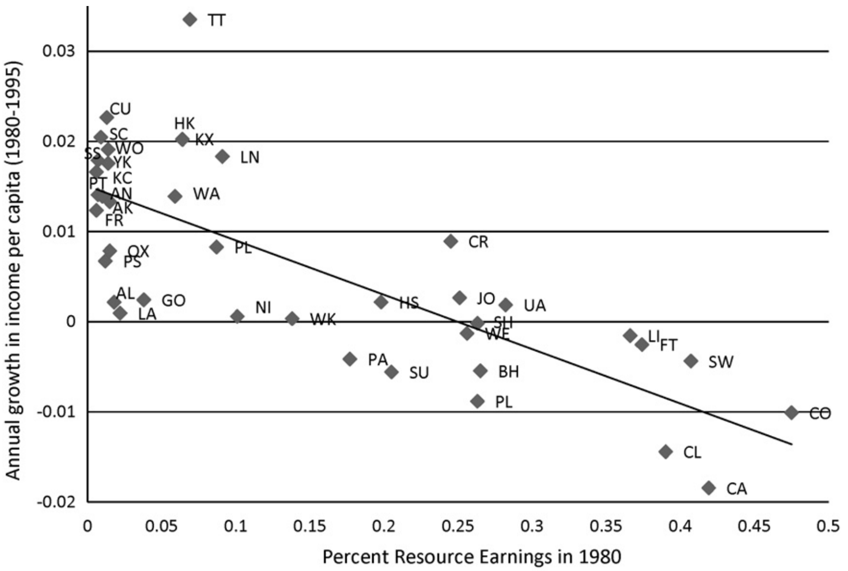
5. A brief case study: Maine and Wyoming

Maine and Wyoming, and the counties within, provide excellent case studies for the curse of natural resources. Wyoming depends heavily on the extraction of natural resources such as natural

Table 5
Wyoming and Maine natural resource and personal income data.

State/County	Resource earnings (measured in $1000)	Resource earnings (% income in 1980)	Annual per capita income growth (1980–95)	State/County	Resource earnings (measured in $1000)	Resource earnings (% income in 1980)	Annual per capita income growth (1980–95)
Maine	122,145	0.016	0.018	Wyoming	1,201,203	0.252	−0.002
Androscoggin (AN)	4380	0.007	0.014	Albany (AL)	3787	0.018	0.002
Aroostook (AK)	7975	0.015	0.013	Big Horn (BH)	22,069	0.265	−0.005
Cumberland (CU)	24,759	0.013	0.023	Campbell (CL)	136,844	0.390	−0.014
Franklin (FR)	1267	0.006	0.012	Carbon (CA)	119,660	0.419	−0.018
Hancock (HK)	14,864	0.064	0.020	Converse (CO)	71,093	0.475	−0.010
Kennebec (KC)	5117	0.006	0.017	Crook (CR)	7723	0.245	0.009
Knox (KX)	11,421	0.064	0.020	Fremont (FT)	120,459	0.374	−0.003
Lincoln (LN)	9190	0.091	0.018	Goshen (G)	2763	0.038	0.002
Oxford (OX)	4449	0.015	0.008	Hot Springs (HS)	7841	0.198	0.002
Penobscot (PT)	9789	0.010	0.014	Johnson (JO)	11,569	0.251	0.003
Piscataquis (PS)	1225	0.012	0.007	Laramie (LA)	15,017	0.022	0.001
Sagadahoc (SC)	2373	0.009	0.020	Lincoln (LI)	38,748	0.366	−0.002
Somerset (SS)	1550	0.007	0.018	Natrona (NA)	244,930	0.263	−0.009
Waldo (WO)	1258	0.014	0.019	Niobrara (NI)	1809	0.101	0.001
Washington (WA)	10,450	0.059	0.014	Park (PA)	34,485	0.177	−0.004
York (YK)	12,078	0.014	0.018	Platte (PL)	7742	0.087	0.008
				Sheridan (SH)	57,789	0.263	−0.000
				Sublette (SU)	8460	0.205	−0.006
				Sweetwater (SW)	222,235	0.407	−0.004
				Teton (TT)	7334	0.069	0.034
				Uinta (UA)	31,000	0.282	0.002
				Washakie (WK)	11,440	0.138	>0
				Weston (WE)	16,406	0.258	−0.001

Notes. All data are taken from the U.S. Census Bureau. ">0" indicates that resource earnings are censored to zero.



Notes. The term "Unconditional" refers to the lack of controls for initial income, socio-demographic variables, state-specific effects and spatial correlation.

Fig. 3. Scatter plot of the *Unconditional* resource curse for Maine and Wyoming counties. *Notes*. The term "Unconditional" refers to the lack of controls for initial income, socio-demographic variables, state-specific effects and spatial correlation.

gas, coal, coalbed methane, crude oil, sodium carbonate, uranium, gold, iron and clay.[3] In addition, the climate and large open spaces make possible the production of cattle, hay, corn, wheat and sugar beets. The majority of the resource extraction in Wyoming takes place in the counties of Campbell, Carbon, Fremont, Natrona and Sweetwater. See Fig. 2 for the counties in Wyoming and Table 5 for a description of county resource earnings and income growth.

Unlike Wyoming, the contribution of Maine's natural resource sector is less than 2% of total state earnings. The primary resource industries in Maine are in agriculture, forestry and fishing. The fishing industry is comprised of lobster, shell fish, ground fish and salmon. Lobster harvests made up 77% of all fishing earnings in 2007, with the majority of lobster landings coming from Knox, Lincoln and Washington counties (Department of Marine Resources, 2009). Maine also produces several notable agricultural/resource products: blueberries, maple sugar, apples, dairy, cattle, sand, and gravel. See Fig. 2 for the counties of Maine and Table 5 for a description of county resource earnings and income growth.

The resource curse suggests that, all else equal, Wyoming's dependence on resource extraction should lead to slower economic growth relative to Maine. Fig. 3 shows a scatter plot of 1980 resource earnings and income growth (1980–1995) for all the counties in Maine and Wyoming. There is a clear negative (unconditional) relationship between resource earnings and economic growth. Conversely, the scatter plot of 1980 manufacturing earnings and income growth (1980–1995) for all the counties in Maine and Wyoming (Fig. 4) shows a clear positive relationship. In terms of industry specializations, Maine and Wyoming are on opposite ends of the spectrum. In 1980, nearly 28% of Maine earnings were derived from manufacturing and less than 2% were derived from natural resources. In the same year, approximately 25% of Wyoming's earnings were derived from natural resources and less than 5% were derived from manufacturing (USA Counties, 2009). Wyoming's decision to specialize in natural resource extraction and production appears to have limited its relative potential for economic growth, at least for the sample periods since 1980.

[3] In 2007, Wyoming was number one in coal production and number two in natural gas production in the U.S. (Wyoming State Geological Survey, 2009).

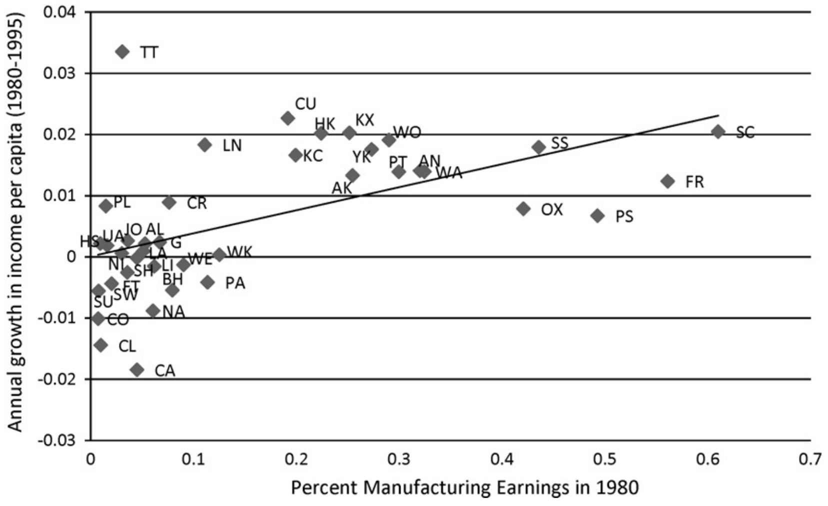
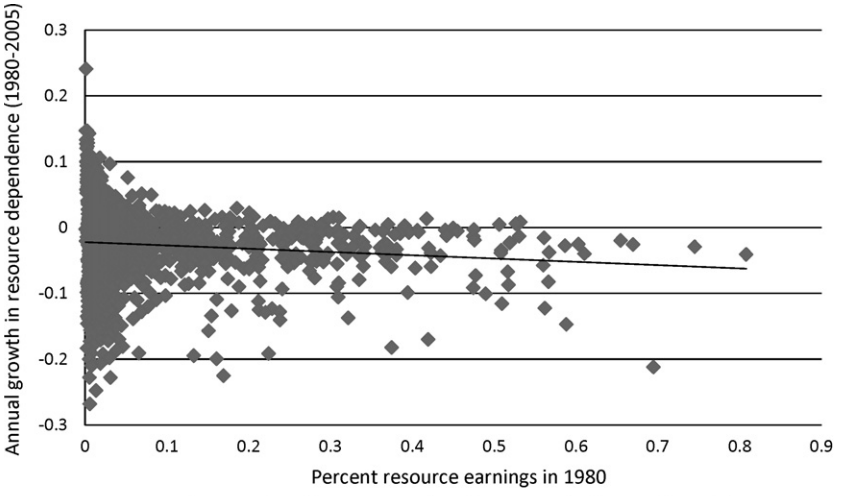


Fig. 4. Income growth versus manufacturing earnings for Maine and Wyoming counties.



Notes. $N = 1{,}624$ counties. Counties without resource dependence are omitted. Annual growth in resource dependence is measured as $\boldsymbol{ln(R_{2005}/R_{1980})}/25$, where $\boldsymbol{R}_{2005}$ and $\boldsymbol{R}_{1980}$ are percent resource earnings in 2005 and 1980. The trend line is based on an OLS regression with estimated intercept of **−0.020** and estimated slope of **−0.050**, standard error of 0.012.

Fig. 5. Annual growth in resource dependence versus initial resource dependence. *Notes.* $N = 1624$ counties. Counties without resource dependence are omitted. Annual growth in resource dependence is measured as $(R_{2005}/R_{1980})/25$, where R_{2005} and R_{1980} are percent resource earnings in 2005 and 1980. The trend line is based on an OLS regression with estimated intercept of −0.020 and estimated slope of −0.050, standard error of 0.012.

6. Conclusion

Economic theory suggests an abundance of natural resources promotes economic growth by providing "natural capital." However studies such as Sachs and Warner (1995, 1999, 2001) have found an inverse relationship between the rate of economic growth and natural resource dependence at the international level. Papyrakis and Gerlagh (2007) show that wealthy countries are also unable to escape the curse; the curse exists among U.S. states. Our paper shows that the resource curse is present at an even more disaggregated county level, as highlighted by a brief case study of Maine and Wyoming. Although the resource curse appears to be waning over the sample period 1980–2005, it is always negative and statistically significant. The coefficient estimates imply sizable differences in standards of living if one extrapolates the annual growth differences to future generations.

Exploring the natural resource curse at the county level offers a unique opportunity to peer into a more disaggregated relationship between resources and growth. Future research should more closely examine resource-dependent counties that have been able to avoid the curse and have experienced robust economic growth. Another promising avenue would consider alternative county (or local) resource measures with data available prior to 1980, allowing the resource curse to be examined from a more historical perspective.

Appendix A. Data appendix

All data were downloaded from the U.S. Census Bureau's website (www.census.gov/support/DataDownload.htm) except for the overall price index. The variables discussed in the text and used in the econometric analysis (with Census Bureau mnemonic in square brackets) are listed below:

- Personal Income per Capita. [PIN020180D] Consumer price indices were collected from Table B-6 of the 2009 Economic Report of the President under the heading, "Major expenditure categories, All items." Personal income includes government transfer payments, which cannot be removed because county-level data on transfer payments are not available. The U.S. Census Bureau does not provide county resident populations for 1980, but they do provide estimates for 1979 and 1981. We average the county resident populations for 1979 and 1981 to provide an estimate for 1980.
- Total Industry Earnings. [EAS010180D] Total earnings in all industries. This measure is used to calculate the percent of earnings from various industries, including those associated with resource extraction.
- Resource Earnings. [EAS220180D, EAS210180D] Earnings in "mining" and "agriculture, forestry, fishing and other," respectively. The base year for the growth analysis is 1980 because this was the first year of consistently available data for all counties. All prices are in 1980 dollars. The resource variable is measured as a percent of total earnings.
- High School. [EDU640180D] The U.S. Census Bureau lists total population with only a high school diploma. The percent of the population with a high school diploma is calculated by dividing by the total county population in 1980.
- College. [EDU680180D] The U.S. Census Bureau lists total population with at least a 4-year college education. The percent of the population with at least a 4-year college education is calculated by dividing by the total county population in 1980.
- Over 65 years old. [AGE760180D] The U.S. Census Bureau lists total population aged over 65. The percent of the population aged over 65 years is calculated by dividing by the total county population in 1980.
- Under 18. [AGE270180D] The U.S. Census Bureau lists total population aged under 18. The percent of the population is calculated by dividing by the total county population in 1980.
- Poverty. [PVY020179D] The percentage of the population living in poverty for each county was available for 1979, but not 1980. We approximated the percent of the population living in poverty in each county in 1980 by multiplying the 1979 poverty estimate by one plus the national growth rate in poverty in 1979 (i.e., 1980 poverty rate of county i = 1979 poverty rate of county $i \times 1.0095$). Growth in the poverty rate can be found at: www.census.gov/hhes/www/poverty/histpov/hstpov2.html.
- White. [POP210180D] The total population that is considered Caucasian by the U.S. Census Bureau. The percent of the population that is white is calculated by dividing by the population estimate in 1980.
- Population. [POP600180D] The total population in each county.
- Land area. [LND110180D] The 1980 estimate of total square miles in each county. Population per square mile is calculated by dividing the population estimate by total land area in square miles.

- Distance. Latitude and Longitude for each county was collected from the Census 2000 U.S. Gazetteer Files: www.census.gov/geo/www/gazetteer/places2k.html.
- Manufacturing. [EAS240180D] Total manufacturing earnings. Dividing by total industry earnings yields the percent of manufacturing earnings.

Our dataset covers 3092 counties in the U.S. with 52 counties omitted because of missing data. Of the 52 omitted data points, 42 were due to missing estimates for the dependent variable (personal income per capita). The 10 other omitted observations were due to missing estimates for resource earnings, poverty or Caucasian estimates. Nearly one quarter of the omitted observations were from Virginia.

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