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Abstract

New Mexico is a relatively poor state. In 2008, New Mexico's per capita income of $33,430 (83 percent of the national average) ranked 44th among the 50 states –only a slight improvement over its 1969 per capita income ranking of 45th. New Mexico is also an energy state. In 2008, New Mexico's marketed value of oil and gas was $19.2 billion (24.0 percent of state GDP). This paper will analyze the relationship between energy production and economic growth in New Mexico using cross section data for the state's 33 counties in Census years 1960, 1970, 1980, 1990, and 2000. The central question is whether or not New Mexico's counties are subject to the resource curse, a phenomenon documented frequently in the literature. The resource curse literature suggests that those areas with a high concentration of economic activity in natural resource industries perform worse (in terms of income, employment, or population growth) than other areas. Most of the empirical studies of the resource curse hypothesis have used national or state level data and a broad definition of natural resources. In contrast, this analysis uses county level data with a focus on oil and gas extraction. The estimated models suggest that oil and gas extraction in New Mexico Counties has had a small but positive effect on income, employment and population. Similar results were obtained when the model was estimated for 925 counties in 13 energy producing states for the year 2000.

About this report

This report is one of a series of studies prepared by the Arrowhead Center PROSPER project at New Mexico State University. The PROSPER project is a policy initiative linking fossil fuels, economic development, and water in New Mexico. All reports prepared by the PROSPER project are available on its website: http://arrowheadcenter.nmsu.edu/policy/pep/index.html . Funding for the PROSPER project was provided by the National Energy Technology Laboratory of the U.S. Department of Energy (DOE AWARD Number: DE-NT0004397).

Comments and suggestions for improvement are welcome and should be sent to James Peach at jpeach@nmsu.edu .

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Table of Contents

List of Figures and Map

List of Tables

Oil and Gas Production and Economic Growth in New Mexico

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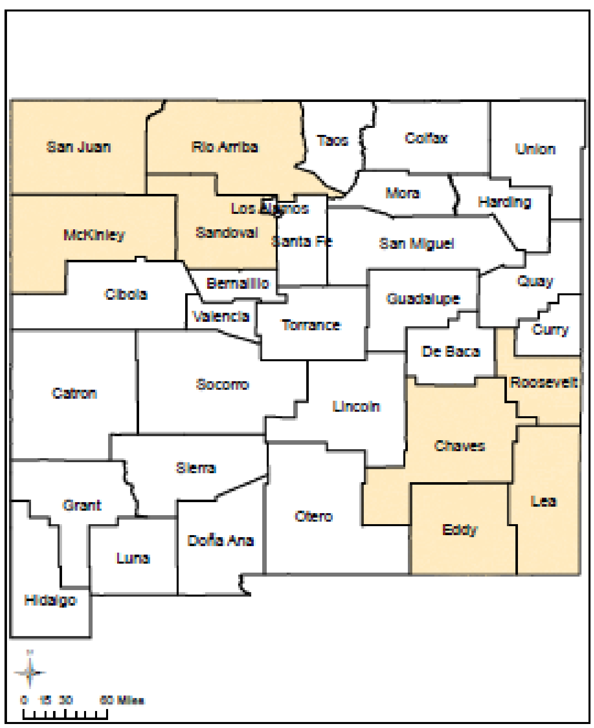
Introduction

The central question addressed in this paper is whether or not New Mexico's counties are subject to the resource curse, a phenomenon documented frequently in the literature. Most of the empirical studies of the resource curse hypothesis have used national or state level data and a broad definition of natural resources. In contrast, this analysis uses county level data with a focus on oil and gas extraction. The relationship between oil and gas production and economic growth in New Mexico will be analyzed using cross section data for the state's 33 counties in Census years 1960, 1970, 1980, 1990, and 2000. The model is also estimated for 2000 only using a larger sample of 925 counties in the 13 states that produce more than 90 percent of the nation's oil and gas.

New Mexico is an energy state (Snead 2009). In 2008, New Mexico's marketed value of oil and gas was $19.2 billion or 24.0 percent of the state's GDP (Peach and Starbuck, 2009). Natural gas accounted for slightly more than two-thirds (67.1 percent) of total market value. Crude oil and marketed natural gas production in 2008 for the leading energy states are presented in Table 1. New Mexico was the fourth largest producer of marketed natural gas in the US and accounted for 7.8 percent of total production. New Mexico's 59.4 million barrels of oil production in 2008 accounted for 4.3 percent of total US production and the state ranked seventh among oil producing states. Eight counties (shown in Map 1) currently produce oil and gas in New Mexico.

Map 1. New Mexico Oil and Gas Producing Counties



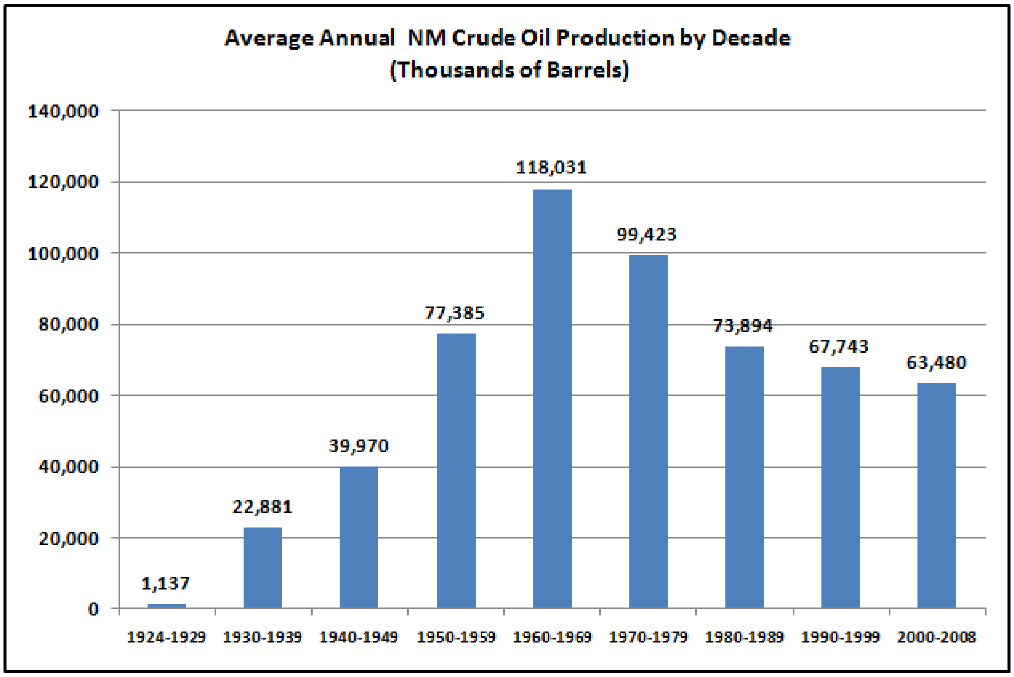
Source: Arrowhead Center, New Mexico State University

Table1. Crude Oil and Natural Gas Production in Leading Energy States (2008)								
Crude Oil				Natural Gas				
Area	1,000s of bbls	Percent of Total	Rank	Area	MMCF	Percent	Rank	Per Capita Income Percent of US
Texas	398,014	29.1	1	Texas	6,874,209	37.0	1	94.1
Alaska	249,874	18.3	2	Wyoming	2,274,850	12.3	2	120.9
California	214,544	15.7	3	Oklahoma	1,913,029	10.3	3	89.6
Louisiana	73,011	5.3	4	**New Mexico**	1,446,204	**7.8**	**4**	**83.1**
Oklahoma	64,065	4.7	5	Colorado	1,389,399	7.5	5	107.1
Wyoming	62,776	4.6	6	Louisiana	1,292,478	7.0	6	89.9
New Mexico	**59,403**	**4.3**	**7**	Arkansas	446,551	2.4	7	80.3
Kansas	52,943	3.9	8	Utah	433,566	2.3	8	79.8
N. Dakota	39,582	2.9	9	Kansas	374,310	2.0	9	96.8
Florida	31,545	2.3	10	Alaska	337,359	1.8	10	109.4
Mississippi	24,054	1.8	11	Michigan	272,159	1.5	11	87.0
Michigan	22,102	1.6	12	California	259,988	1.4	12	109.2
Montana	21,998	1.6	13	West Virgini	245,578	1.3	13	78.8
Colorado	9,423	0.7	14	Pennsylvani	198,295	1.1	14	99.0
Utah	7,546	0.6	15	Alabama	140,401	0.8	15	83.8
Illinois	6,223	0.5	16	Virginia	128,454	0.7	16	109.7
Alabama	6,079	0.4	17	Kentucky	114,116	0.6	17	79.5
Arkansas	5,715	0.4	18	Montana	112,529	0.6	18	86.2
Ohio	3,611	0.3	19	Mississippi	96,641	0.5	19	75.6
Nebraska	2,645	0.2	20	Ohio	84,858	0.5	20	89.4
Kentucky	2,394	0.2	21	N. Dakota	61,437	0.3	21	99.3
Indiana	1,956	0.1	22	New York	50,320	0.3	22	121.5
Pennsylvania	1,858	0.1	23	Indiana	4,701	0.0	23	86.0
West Virginia	1,697	0.1	24	Tennessee	4,700	0.0	24	86.7
S. Dakota	1,593	0.1	25	Nebraska	3,082	0.0	25	97.6
Tennessee	436	0.0	26	Florida	2,436	0.0	26	97.3
New York	386	0.0	27	S. Dakota	1,644	0.0	27	96.2
Nevada	344	0.0	28	Illinois	1,193	0.0	28	105.9
Arizona	99	0.0	29	Arizona	523	0.0	29	85.5
Missouri	52	0.0	30	Nevada	4	0.0	30	101.9
Virginia	7	0.0	31	Missouri	0	0.0	31	90.5
Total Onshore	1,365,975				18,565,015			

Source: Energy Information Administration, U.S. Department of Energy, Crude Oil Production Workbook, available at:
http://tonto.eia.doe.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm
Downloaded February 17, 2010.
and, Energy Information Administration, Natural Gas Production Workbook, available at:
http://tonto.eia.doe.gov/dnav/ng/ng_prod_sum_a_epg0_vgm_mmcf_a.htm
Natural Gas is on-shore marketed production

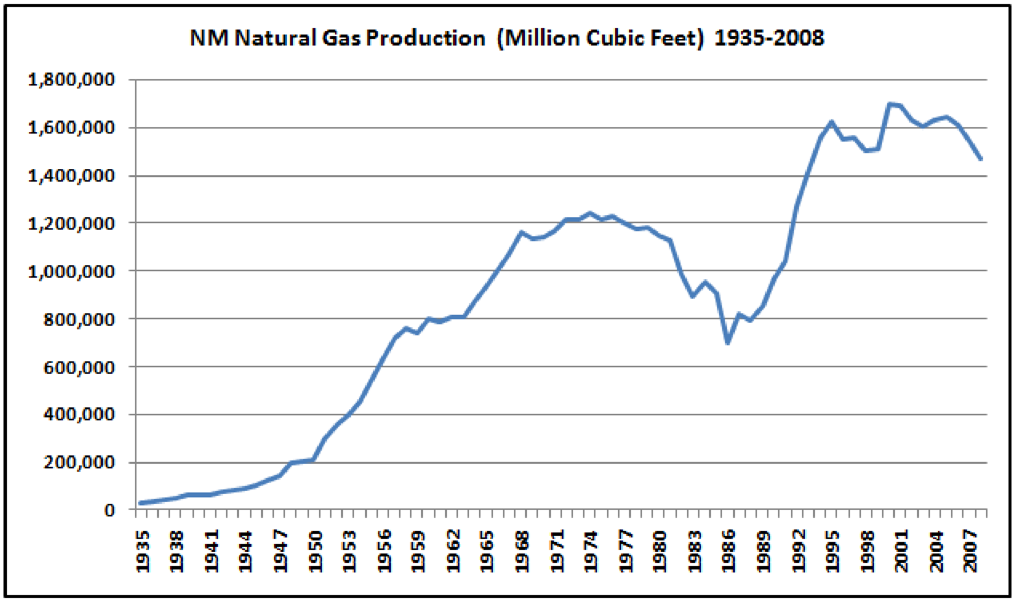
Despite large proven reserves of oil, New Mexico's oil production peaked in the late 1960s (Figure 1). Natural gas production declined slightly in recent years but may not have reached its peak (Figure 2).

Figure 1



Source: Peach, Delgado and Starbuck, 2009, p. 12.

Figure 2.



Source: Peach, Delgado and Starbuck, 2009, p. 17.

In addition to oil and gas production, New Mexico mines produce approximately 25 million short tons of coal each year (Peach and Starbuck, 2009). Coal production is not considered in the analysis below because there are currently only four operating coal mines in the state.

Revenue received from fossil fuels and related industries (refineries, pipeline transportation, electricity generation from coal, etc) in New Mexico accounted for 33.4 percent of all state revenue in 2008. Oil and natural gas extraction is by far the most important fossil fuel industry in the state. Oil and gas extraction accounted for 23.8 percent of state revenue, 10.1 percent of private sector employment, and 14.9 percent of state GDP (Peach and Starbuck, 2009).

New Mexico is also a relatively poor state. In 2008, New Mexico's per capita income of $33,430 (83 percent of the national average) ranked 44th among the 50 states –only a slight improvement over its 1969 per capita income ranking of 45th (Bureau of Economic Analysis, Regional Economic Information System, Table SA1-3). New Mexico's per capita income was the lowest of the top ten oil producing states in 2008 (Table 1).

Per capita income varies widely in New Mexico's 33 counties. Per capita income in four of the state's 33 counties is less than half of the national average (Guadalupe 43.0 percent, Harding 43.7 percent, Mora 48.1 percent, and Catron 49.9 percent). Two counties have per capita incomes higher than the national average (Los Alamos 142.7 percent and Santa Fe 109.0 percent).

Literature Review

Natural resource abundance was once commonly assumed to be a distinct advantage in the process of economic growth. Hirschman (1958, p. 1) maintained that: "For a long time, certainly until 1914 and perhaps until 1929, natural resources held the center stage when the chances of a country's development were considered." By the 1940s, economists concerned with economic growth focused mainly on factors other than natural resource availability. The models of Harrod (1939), Domar (1947), and Solow (1956) dominated the economic growth debate from the 1940s to the 1960s. These models were focused on investment, the capital stock, and the growth of the labor force without reference to natural resources.

During the 1950s and 1960s, some economists (e.g., Galbraith 1962, pp. 15-16) noted an inverse relationship between economic growth and resource abundance. How, they asked, could you explain the relatively high incomes of resource poor areas such as Israel, Switzerland, or Japan and the relatively low incomes of resource rich areas such as West Virginia or Mexico? What began as a simple observation that resource abundance did not necessarily provide the basis for income growth was later formalized as the 'resource curse hypothesis." The term resource curse is relatively new. Auty (1993) was the first to use the term.

Statistical studies of the resource curse hypothesis are mainly, but not exclusively, focused on international comparisons (Sachs and Warner, 1995, 2001; Toman, Michael, and Jemelkova, 2002; Boulhol, de Serres, and Molnar, 2008; Mankiw, Romer, and Smith, 1992; Atkinson, Giles, and Hamilton, 2003; Neumayer, 2004; and Robinson, Torvik, and Verdier, 2006). Sachs and Warner (2001, p. 828) maintains that: "Empirical support for the curse of natural resources is not bulletproof, but it is quite strong." Sachs (2001 p. 828) explains that the "finding in repeated regressions using growth data from the post-war period is that high resource intensity tends to correlate with slow growth. This finding is not easily explained by other variables…"

The literature is inconclusive as to the causes and nature of this inverse relationship. One of the most prevalent hypotheses regarding the source of the resource curse is the tendency for resource extraction to crowd out other economic activities (particularly manufacturing) and reduce the growth of other sectors of the economy (Sachs and Warner, 2001; and Mankiw, Romer, and Smith 1992). Others (Papyrakis, Elissaios , Gerlagh,and Reyer 2004) maintain that resource abundance crowds out public investment in infrastructure and physical capital. Some (Palley 2003; Brollo et al. 2010) maintain that resource intensity leads to political corruption.

In another strand of the resource curse literature, regional economic development approaches have been taken in order to examine county, region, or state level development differences. This literature exploits significantly smaller differences in political and economic structures when examining different spatial areas within the same country. Differences in economic outcomes that can be measured between areas that are very similar except for their level of resource extraction, can provide a test of the resource curse (Freeman, 2009; Michaels, 2007; Eggert, 2001; and Freudenburg and Wilson, 2002).

The regional literature also suggests that there are substantial differences in growth patterns between metropolitan and non-metropolitan areas (Hammond and Thompson, 2008). Key variables in the Hammond and Thompson study included: private sector investment in manufacturing, local public capital outlays, change in years of schooling, population growth, manufacturing depreciation, and technology growth, and real per capita personal income in the base year. Hammond and Thompson concluded that human capital variables and metropolitan status are the principal drivers of regional economic activity. The Hammond and Thompson findings are consistent with other regional growth studies such as Carlino and Mills (1987) in which they studied economic growth in the nation's 3,108 counties.

Using a fairly standard model from the regional growth literature, Freeman (2009, p. 527) found that "…regression of State GSP growth on resource intensity consistently shows a negative relationship." Freeman (2009, p. 528) argued that "crowding out of manufacturing may contribute to the slower growth of energy-based economies."

Michaels (2007) examined three different channels by which resource abundance may inhibit economic growth. Using a county level model and data from 1890 to 1990, Michaels (2007, pp. 1) concluded that resource wealth has not resulted in an economic development curse in the southern US, but has instead served as an important source for economic development.

Michaels (2007) found that in 1890 resource abundant and non-resource abundant counties were mostly agricultural. Between 1890 and 1940, oil abundant counties performed much better than oil poor counties. Oil abundant counties had higher levels of income and education per capita than their more agricultural counterparts (Michaels 2007, pp. 23-24).

After 1940, the specialization in oil extraction reduced the share of employment in the manufacturing sector relative to non-oil abundant counties. However, these same counties had higher levels of population growth, higher income levels, and higher education growth rates. Michaels (2007, pp. 24) argued that resource specialization slows the change of industry composition over time and that the accumulation of education over time begins to slow. The explanation may not be resource specialization, but specialization itself. Any economy that retains a comparative advantage in a single industry and thereby specializes in that industry may see the same inverted U pattern of development and accumulation of education (Michaels 2007, pp. 24).

The Michaels study is similar to the analysis presented below in the sense that it was focused on oil and gas production and economic growth at the county level. Unlike the analysis below, Michaels did not use county level oil production data and natural gas production was not considered. Rather, Michaels created a binary variable for each county depending on whether or not the county contained all or part of one of the 100 largest oil pools as identified by the U.S. Geological Service. Obtaining oil and gas production data at the county level is no easy task –and a nearly impossible task for the years covered in Michaels' analysis.

In contrast to the Michaels (2007) paper, Headwaters Economics published a report finding that counties that pursue a resource extraction based development policy fare worse in the long run than counties that do not pursue this strategy (Headwaters Economics 2008, pp. 2). Headwaters (2008) argued that energy-focusing counties (defined as counties with more than 7 percent employment in oil and gas extraction) suffered a decline in employment in energy-related occupations. Non-energy counties exhibited faster growth in employment, population, and income. The Headwaters report suggests that energy focusing counties have: (1) lower levels of economic diversity and resilience; (2) lower levels of education; (3) greater income gap between high and low income households; (4) increasing wage disparity between energy workers and all other workers; and finally (5) less ability to attract investment and retirement dollars (Headwaters Economics 2008, pp. 3). These conclusions are based on comparisons over three time periods for a sample of 25 energy focusing counties and 254 non-energy focusing counties. The Headwaters sample included small population counties in the western U.S. and excluded some energy focused counties such as San Juan County in New Mexico because the population was greater than 57,000 (Headwaters Economics 2008, pp. 4).

Power and Barrett (2001) argued that the decline in extractive industries (defined broadly to include agriculture, logging, mining and mineral processing) as a share of total economic activity in the Mountain West states has been beneficial to economic growth in that region. Rather, the decline of natural resource industries and the changing industrial structure "…has not triggered a decline in the region or an overall loss of jobs, income, or residents." (Power and Barrett 2001, p. xviii).

To summarize briefly, the literature suggests that: (1) a resource curse effect on economic growth is found in virtually all studies using the nation-state as a unit of analysis, (2) there is no general agreement on the causes of the resource curse, (3) state and county level analysis in the U.S. sometimes points to a resource curse effect, and (4) key variables in a well-specified growth equation include metropolitan status, human capital variables such as education and various demographic and investment factors. The model described and estimated below is based largely on these conclusions.

The Model and the Data

A typical economic growth model, if such a thing exists, is generally based on some form of a production function that relates output to inputs. Functional forms of the production function are generally limited to the traditional Cobb-Douglas (Equation 1) or Constant Elasticity of Substitution (Equation 2).

$$(1)\ Y = \alpha K^{\beta} L^{1-\beta}$$

$$(2)\ Y = A[\delta K^{-\rho} + (1 - \delta)L^{-\rho}]^{-1/\rho}$$

Both functional forms include some measure of capital (K) and labor (L) as the key variables. Depending on the problem being considered, additional variables (such as measures of human capital and demographic characteristics) are included in the final estimating equation. The model to be estimated here is very similar to the equations used in other energy and regional growth studies. The model is specified in equation (3).

$$(3) LN(Y_{i,t}) = \beta_0 + \beta_1 PCTHS + \beta_2(MEDAGE) + \beta_3 MEDAGESQ + \beta_4 LFPRW + \beta_5 METRO + \beta_6 RCAPEX + \beta_7\ REALVALOILGAS + \epsilon_i$$

Where,

i ≡ subscript (1…n) for the counties in the sample

LN(Yi) ≡ natural log of real ($2005) household income, employment, or population in county i

PCTHS ≡ percent of population aged 25 years old and older with high school diploma

MEDAGE ≡ median age

MEDAGESQ ≡ median age squared

LFPRW ≡ Labor Force Participation Rate of Women

METRO ≡ 1 if county is in an MSA, 0 otherwise

RCAPEX ≡ State and county infrastructure spending in real ($2005) dollars

REALVALOILGAS ≡ Real ($2005) value of oil and gas production

ϵ_i ≡ stochastic error term assumed N(0,σ^2).

The equation is estimated using three different dependent variables: median household income (RHHINC), total employment (EMPL), and total population (TPOP). The three dependent variables are common indicators of regional economic activity. RHHINC is measured in 2005 real dollars.

The explanatory variables include a series of human capital, demographic and investment variables. The percent of the population aged 25 and older with a high school diploma (PCTHS) is a frequently used human capital variable. This variable (PCTHS) has been measured in a consistent fashion by the Census Bureau in all five years considered. Consistent with any number of previous studies and the human capital literature, the expected sign of the PCTHS coefficient is anticipated to be positive.

Median age (MEDAGE) and its square (MEDAGESQ) are included as explanatory variables because the age distribution of a population affects income, employment, and migration patterns. The relationship between age and the dependent variables is anticipated to be non-linear. The expected signs of the coefficients are positive for MEDAGE and negative for MEDAGESQ.

The Labor Force Participation Rate of Women (LFPRW) has been included as an explanatory variable because high (low) rates of labor force participation are typically associated with high (low) income regions. This variable is not generally included in economic growth models. It should be. The anticipated sign of the coefficient of LFPRW is positive.

Metropolitan and non-metropolitan counties exhibit very different growth patterns. The variable METRO (=1 if the county is within a Metropolitan Statistical Area and zero otherwise) has been included to reflect urban rural differences. The anticipated sign of METRO is positive.

While it would be desirable to have both public and private investment expenditures included in the model, we know of no county level data on private investment. The variable RCAPEX is real ($2005) capital expenditures by state and county governments. The anticipated sign of the RCAPEX coefficient is positive.

Oil and gas production is a critical explanatory variable. Oil and gas production are reported separately, but they are all too frequently joint products and have been combined into a single variable: the real ($2005) value of oil and gas production per county (REALVALOILGAS). The prices used for the conversion were the price per barrel of West Texas Intermediate (WTI) and the Henry Hub Spot price of natural gas per mcf deflated by the appropriate producer price index. The anticipated sign of REALVALOILGAS is positive.

The expected signs of the estimated coefficients are summarized below:

PCTHS > 0

MEDAGE > 0 and MEDAGESQ < 0

LFPRW > 0

METRO > 0

RCAPEX > 0

REALVALOILGAS > 0

Most of the data were obtained from the 1960, 1970, 1980, 1990 and 2000 Censuses of Population and Housing. The Censuses were the source of all three dependent variables and the following explanatory variables: PCTHS, MEDAGE, LFPRW, and METRO. The data for RCAPEX were obtained from the Census of Government reports for the years nearest the Census of Population dates.

The data for oil and gas production were obtained from a variety of sources (New Mexico Oil and Gas Engineering Committee 1960 and 1970, New Mexico Energy Minerals and Natural Resources Department 1986, 1991, 2001) and was a challenging aspect of the project.

Results

The New Mexico model was estimated for 1960, 1970, 1980, 1990, and 2000 and in combined form with year dummies. In all cases, the model was estimated using Ordinary Least Squares with White's heterosecdasticity consistent standard errors and covariances. Given the rather robust results, there was no particular need to use panel or pooled time-series-cross section techniques. The results are presented in Table 2 (Real Household Income as the dependent variable), Table 3 (Total Employment as the dependent variable), and Table 4 (Total Population as the dependent variable).

In the combined (all years) model with income as the dependent variable, dummy variables were included for 1960, 1970, 1980, and 1990 –with 2000 as the base year (Table 2). The four year dummies are significant at the five percent level. The combined model had an adjusted r-squared of 0.755 and the F-statistic that was significant at the 0.0001 level. With the exception of RCAPEX the signs of the estimated coefficients were as anticipated. The key explanatory variable (REALVALOILGAS) was positive and significant at the five percent level.

The individual equations estimated for each Census year since 1960 (Table 2) exhibit surprisingly good fit given the relatively small sample size in each case ($n \leq 33$). The smallest adjusted r-squared (0.606) is for the 1970 equation –a time when energy prices were very low and before the OPEC oil embargo of 1973. All of the F-Statistics were highly significant. The coefficients of the REALVALOILGAS variable were all positive and significant at the five percent level with the exception of the 1960 equation which had a positive coefficient but was not significant.

Table 2. New Mexico Model Regression Statistics (Dependent Variable = LN (HHINC)						
	Combined	1960	1970	1980	1990	2000
Constant	8.2740* (25.7386)	8.9280* (16.9470)	8.5918* (12.7160)	8.7831* (12.0362)	8.0914* (13.8690)	7.9775* (8.3055)
PCTHS	0.0212* (9.5947)	0.0493* (4.1651)	0.0127* (2.9137)	0.0220* (4.0034)	0.0215* (4.3392)	0.0235* (4.1363)
MEDAGE	0.0024 0.1569)	-0.0063 (-0.1503)	0.0363 (0.8184)	0.0042 (0.1114)	-0.0031 (-0.1130)	0.0321 (0.6937)
MEDAGSQ	-7.38E-5 (-0.3656)	-0.0002 (-0.3297)	-0.0006 (-0.8716)	-0.0002 (-0.3324)	5.34E-5 (0.1546)	-0.0005 (-0.7871)
LFPRW	0.0073* (2.1279)	0.0069 (0.7613)	0.0085 (0.8613	-0.0002 (-0.0394)	0.0068 (1.3747)	-0.0008 (-0.1341)
METRO	0.1146* (2.1985)	0.0830 (0.3026)	-1.210* (-4.0174)	-0.0086 (-0.1038)	0.0622 (1.0245)	0.3028* (3.7796)
RCAPEX	1.70E-6 (0.4297)	-2.40E-5 (-0.5521)	0.0001* (3.3428)	1.04E-5 (0.8220)	9.46E-6 (1.4962)	-5.84E-6 (1.3222)
REALVALOILGAS	5.77E-11* (5.8142)	6.08E-11 (1.4591)	6.98E-11* (5.6731)	6.73E-11* (4.6925)	8.20E-11* (5.7007)	3.81E-11* (4.0787)
D60	0.9254* (8.6944)*	--	--	--	--	--
D70	0.4835* (6.8565)	--	--	--	--	--
D80	0.2261* (5.1049)	--	--	--	--	--
D90	-0.2177* (-7.2049)	--	--	--	--	--
N**	162	32	32	32	33	33
R-SQUARED ADJUSTED	0.755	0.797	0.606	0.727	0.796	0.834
F	46.109*	18.43*	8.092*	12.793*	18.816*	24.044*

*Denotes significant at 0.05 level. t statistics in parentheses. Estimated with White's heteroskedasticity consistent standard errors and covariances.

**Cibola County was created in 1983 and the number of New Mexico counties increased at that time from 32 to 33.

Table 3. New Mexico Model Regression Statistics (Dependent Variable = LN (EMPL)						
	Combined	1960	1970	1980	1990	2000
Constant	10.9882* (7.8078)	14.2612* (8.6910)	12.6430* (6.6536)	14.8193* (5.7447)	21.1172* (5.1137)	11.6798* (2.0049)
PCTHS	0.0171 (1.5524)	0.0469 (1.3914)	0.0371* (3.1234)	0.0235 (1.2152)	0.0362 (1.0422)	0.0560 (1.7110)
MEDAGE	-0.3035* (-3.4280)	-0.6018* (-4.3963)	-0.5215* (-3.9665)	-0.5769* (-3.7072)	-0.7999* (-3.6826)	-0.0970 (-0.3240)
MEDAGSQ	0.0031* (2.2033)	0.0087* (4.0890)	0.0071* (3.4301)	0.0075* (3.5751)	0.0093* (3.3828)	-0.0008 (-0.1962)
LFPRW	0.0634* (4.4001)	0.0878* (2.6898)	0.0817* (4.6799)	0.05825* (2.2380)	0.0210 (0.4919)	-0.0504 (-0.8344)
METRO	1.0215* (4.6972)	2.1740 (1.4232)	6.7643* (8.5073)	0.9912* (3.0256)	0.9382* (2.0482)	0.9744* (2.4258)
RCAPEX	7.91E-5* (4.7211)	-2.00E-5 (-0.0809)	-0.0006* (-5.3222)	0.0002 (1.7650)	8.19E-5* (2.0045)	0.0001* (4.9908)
REALVALOILGAS	2.38E-10* (6.3892)	3.13E-10 (1.4418)	2.08E10* (4.2190)	1.89E-10* 2.6080)	3.67E-10* (3.1252)	1.35E-10* (2.572)
D60	0.6956 (1.4004)	--	--	--	--	--
D70	0.15201 (0.4598)	--	--	--	--	--
D80	-0.0289 (-0.1164)	--	--	--	--	--
D90	-0.1388 (-0.6189)	--	--	--	--	--
N**	162	32	32	32	33	33
R-SQUARED ADJUSTED	0.679	0.681	0.796	0.713	0.644	0.714
F	31.945*	10.475*	18.234*	12.022*	9.257*	12.418*

*Denotes significant at 0.05 level. t statistics in parentheses. Estimated with White's heteroskedasticity consistent standard errors and covariances.

**Cibola County was created in 1983 and the number of New Mexico counties increased at that time from 32 to 33.

Table 4. New Mexico Model Regression Statistics (Dependent Variable = LN (POP)						
	Combined	1960	1970	1980	1990	2000
Constant	14.3423* (9.9455)	17.9744* 11.1357)	16.126* (8.7198)	18.0031* (6.5980)	24.4383* (5.9176)	14.4022* (2.3248)
PCTHS	0.0133 1.1776)	0.0352 (1.0692)	0.0372* (3.5951)	0.0197 (1.0112)	0.0375 (1.0852)	0.0516 (1.5453)
MEDAGE	-0.3717* (-3.9911)	-0.7335* (-5.4881)	-0.6252* (-4.8670)	-0.6567* (-3.913)	-0.8769* (-4.0034)	-0.1117 (-0.3486)
MEDAGSQ	0.0040* (2.6346)	0.0106* (5.1250)	0.0086* (4.1956)	0.0086* (3.7741)	0.0102* (3.6816)	-0.0007 (-0.1710)
LFPRW	0.0488* (2.6346)	0.0800* (2.5844)	0.0634* (3.7872)	0.0464 (1.701)	0.0025 (0.0600)	-0.0693 (-1.1129)
METRO	1.0026* (4.6203)	2.2498 (1.3899)	7.1117* (10.3413)	0.9867* (3.1344)	0.9018 (1.9048)	0.9435* (2.3335)
RCAPEX	7.84E-11* (4.726)	-2.48E-5 (-0.0961)	-0.0007* (-6.5462)	0.0002 (1.7006)	7.96E-5 (1.9033)	0.0001* (4.9917)
REALVALOILGAS	2.17E-10* (5.9729)	2.92E-10 (1.2817)	1.86E-10* (3.9234)	1.58E-10* (2.1832)	3.43E-10* (2.8930)	1.24E-10* [illegible]
D60	0.2150 (0.4313)	--	--	--	--	--
D70	-0.1362 (-0.4092)	--	--	--	--	--
D80	-0.02280 (-0.8958)	--	--	--	--	--
D90	-0.2054 (-0.9014)	--	--	--	--	--
N**	162	32	32	32	33	33
R-SQUARED ADJUSTED	0.632	0.666	0.795	0.736	0.607	0.760
F	26.144*	9.821*	18.153*	9.783*	8.049*	11.174*

*Denotes significant at 0.05 level. t statistics in parentheses. Estimated with White's heteroskedasticity consistent standard errors and covariances.

**Cibola County was created in 1983 and the number of New Mexico counties increased at that time from 32 to 33.

As should be expected from numerous studies of the relationship between income and education, the coefficients of PCTHS were all positive and significant at the five percent level. The MEDAGE and MEDAGESQ coefficients were not significant at the five percent level but generally had the anticipated sign.

In contrast to the combined model, the coefficients of LFPRW were not significant at the five percent level in the individual models. Three of the five LFPRW coefficients had the anticipated positive sign. Three of the five METRO coefficients exhibited the anticipated positive sign, but only two were significant at the five percent level. These results may simply reflect the changing designations of MSAs within the state. In 1960 and 1970, only one county (Bernalillo County) was designated as a metropolitan area –actually in 1960 and 1970 the designation was that of a Standard Metropolitan Statistical Area SMSA). In 2000 there were four MSAs (Albuquerque, Las Cruces, Santa Fe and Farmington) comprised of six different counties.

Only one of the RCAPEX coefficients was significant at the five percent level and two (1960 and 2000) had the wrong sign. The RCAPEX variable reflects only state and local public capital expenditures and is probably the weakest variable in the model.

The equations were also estimated with employment and population as dependent variables (Tables 3 and 4). As with the income model, the estimated employment equations exhibit surprisingly high goodness of fit measures (R-squared and F-statistic). The smallest adjusted r-squares in the employment equations was in the 1960 model (0.679). All of the F-statistics were significant at the 0.001 level. And, consistent with the income equations, the sign of the estimated coefficients of the oil and gas variable are all positive and significant –with the exception of 1960 in which the oil and gas variable was positive but not significant. The other explanatory variables exhibited the same general characteristics as in the income equations.

As with the employment and income equations, the population equations (Table 4) produced high goodness of fit measures. The smallest adjusted R-squared value was 0.607 in the 1990 equation. All of the F-statistics were significant at the 0.05 level. As in the other models, all of the coefficients of REALVALOILGAS variable were positive and significant in four of the five equations.
In brief, the employment and population equations tell the same basic story as the income equations. These results occurred despite the fact that oil and gas production is inherently a high income but low employment industry.

Although the focus of the current study is on New Mexico Counties, the income model was estimated for the 925 counties in the 13 states that produce more than 90 percent of oil and gas in the US (Table 5). Binary variables were included for 12 states. New Mexico is the omitted state. The results suggest that the basic model can be used effectively for other oil and gas producing states. As with the New Mexico equations, the adjusted r-squared (0.740) and F-statistics (139.2) indicate a strong fit. All of the estimated coefficients have the anticipated signs and all coefficients are significant at the 0.05 level.

Table 5: Regression for 13 states Year = 2000, Dependent Variable = LN(HHINC)

Dependent Variable: LNRHHINC
Method: Least Squares
Date: 04/12/10 Time: 10:52
Sample: 1 925
Included observations: 925
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.899768	0.238141	33.17264	0.0000
PCTHS	0.010570	0.000956	11.06165	0.0000
MEDAGE	0.056796	0.013287	4.274493	0.0000
MEDAGESQ	-0.000780	0.000181	-4.311111	0.0000
LFPRW	0.013051	0.001211	10.77387	0.0000
METRO	0.102428	0.011871	8.628344	0.0000
RCAP	8.98E-08	4.53E-08	1.980423	0.0480
REALVALOILGAS	8.12E-12	1.55E-12	5.228644	0.0000
D_AK	0.196862	0.034515	5.703630	0.0000
D_CA	0.190320	0.032586	5.840543	0.0000
D_CO	0.022122	0.031834	0.694909	0.4873
D_KS	-0.003002	0.027927	-0.107498	0.9144
D_LA	0.041514	0.027470	1.511229	0.1311
D_MS	0.004907	0.025141	0.195173	0.8453
D_MT	-0.133825	0.028148	-4.754378	0.0000
D_ND	-0.013957	0.030123	-0.463330	0.6432
D_OK	-0.030175	0.024975	-1.208210	0.2273
D_TX	0.117928	0.023996	4.914468	0.0000
D_UT	0.096391	0.037004	2.604875	0.0093
D_WY	-0.021398	0.036154	-0.591857	0.5541

R-squared	0.745004	Mean dependent var	10.50278
Adjusted R-squared	0.739651	S.D. dependent var	0.233775
S.E. of regression	0.119282	Akaike info criterion	-1.393264
Sum squared resid	12.87658	Schwarz criterion	-1.288836
Log likelihood	664.3844	Hannan-Quinn criter.	-1.353424
F-statistic	139.1621	Durbin-Watson stat	1.900734
Prob(F-statistic)	0.000000		

Concluding Remarks

Natural resource extraction and its effects on economic growth have become hotly debated issues in energy producing states such as New Mexico. The energy-growth debates have become more contentious, at least in New Mexico, during the recent economic crisis. In part, these debates stem from the resource curse literature which suggests that resource intensity and economic growth are inversely related –at least using the nation-state as the unit of analysis. The analysis in this paper was not conducted to solve the debate. Rather, the purpose of the analysis was to investigate whether fossil fuel energy production in New Mexico counties contributed to or restrained economic growth.

A regression model similar to those found in the resource curse and regional growth literature was estimated using median household income, employment, and population as dependent variables. The dependent variables included the value of oil and gas production and a series of human capital and demographic variables. The models were estimated in census years for 1960, 1970, 1980, 1990, and 2000.

In contrast to much of the resource curse literature, the estimated models suggest that oil and gas extraction in New Mexico Counties has had a small but positive effect on income, employment and population. Similar results were obtained when the model was estimated for 925 counties in 13 energy producing states for the year 2000.

One reason why the results presented here differ from those in most resource curse studies is that the current study was narrowly focused on oil and gas production, while the usual practice has been to examine a broadly defined natural resource variable. A second explanation of the differences in this and other studies is the unit of analysis. Most resource curse models are conducted using national level data, while the models estimated here were based on county level data.

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