The Influence of Oil and Gas on Local Sales and Use Tax Receipts: Evidence from Oklahoma Panel Data

Dylan Johnston, Oklahoma State University
dylanlj@okstate.edu · (405) 744-9357

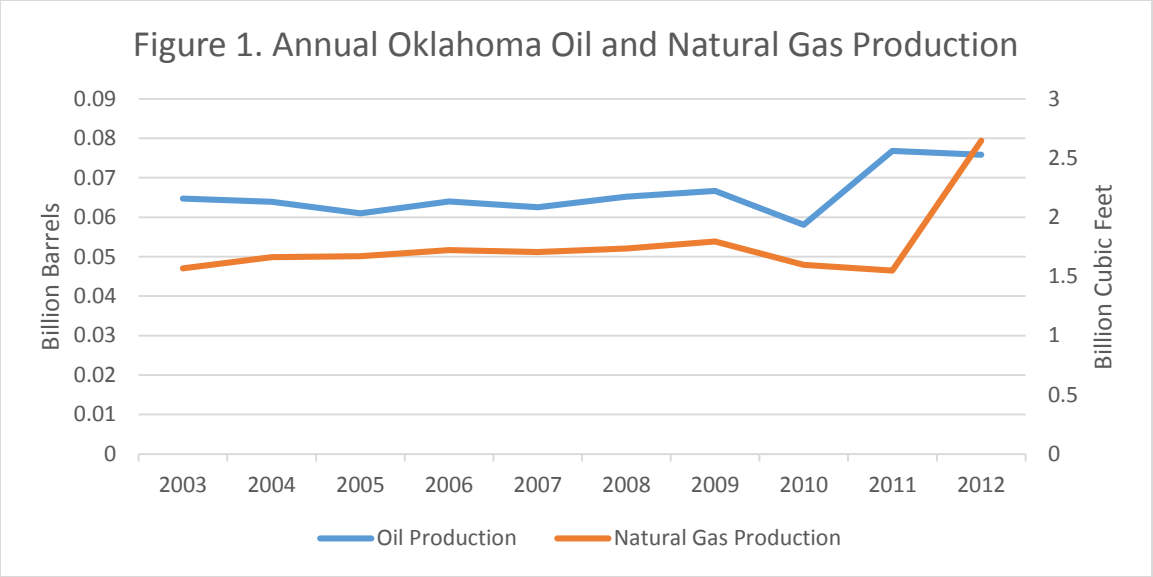
Dr. Brian Whitacre, Oklahoma State University
brian.whitacre@okstate.edu · (405) 744-9825

Selected Paper prepared for presentation at the Southern Agricultural Economics Association's 2016 Annual Meeting, San Antonio, Texas, February 6-9, 2016

Introduction:

Recent volatility in the oil and natural gas markets has led to questions about how local government revenues might be affected. This report attempts to quantify the relationship between changes in oil / natural gas production and local sales tax collections.

Over the last decade, rural economies and infrastructures have been affected by increased production during the recent oil and natural gas boom (Raimi and Newell, 2014). This holds true for the state of Oklahoma, which has traditionally been strong in these industries. Estimates suggest that, while oil and natural gas production in Oklahoma has generally increased since 2003, a dramatic rise has been seen since 2010. This is shown in Figure 1 below.



Source: Oklahoma Corporation Commission Annual Data

During that same time period, oil and gas companies in Oklahoma received gross production tax breaks ranging from three to six percent to incentivize technological advances in extraction techniques (Blatt, 2012). From fiscal year 2010 to fiscal year 2012, an estimated $645 million in gross production taxes were lost to rebates for unconventional drilling techniques. Proponents of the tax breaks, note, however, that increased drilling activity leads to other revenue

opportunities for cities and counties. These include sales tax, use tax and property taxes, which may rise with increased production and are significant sources of revenue at the city and county level.

Over the last 12 months, the price of oil and natural gas has fallen, ultimately affecting the state budget and causing energy production to decrease. With production slowing and oil prices falling, local governments face questions about how they should plan for the future. This report hopes to quantify how changes in oil and natural gas production impact the amount of sales and use taxes collected. Research has yet to uncover how Oklahoma counties are responding to the changing energy sector, specifically in areas of sales and use tax.

In terms of revenue, this report will consider the collection of sales and use tax at the county level for the specified period, with specific focus on SIC codes. Sales tax is generated from everyday transactions of personal/tangible goods and services within a county. For example, if Payne County experiences an inflow of workers to drill new wells for an energy company, those workers would be expected to cause local sales tax collections to increase through their consumption of goods and services (i.e. fast food restaurants, clothing, and fuel). These taxes are useful indicators of the economic health of Oklahoma counties (indeed, they are the primary sources of county revenue) and will be coupled with measures of oil and gas production value to highlight relationships between each.

This report will consider the effects, both positive and negative, of increased oil and natural gas production on local economies in Oklahoma. The specific objective is to quantify the relationship between the value of oil and natural gas activity and county-level sales tax, use tax, and Standard Industrial Classification (SIC) codes.

One particular advantage of this report is the use of panel data, since information on all 77 Oklahoma counties is gathered over the years 2003-2012. Utilizing the information gathered from the points above, this report hopes to quantify some specific ways that Oklahoma counties have been affected by the recent oil and natural gas boom. Some specific hypotheses related to the objectives are that retail sales tax will be higher in counties with elevated levels of oil and natural gas production, and that natural gas production will have a stronger effect on retail sales tax than oil production. Additionally, the report looks to determine which categories of SIC codes (i.e. hardware sales, food stores, etc.) will be closely related to energy production.

As the following literature review details, a significant amount of work has already been done on the relationship between oil and natural gas activity and local economies. This report adds to this body of literature by considering *Oklahoma counties* and the effects seen on retail sales tax collections, and more specifically SIC codes, when oil and natural gas production is in a boom phase.

Review of the Literature:

Oil and natural gas production is an area of economic interest that has been studied very heavily in the last four to five decades. During the last decade, the energy sector has experienced booming growth including a tenfold increase in U.S. production of natural gas (Weber, 2013). Since the late 1990's and early 2000's, the adoption of horizontal drilling, deep well drilling, and hydraulic fracturing has increased. The claim has been made that hydraulic fracturing and unconventional drilling are new technologies, but the reality is that both were developed early in the 20th century (Burnett and Weber, 2014). However, the technology was not readily utilized until the last twenty years when Mitchell Energy Corporation and Devon Energy Corporation combined horizontal drilling with hydraulic fracturing to remove natural gas from shale formations deep

beneath the ground. Their technological hybridization, coupled with increasing oil and natural gas prices, allowed for a process that was once too expensive to become very economically feasible.

According to Weber (2013), the ability to estimate the effects of an oil and gas boom on local economies is pivotal in providing policy makers with information about maintaining, increasing, or decreasing tax incentives for energy companies. In the 1990's Oklahoma legislators passed a bill that provided tax rebates to oil and gas companies in order to incentivize the use of unconventional horizontal drilling and hydraulic fracturing. This was at a time when such drilling practices were virtually nonexistent. For oil and natural gas production in Oklahoma, the standard gross production tax rate is 7%, but that rate falls to lower percentages when the prices of the commodities fall or if certain unconventional extraction techniques are used (Blatt, 2012). Techniques such as horizontal drilling or deep well drilling may yield a drop in percentage from 7% to 4%. There are seven categories of production that lead to these rebates and most deal with new methods of extraction techniques.

As these drilling procedures have become more common, lobbyists and lawmakers in Oklahoma remain interested in those gross production tax rebates that influence the annual state budget. Additionally, a recent decrease in the price of oil and natural gas since early in 2014 has caused a budget shortfall in the Oklahoma State Budget. A decrease in the price of oil and natural gas also triggers a decrease in the gross production tax rate applied to oil and natural gas production in the state. In times of economic hardship, critics of the gross production tax rebates are more vocal about the need for legislative reform. The Oklahoma Policy Institute has produced several papers and is actively advocating for the re-evaluation of our state's current gross production tax policy. An article published by the Oklahoma Policy Institute estimated that $645 million was paid to oil and gas producers in the form of gross production tax rebates from fiscal year 2010-2012

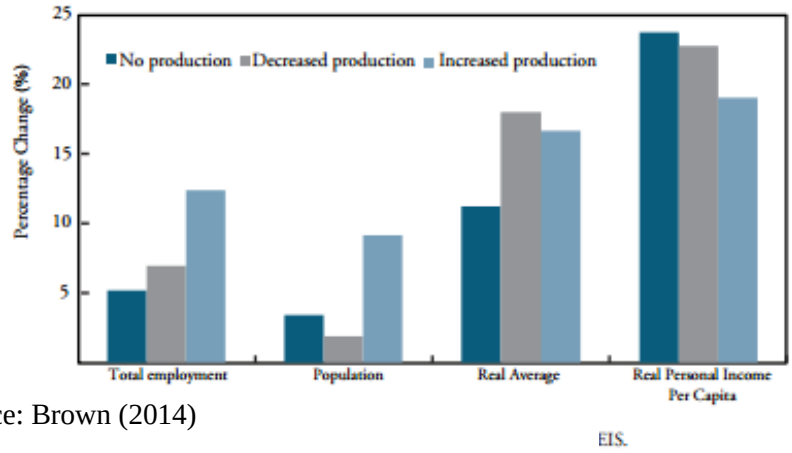
(Blatt, 2012). Recently, the Oklahoma House of Representatives heard and passed HB2562 which raises the lowest tax rate of 1% up to 2% for new wells drilled on or after July 1, 2015. It should be noted that these tax rebates are only allotted for newly drilled wells and only last for the first three to four years of production (the first few years are generally the most productive).

The State Chamber of Oklahoma, a lobbyist group for Oklahoma businesses, has argued against the elimination of tax rebates. In their annual Oil and Gas Policy Report, the State Chamber makes the claim that no one area of well exploration is the same and each well location requires experimentation with drilling and "fracking" inputs to determine the optimal combination. With that experimentation, additional costs arise that can become quite expensive given a large number of new wells for a company. The State Chamber and the energy companies it represents believe that the tax rebates incentivize oil and gas production on Oklahoma land as opposed to other states, as well. On the other hand, a survey by the Oklahoma Policy Institute found that oil and natural gas producers ranked state tax incentives last (out of 10 other choices) when considering the development of a new well (Blatt, 2012).

Raimi and Newell (2014) collected and analyzed data from non-metropolitan counties in nine U.S. states that recently exhibited significant oil and gas production increases. The researchers considered primary and secondary data during their study, collecting data from state and county officials by means of surveys, in-person interviews, and hard data from reporting agencies. Each county in the study, with few exceptions, was contacted and surveyed about their experiences with the energy sector during a time period of increased oil and natural gas production. Raimi and Newell (2014) discovered that over half of the states experienced positive economic growth during or shortly after a production boom.

Brown's 2014 study looked at the "natural resource curse" on a local level as opposed to the national level. Much like the case study above, Brown used a nine state sample from 2001 to 2011 and collected 647 non-metropolitan counties worth of data for his analysis. Counties were sorted into categories based on production: no production, decreased production and increased production. Dependent variables such as: employment, real wages, population and real per capita income were employed in an attempt to detect how changes in natural gas production can affect a local economy.

Figure 2. Change in County-Level Outcomes by Production Category, 2001-2011



Source: Brown (2014)

As shown in Figure 2 above, Brown found that, on the average, local economies saw either net benefits from a boom, or no effect at all. In either case, there was no evidence that a net decline in the local economy was a normal result of an energy boom.

Recently, economists at Penn State University have been conducting research on the Marcellus Shale play in Pennsylvania. A study conducted by Costanzo & Kelsey (2012) found that counties with above average oil and gas production experienced elevated sales tax revenue, higher wages, and slower declines in housing conditions. One inconsistency, noted in the project, related to the variance in effects that each county experienced. Not every county with elevated production

experienced the same uniform reaction to the oil and gas boom. Trends supported the previous statements about high production being related to economic growth, but a few counties in each category of production broke the trends.

This report will attempt to quantify the drivers of local sales tax with regards to oil and natural gas production. The results will be useful for identifying how an increase in oil and natural gas production might affect the revenue generated for a county. With this information, government officials might have a better idea of how their community looks in terms of tax revenue associated with energy production. The methodology used will also allow for estimates of reduced revenue as production declines.

This report looks to generate findings that add to the body of evidence demonstrated in the articles and areas of thought discussed above. The following section will continue to build from the methods and variables used in previous studies. This study will consider Oklahoma counties alone and will quantify specific factors related to the energy industry within state lines. Additionally, the hope is for this paper to provide a way for Oklahoma government officials to estimate how changes in oil and natural gas production might affect retail sales tax. The model will also be applicable to other states with comparable revenue structures to Oklahoma, and could help to determine more about how the energy industry is affecting local economies.

Data and Methods:

In an attempt to quantify the effects the oil and natural gas industries have on Oklahoma counties, the following data will be used from the years 2003-2012. The time period selected

comes at a point in Oklahoma's oil and natural gas production where the annual number of mcf ("million cubic feet" – measure for natural gas production) and barrels (measure of crude oil production) are climbing. This time frame was also the longest period for which consistent data in each of the parameters was available, providing the maximum number of observations while still capturing specific parameters. Because of the nature of the data, a snapshot of the same elements in the same county over a period of ten years, panel regression will be used to predict the coefficients. The advantages of this technique are discussed later in this section.

The dependent variables (retail sales tax, use tax and individual SIC code collections) were selected for the value of information provided when considering their correlation with the independent variables of interest (oil and natural gas production value and volume). After regression analysis is complete, the variables will indicate how a unit change in an independent variable, crude oil production for example, will elicit a specific unit change in the dependent variables, retail sales tax collections for example. With this information conclusions will be made about how increasing an independent variable by one unit causes a specified dependent variable to respond by a given number of units. Retail sales tax is directly related to the amount of spending at the county level on goods and services. Using this measure allows the regression analysis to accurately predict economic activity at the county level. Increased economic activity can be shown through increased spending on goods such as food, clothing, or building materials as well as gasoline tax. Therefore, measuring the tax generated from those transactions should provide an accurate insight about how the independent variables affect retail sales tax generation.

Panel regression provides a look at the elements of a study over a specific time period. It allows for the researcher to isolate fixed effects, in this case a year or county. When the regression analysis controls for these fixed effects, the estimated parameters are free of county-specific or

year-specific factors that may affect the results. For example, consider panel data for 77 Oklahoma counties in the year 2001 and 2010 with a dependent variable of county road expense and an independent variable of natural gas production. By including fixed effect variables for the county and year, the regression will account for both an aggregate time trend and specific county-level impacts on county road expenditures. The fixed effect variables essentially eliminate the effect of the year and county on each observation, allowing for isolation of the impact of the variables of interest-namely, specific measures of oil and natural gas production.

A preliminary look at the county level oil and natural gas production is helpful in learning about trends in energy production around the state. The maps produced below indicate the intensity with which energy is produced in a given county in Oklahoma. The darkest red indicates the production of 2,000,000+ barrels of oil or 50,000,000+ cubic feet of natural gas. As the color intensity fades (light red, orange, light orange, yellow, and tan) the production average decreases in a stair step fashion. The lowest grouping (tan color) displays counties averaging fewer than 1,000 barrels of oil or fewer than 15,000 cubic feet of natural gas.

Both maps indicate weaker production statistics on the eastern border of the state and a somewhat uniform distribution of above average production in counties west of Interstate 35. It is also apparent that oil and natural gas production, although heavy in certain areas, is well represented in the majority of Oklahoma counties. This idea provides support for the research in this paper and on the topic of local economies and how they are affected by the energy sector.

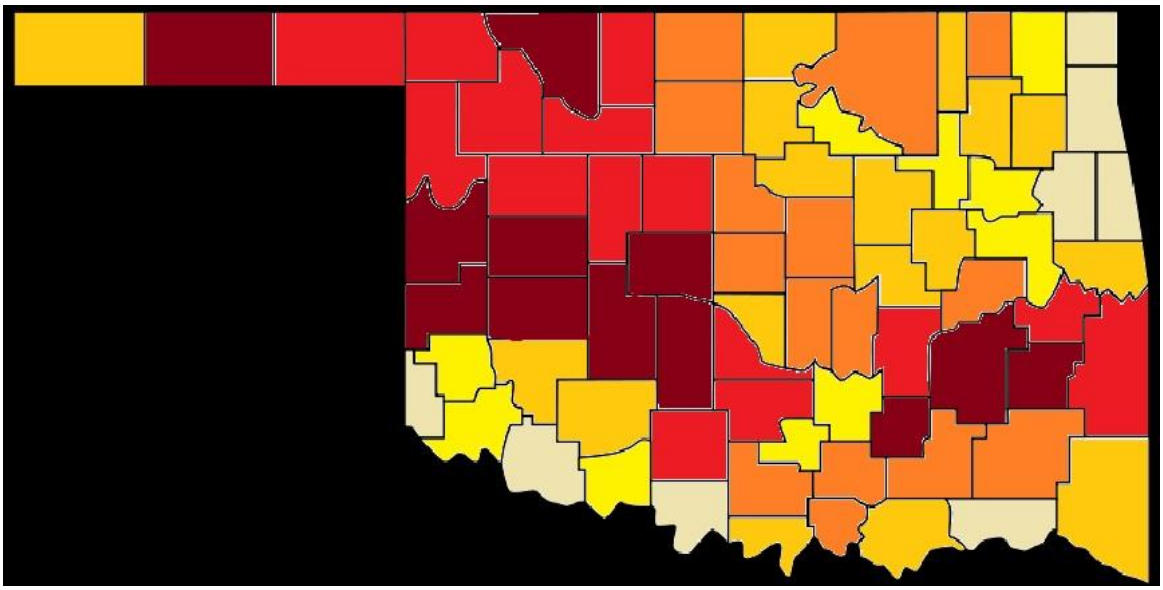


Figure 3. Average Oil Production (2003-2012) by County

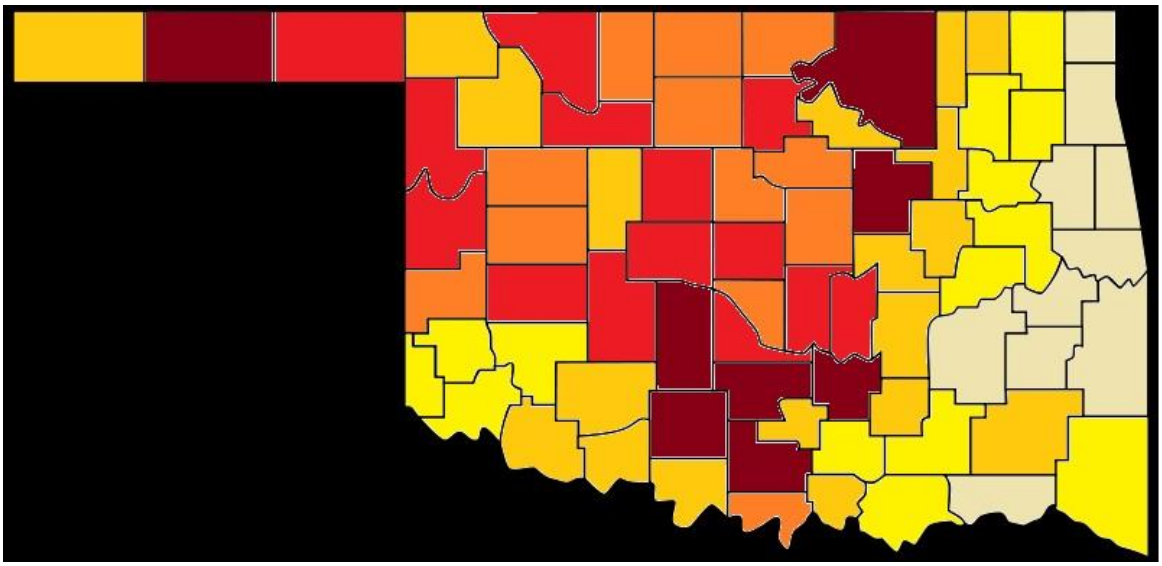


Figure 4. Average Natural Gas Production (2003-2012) by County

Annual county retail sales tax data was collected from the Oklahoma Tax Commission for all Oklahoma counties from 2003-2012. In addition, oil and natural gas production volume was gathered for all Oklahoma counties from the Oklahoma Corporation Commission for the same time period (an average of production by county is shown in Figure 3&4 above). The data was formatted in Microsoft Excel and transferred to STATA 13.1 for analysis.

The *xtset* command was used to prepare the data for panel regression analysis and the *xtreg* command was used to carry out the regression. Because of the size of the numerical observations, a logarithmic transformation was performed on specific variables in an attempt to better fit the data. Another transformation was made to collected tax data in an attempt to normalize the collections by county. The initial tax data was presented as collections by county which varied depending on the individual county's tax rate. The data was normalized by dividing the collections by the respective county rate to generate a pre-tax collection amount. The results from the model equations are presented in Table 1 below.

$$(1)\ lnRetail_{it} = \beta_0 + \beta_1 lnOilValue_{it} + \beta_2 lnGasValue_{it} + \beta_3 Unem_{it} + \beta_4 lnPopulation_{it} + \beta_5 lnMHI_{it} + \beta_6 Poverty_{it} + \varepsilon_{it}$$

In the equation above, $lnRetail$ serves as the dependent variable representing county-level retail sales tax collections, β_0 serves as the intercept estimator, β_1 serves as the coefficient estimator for county-level oil production value, β_2 serves as the coefficient estimator for county-level natural gas production value, β_3 is the coefficient for unemployment rate, β_4 represents the coefficient for population, β_5 represents median household income, β_6 represents the coefficient for poverty, and ε serves as the error estimator. The independent variables involving unemployment, population, median household income, and poverty serve as controls for the regression model. This report is most interested in the ways production volume, well completions and value affect the generation of retail sales and use tax. The regression is also modeled using SIC codes 52-59 and use tax receipts as the dependent variables and the same independent variables from Equation (1). Results are shown in the results table below.

Results:

The following results were recorded after regressing the dependent variables in the far left column against the independent variables presented in the methods section of this report.

Table 1. Results from Panel Regression Models

Dep. Variable	Intercept	lnOilValue	lnGasValue	Unem	lnPopulation	lnMHI	Poverty
Retail	1.937	**0.042**	**0.034**	-0.004	**1.538**	0.124	*-0.015*
Use	**-22.596**	0.069	**0.073**	-0.018	**0.621**	**2.835**	0.028
SIC52	*-3.535*	*0.042*	*0.026*	*-0.023*	**1.639**	*0.320*	*-0.017*
SIC53	**-8.523**	0.026	0.026	0.007	**1.926**	**0.602**	0.011
SIC54	**11.780**	**0.048**	**0.032**	-0.008	**1.150**	**-0.555**	**-0.036**
SIC55	2.447	**0.059**	**0.057**	0.009	**1.482**	-0.205	**-0.023**
SIC56	**-13.122**	0.019	0.036	-0.016	**2.300**	0.420	-0.018
SIC57	**-5.207**	**0.053**	**0.046**	**-0.033**	**1.692**	0.327	-0.009
SIC58	**-4.267**	**0.043**	**0.030**	-0.004	**1.623**	**0.427**	0.003
SIC59	1.290	**0.055**	**0.032**	-0.008	**1.606**	-0.115	**-0.029**

The columns labeled lnOilValue & lnGasValue are of most concern to the hypotheses of this study. The interior cells represent the coefficients for each of the parameters outline above, but lnOilValue & lnGasValue deal specifically with the value of oil and natural gas production in each county. As shown, retail sales tax collections and SIC codes 54, 55, 57, 58 and 59 show significant positive correlations with the production of oil and natural gas. Bold cells indicate significance at the 95% level and italicized cells indicate significance at the 90% level. All other cells are considered less significant under the given modeling conditions. Additionally, the logarithmic transformation performed on the value of production data means that those results listed for lnOilValue & lnGasValue are interpreted as percentages. For example, a 1% increase in the value of oil production would yield a 0.042% increase in the amount of retail sales tax generated for a county. lnOilValue, lnGasValue, lnPopulation and lnMHI all represent percent changes because of the logarithmic treatment they received.

Conclusion:

After analyzing the Oklahoma county-level production and sales tax data, support is shown for the idea that elevated energy production increases retail sales tax in a given county. There is less support for increases in use tax caused by energy production, but the model indicates natural gas value has a significant positive impact. For a practical example of the interpretation of the results consider Logan County. A county that produces an average of 658,860 barrels of oil and 13,442,594 cubic feet of natural while generating an average of $2,861,881 in retail sales tax. Given the coefficients from the model, Logan County could generate $1,201.99 (0.042%) more revenue given an increase of 6,588 barrels of oil or $973.04 (0.034%) given an increase of 134,425 cubic feet of natural gas. While this may seem insignificant in terms of dollars and energy units, it does provide support for the argument that production has a positive impact on local economies.

The results from Table 1 also support the idea that specific areas of business are affected by the energy industry. Food stores (SIC54), automotive dealers & gasoline services (SIC55), home furniture, furnishing, & equipment (SIC57), eating & drinking places (SIC58) and miscellaneous retail (SIC59) all experienced significant positive correlations with oil and natural gas production. As expected, apparel & accessory stores (SIC56) did not show strong correlations with the oil and natural gas industry. A somewhat surprising detail is the lack of effect seen on building materials, hardware, garden supply, and mobile home dealers (SIC52). The results show a significance level of 90%, which is less intense as predicted by the hypotheses.

In conclusion, the analysis seems to support the idea that oil and gas production increase the generation of retail taxes and can be traced to a few specific areas of retail sales tax generation.

This information should provide aid to organizations and businesses looking to understand how the condition of the energy sector affects the way people are spending money in local economies.

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