

Honors College Thesis

The Effect of Crude Oil Price on Employment in Oklahoma Non-Energy Sectors

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Abstract

The energy sector is an integral part of the Oklahoma economy. Nationally, low oil prices are seen as good for the overall economy. The loss of income from domestic producers is offset with more disposable income for those not employed by the energy sector. This is a net gain for the country as a whole (Kang et al). However, in Oklahoma in 2014, the location quotient in Oklahoma for the mining sector was 7.06 when compared to national averages (BLS). This means that while a downturn in oil prices may be good for the nation as a whole, it is not beneficial for the state of Oklahoma.

This issue is important, especially in Oklahoma and other oil-dependent states, because the energy sector has been notorious for its cyclical nature. A more thorough understanding of the benefits and detriments of oil prices on local economies can help drive business and policy decisions on a local, state and national level.

This study backs up the assertion made by Kang that Oklahoma is a state that stands in contrast to the majority of the U.S. in that low oil prices have a negative impact on the local economy. While it is true that some industries, such as manufacturing and information, have had a positive reaction to low oil prices over the last 26 years, economy-wide the impact has been a negative one. In terms of policy, this paper shows the importance of a strong mining sector to Oklahoma's economy.

Introduction:

The energy sector is an integral part of the Oklahoma economy. Nationally, low oil prices are seen as good for the overall economy. The loss of income from domestic producers is offset with more disposable income for those not employed by the energy sector. This is a net gain for the country as a whole (Kang et al). However, in Oklahoma in 2014, the location quotient in Oklahoma for the mining sector was 7.06 when compared to national averages (BLS). This means that while a downturn in oil prices may be good for the nation as a whole, it is not beneficial for the state of Oklahoma.

The mining sector has a profound impact on Oklahoma's economy due to the number of jobs employed in oil and gas. With an increase in wages and employment during times of high oil prices, comes the need for increased services and businesses outside of the energy sector to provide for the necessities of the growing population. The intent of this paper is to measure the effect that oil prices have on non-energy sector employment.

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Specifically, this research is intended to discover what industrial sectors, if any, have a high rate of correlation to spikes and drops in oil prices. Additionally, this research will uncover what industries are immune to the affects of changes in oil price.

The answers to these questions will help shape policy in terms of knowing the overall economic impact for tax incentives to bring energy companies to a region or for better preparing for an economic downturn when the energy sector is in a downward trending cycle.

Literature Review:

According to Wei Kang, Regional Economist at Regional Economic Models, Inc, sudden increases in the price of oil often lead to a recession. However, the same is not true in reverse – a decrease in oil price does not necessarily lead to a period of economic expansion. Kang's research focuses on the impact of oil price changes on particular states. He found that a sudden price change in oil will lag in its affect on the Oklahoma economy as a whole for about three quarters, as compared to no lag for Texas and an eight quarter lag for Missouri. This study concludes that Oklahoma is a state that has an increase in income and growth when oil prices rise, which is in contrast to national averages.

Bachmeier, Li and Liu conclude that oil prices are not a viable predictor for the future of the economy. While oil price volatility may help predict some GDP growth or CPI inflation, it is an unreliable source for most economic growth measures. They

conclude that it is not in the best interest of industries or the Federal Reserve in particular to change policy in response to spikes or sudden drops in oil price (Bachmeier et al).

James Hamilton with the UC-San Diego Department of Economics agrees with Kang that, "oil price increases are much more important than oil price decreases." These spikes in price matter because the cause consumer to have unexpected sudden expenditures. Additionally, his paper points out that the data for studying oil price shocks somewhat accurately only goes back to 1973. That is around the time that the Texas Railroad Commission ceased to be relevant in determining world prices and Middle East producers began to drive the market. Hamilton concludes that price shocks are not necessarily a problem due to their effect on the overall economy, but instead on their effect on disrupting, "certain categories of spending by consumers and firms." (Hamilton)

"Oil shocks account for 20-25 percent of the variability in employment growth," according to Davis and Haltiwanger with the University of Chicago. Their research shows that jobs will be lost and gained in an oil shock, but the job losses will come quickly and job creation will come about over an extended period of time. In a study of the 1973-1974 oil shock, their research concludes that job reallocation took place equal to 11% of total employment in the 15 quarters following the oil episode.

Dr. Noel Uri examined the effects of changes to the real price of crude oil specifically on agricultural employment. He concludes that it takes a full three years for the agricultural industry to feel the effects of an oil price shock. His study is unique in that it quantifies the effect that oil prices have had on the agricultural industry by stating, "The increase in the real price of crude oil on average has accounted for an annual decrease in the agricultural employment of approximately 0.21%."

This paper's research differs from others in that it provides an analysis of the most recent drop in oil prices and focuses on the effect that this downturn in the energy sector has had on the Oklahoma economy. Other papers focus mainly on the opposite – the effect that a price spike has on an overall economy.

Methods:

In order to conduct this research, data was obtained from the United States Department of Labor Bureau of Labor Statistics (BLS) website. All employment graphs with data from 2012 - present were obtained via the BLS *Quarterly Census of Employment and Wages*. All data from pre-2012 was obtained through the BLS *Current Employment Statistics* through the BLS *Data Viewer*. Crude oil price data was obtained from the U.S. Energy Information Administration. Information from the BLS was used to discover monthly and quarterly data from all of the two-digit NAICS sectors in Oklahoma. BLS also provides information on industries by establishment size, which allowed for the examination of the effects of oil prices on businesses based upon size. The Energy Information Administration website provided monthly average oil prices in the United States dating back to the 1980s. For the intents of

this research, we used available data from their site pertaining to prices based on the monthly average Spot Price Dollars per Barrel in Cushing, Oklahoma.

First, monthly employment data was obtained from the BLS by industry. This was used to compare the overall economy as well as individual industries to monthly oil prices. Each industry was compared with oil prices and correlations were measured using Microsoft Excel’s “=Correl” feature.

Job growth and loss associated with oil prices often come with a lag (Davis). Due to this lag and its varying effects across industries, monthly correlation lags were built into the Excel formula from 0 months all the way to 18 months, beginning in January of 1990 and finishing in January of 2016, which is the most recently available data. Again, due to the variation in oil price’s effect on various industries, the lag with the greatest correlation to oil prices for each industry was used. For instance, Construction had its greatest correlation of 0.762 with a 7-month delay and Manufacturing had its greatest correlation of -0.754 after an 18-month delay. Figure 1 below shows an example of how this lag process was determined.

Correlation Delay	Goods-Producing	Education & Health Services	Construction
0 Month	0.491	0.794	0.729
1 Month	0.510	0.800	0.737
2 Month	0.527	0.805	0.745
3 Month	0.541	0.809	0.751
4 Month	0.551	0.813	0.756
5 Month	0.557	0.816	0.759
6 Month	0.559	0.820	0.761
7 Month	0.556	0.823	0.762
8 Month	0.549	0.826	0.762
9 Month	0.539	0.828	0.759
10 Month	0.526	0.830	0.756
11 Month	0.513	0.833	0.753
12 Month	0.500	0.837	0.753
13 Month	0.485	0.840	0.751
14 Month	0.470	0.844	0.751
15 Month	0.455	0.846	0.748
16 Month	0.440	0.846	0.744
17 Month	0.426	0.845	0.740
18 Month	0.414	0.845	0.735

Figure 1: Process for Determining Oil Prices’ Lagging Effect on Industrial Employment
Source: BLS *Current Employment Statistics*, EIA

Next, all North American Industry Classification System (NAICS) industries with declining employment from September 2014 – September 2015 (most recently available data for NAICS) were measured. The job total for September 2015 was subtracted by the employment total for September 2014.

Our third measurement was to determine if the size of companies was driving or hindering growth by measuring the percent change in employment from March 2013 to March 2015 (most recent data). Due to the lack of available data and the lag of industries in feeling the effects of oil price shifts, this did not yield beneficial results to the study.

	Job Growth from Sept. 2014 - Sept 2015	% Change
NAICS 21 (Mining)	-11287	-18.01%
NAICS 31-33 (Manufacturing)	-5191	-3.71%
NAICS 42 (Wholesale Trade)	-4229	-6.65%
NAICS 51 (Information)	-900	-4.16%
NAICS 53 (Real Estate)	-257	-1.23%
NAICS 55 (Mangmt of Companies)	-460	-2.47%
NAICS 56 (Administrative and Waste Services)	-3397	-3.36%
NAICS 81 (Other Services)	-41	-0.12%
Total, All Industries	-1233	-0.097%

Results:

Figure 2: Oklahoma NAICS Sectors with Declining Employment from Sept 2014 – Sept 2015

Source: BLS *Quarterly Census of Employment and Wages*

Figure 2 shows how economy-wide employment in Oklahoma has gone down as well as the sectors in which employment has recently decreased. Employment in the Mining sector has dropped most significantly, as this is the area most closely associated with crude oil prices.

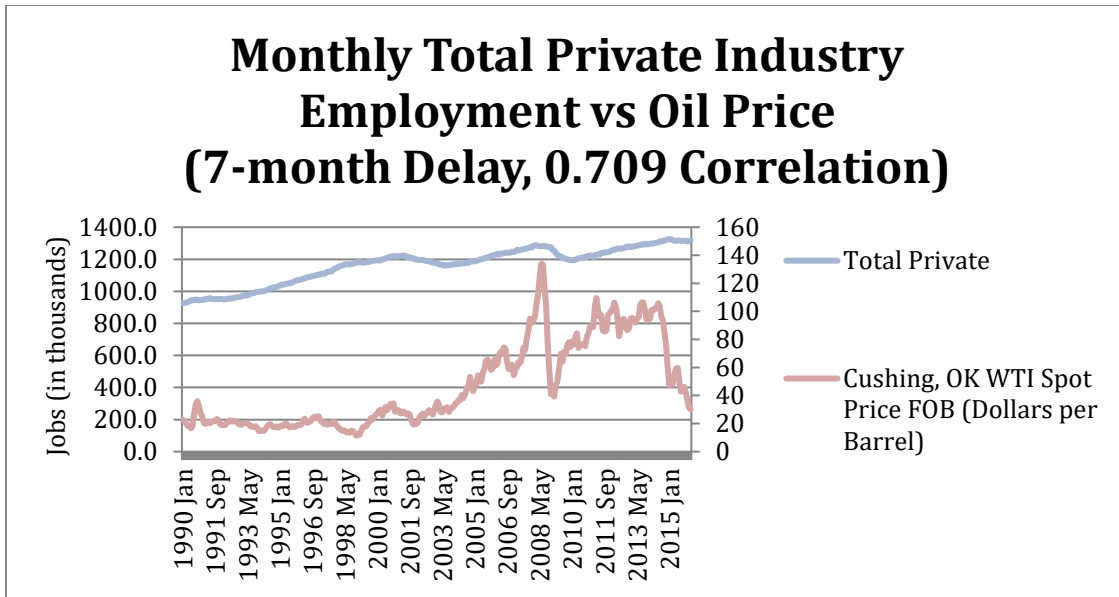


Figure 3: Monthly Total Private Industry Employment vs Oil Price Jan '90 – Jan '16
Source: BLS *Current Employment Statistics*, EIA

Figure 3 displays the monthly private employment in Oklahoma from January 1990 to January 2016. This graphic shows that there is a strong correlation in Oklahoma between the average monthly price of crude oil and total jobs in the private industry with a 7-month lag. (January prices correlate with August employment numbers.) This shows that Oklahoma's overall economy is likely tied closely to the price of crude oil.

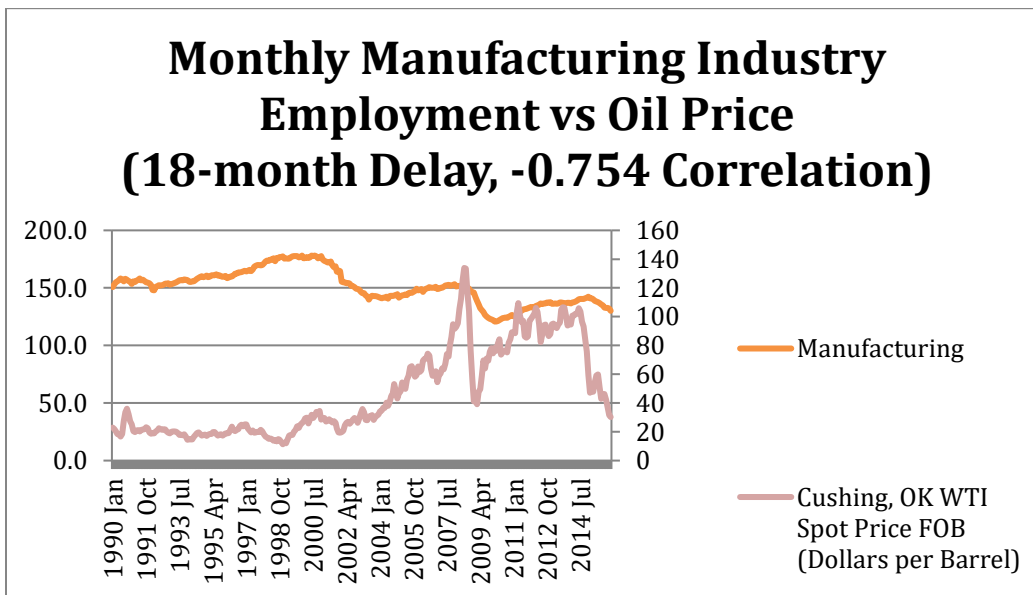


Figure 4: Monthly Manufacturing Industry Employment vs Oil Price Jan '90 – Jan '16
Source: BLS *Current Employment Statistics*, EIA

Figure 4 shows that the Manufacturing industry, since 1990, has reacted inversely to oil prices with an 18-month lag. The scope of this paper does not cover the reasons behind this, however, it could be that manufacturing employees are able to find higher-paying jobs in the oilfield when prices are high, but come back to stable incomes in the manufacturing sector when oil is low. Manufacturing was one of only two industries examined that had a negative correlation with oil prices – the information sector being the other with a -0.55 correlation.

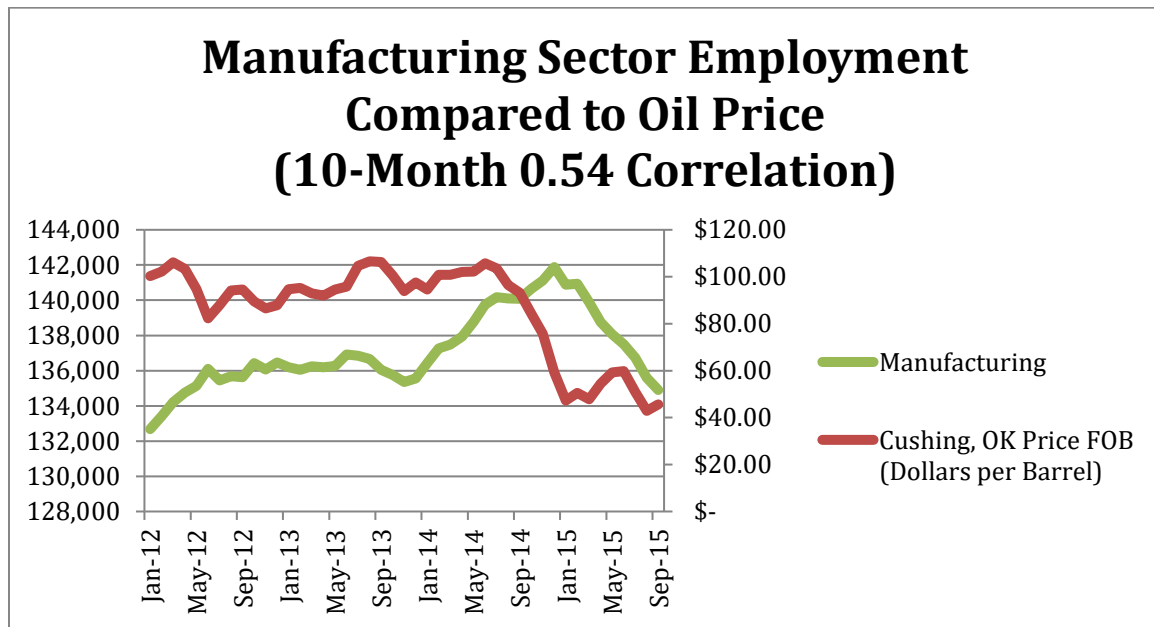


Figure 5: Monthly Manufacturing Industry Employment vs Oil Price Jan '12 – Sep '15
Source: BLS *Quarterly Census of Employment and Wages*, EIA

Figure 5 contradicts the findings of Figure 3 by showing a weak correlation between the manufacturing sector and the price of oil with a 10-month lag. This could show two things. On one hand, it exhibits the danger of looking at a small-scale event and deriving conclusions from it. However, it could also back of Davis' study stating that job losses due to oil booms and busts come quickly and job growth comes slowly. It is possible that the manufacturing sector's growth from the oil bust of 2015 remains to be seen.

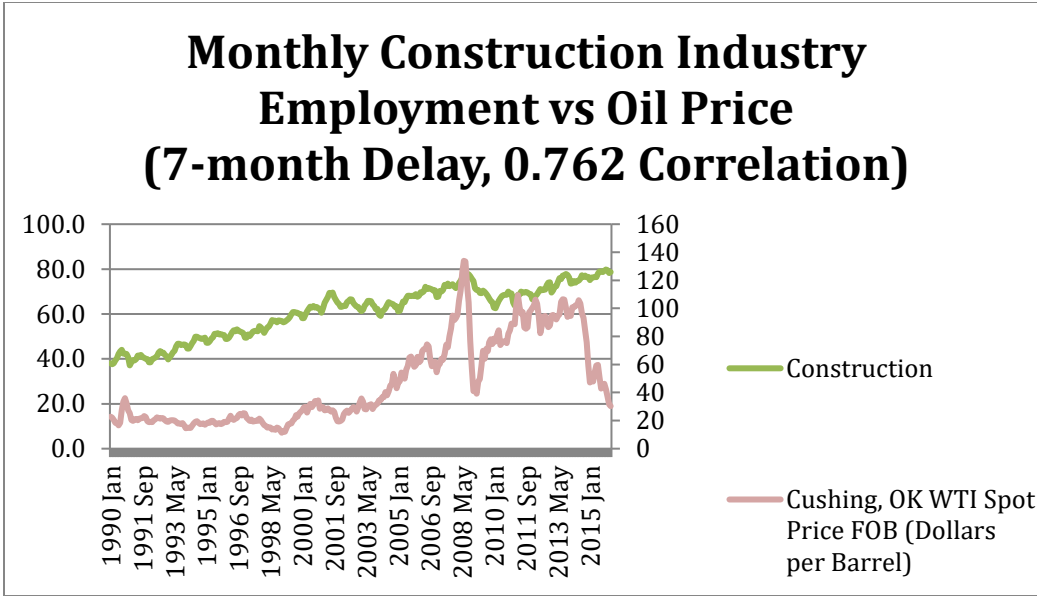


Figure 6: Monthly Construction Industry Employment vs Oil Price Jan '90 – Jan '16
Source: BLS *Current Employment Statistics*, EIA

Construction is another sector with strong correlation to the price of oil. As Figure 6 demonstrates, this sector correlates with a strength of 0.762 at a 7-month delay. However, when the effects of a 2009 drop in oil price hit the construction sector in approximately January of 2010, while the effects were harmful, they did not cause as much distress on Construction as one would expect to an industry with such high correlation to oil prices. This graphic shows that sharp decreases in oil price are harmful, yet not detrimental to the construction industry.

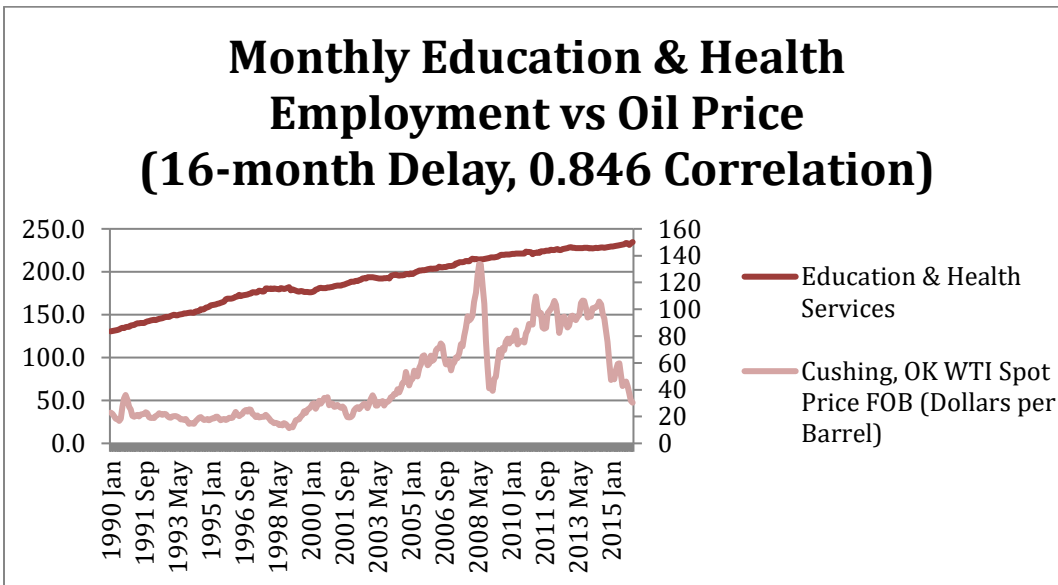


Figure 7: Monthly Education & Health Industry Employment vs Oil Price
Jan '90 – Jan '16

Source: BLS *Current Employment Statistics*, EIA

Figure 7 shows that education & health services has a correlation of 0.846 and has one of the highest correlations of all industries measured. However, upon further inspection of the data, education and health services has steadily increased from January 1990 to present. Most notably, the price spike and drop in oil prices from Sept. 2006 – Jan 2010 does not seem to cause even a glitch on the steady pace of the line for education and health services.

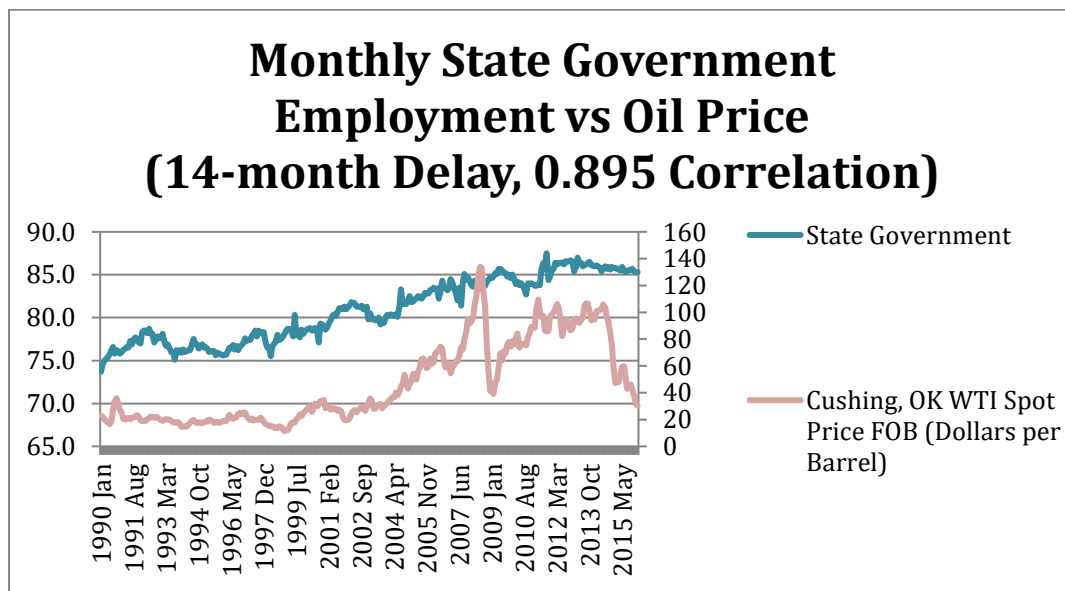


Figure 8: Monthly State Government Employment vs Oil Price Jan '90 – Jan '16
Source: BLS *Current Employment Statistics*, EIA

Outside of the mining sector, State Government has the highest correlation to oil prices at 0.895 with a 14-month delay. This correlation and subsequent delay seems reasonable, given that budgets for state agencies, which determine the amount of employees an agency can afford, are typically done once a year through the state legislature after receiving economic projections.

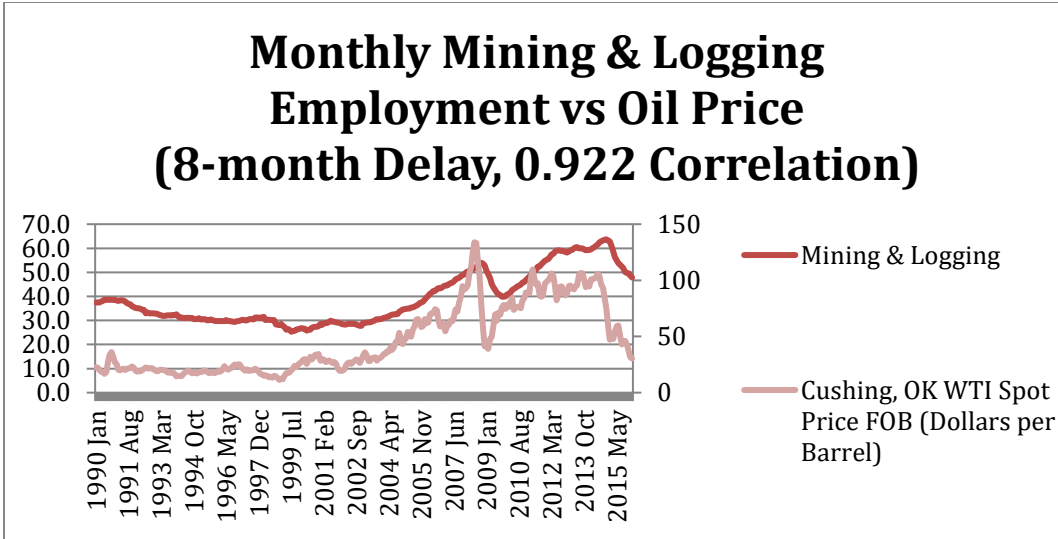


Figure 9: Monthly Mining & Logging Industry Employment vs Oil Price
Jan '90 – Jan '16

Source: BLS *Current Employment Statistics*, EIA

As is expected, the Mining & Logging sector shows an extremely high correlation with oil prices coming in at 0.922. This exhibits the sheer volatility of the industry as high prices allow for exploration and higher employment and low prices call for rig shutdowns and downsized employment. Figure 10 below shows similar results, focused on NAICS 21 specifically and only 2012-2015 data.

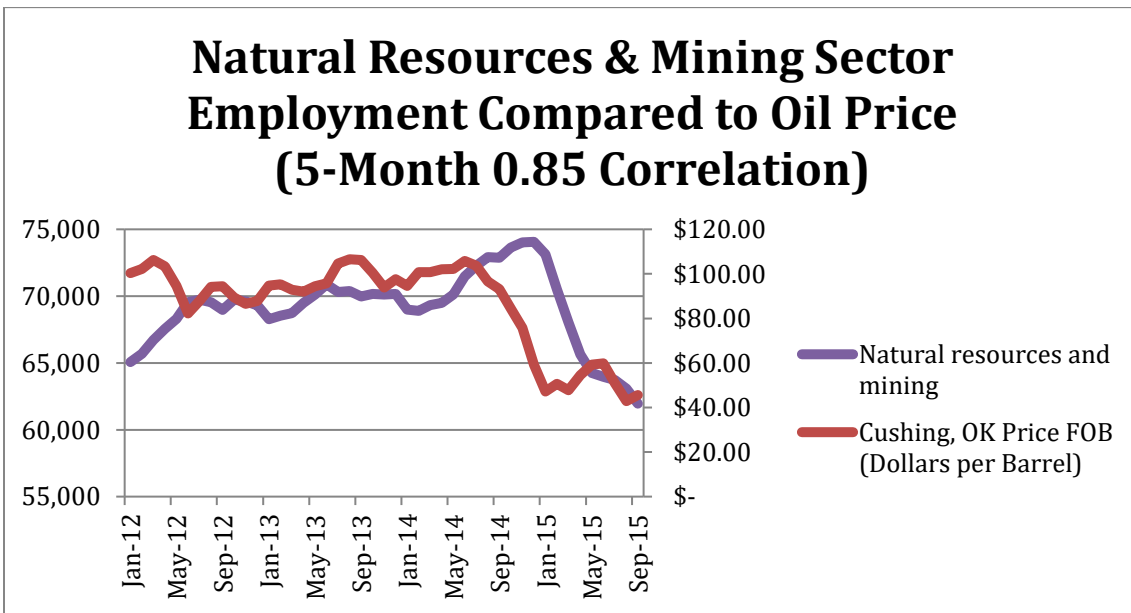


Figure 10: Monthly Nat. Res. & Mining Employment vs Oil Price Jan '12 – Sep '15

Source: BLS *Quarterly Census of Employment and Wages*, EIA

Discussion:

The biggest takeaway from this research is that we have confirmed what we already assumed – Oklahoma is reliant upon the energy sector. However, this research further proves that point by illustrating how economic stress in the oil and gas sector bleeds over into job losses in other sectors as well.

This study backs up the assertion made by Kang that Oklahoma is a state that stands in contrast to the majority of the U.S. in that low oil prices have a negative impact on the local economy. While it is true that some industries, such as manufacturing and information, have had a positive reaction to low oil prices over the last 26 years, economy-wide the impact has been a negative one. In terms of policy, this paper shows the importance of a strong mining sector to Oklahoma's economy.

Another lesson learned is that the short-term effects seen from the most recent oil crash in 2015 do not necessarily line up with the effects seen since 1990. For instance, both manufacturing and information sectors have had a strong correlation to oil prices since January of 2012. Manufacturing, with a 10-month lag, has a correlation of 0.54 and Information, with a 1-month lag, has a correlation of 0.65. However, this is an example of how “correlation does not equal causation” as these happen to be the only two industries with negative correlations to oil price since 1990.

Lastly, this study shows that it is highly likely that in Oklahoma sectors outside of mining are strongly impacted by the price of oil. However, further research will need to be done to determine if this correlation is actually due to shifts in oil price or due to the fact that oil prices have been steadily increasing since 1990, as have the employment in each of the sectors with a positive correlation that were studied.

Sources:

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