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BIG OIL IN A SMALL TOWN: THE EFFECTS OF A LARGE ECONOMIC EVENT ON SMALL BUSINESS SALES

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ABSTRACT

The purpose of this research is to determine whether a relationship exists between the sales of small businesses when a large economic event occurs in the area. The sales examined were those of a small auto parts store located within in the Bakken Shale Formation during the rise and fall of the Bakken Oil Boom. In order to observe a relationship, data from the business's sales was gathered along with historical oil prices and oil production in the region. Through the use of two-tailed statistical testing comparing sales to oil price and again to oil production, the differences between two means with dependent samples were observed. Both tests found that the oil production and price were indeed driving factors that affected the sales of the small business causing the sales trends to follow the same patterns as those found in the oil production and price amounts. These same tests can be applied to other businesses in the region to determine whether or not oil had a large effect on their sales figures as well.

JEL: M41, C12, C3, Q31

KEYWORDS: Sales Revenue, Oil Price, Oil Production, Bakken Oil Boom, Statistical Testing, Regression Analysis

INTRODUCTION

Years ago, stretching along the eastern Montana-western North Dakota border lay a huge source of untapped potential now known as the Bakken Shale Formation. The first successful well began producing in 1953, however, the shale formation posed a problem for the common practice of vertical drilling. Because of the way the layer of sandstone and dolomite, the layer from which oil is extracted, was sandwiched between two layers of shale rock, vertical drilling proved to be an extremely difficult way to extract the oil. It was not until 2008 that oil production began to really flourish because of the combination of hydraulic fracturing (fracking) and horizontal drilling processes ("First North Dakota oil well," n.d.). Thus, began the Bakken Oil Boom.

Oil production immediately took off. The area which had been producing, on average, about 33,000 barrels a day at the end of 2007 was pushing upwards of 100,000 barrels a day by the close of 2008 ("ND monthly Bakken oil production statistics," n.d.). Of course, this boom created huge opportunities for oil companies as well as the average American worker. With all the new oil production came a high need for employees and people from all over the country flocked to the region for their share of good fortune. However, all good things must come to an end. The end of 2014 saw the peak of the boom and it has been slowly decreasing ever since. Where once the oil price maxed out at over one hundred dollars a barrel, in 2016 the price has yet to reach even fifty dollars a barrel, and has even dropped to as low as thirty-three dollars a barrel ("Crude oil historical prices," n.d.).

Obviously, the rise and fall of the Bakken oil industry had major effects on the price of oil, but what about those businesses in the area not directly associated with the boom? According to some articles, they were negatively impacted when employees quit their jobs to strike it rich working out in the oil fields, but with the large influx of people coming into the area, were sales affected? After analyzing the data of a small auto parts store located in a small town within the Bakken (for confidentiality purposes, we will call this town xyz), a noticeable trend could be seen in monthly sales. From 2009 to 2016 a distinct increase, peak, and decrease in sales was present, creating a "hill" effect. The obvious question was, what is the explanation for this? And the possible answer could be the Bakken Oil Boom.

The purpose of this study was to examine possible factors that impacted this sales trend. The oil was such a huge part of the economy, it basically defined the region. Was it able to infiltrate small-town business revenues as well? If this is one of the driving factors for a small auto parts store, the oil economy may serve as an explanation for other businesses who might have seen a similar trend in their sales. With this information, these businesses could then plan accordingly and forecast what sales might look like in the future.

In this paper, we first present the literature review, then the data and methodology, the results and finally the conclusion.

LITERATURE REVIEW

Crude oil production has become more and more important as an indicator to measure the economic activity worldwide. Galayini (2011) and Jimenez-Rodríguez & Sanchez (2004) investigated the relationship between oil price and economic growth on a macro-level. While the research of Jimenez-Rodríguez & Sanchez (2004) showed that there is a direct relationship between oil price and economic growth, Galayini (2011) in her research couldn't confirm this finding.

In another research, Idemudia (2009) analyzed Nigeria's Niger Delta case on the relationship between oil extraction and poverty reduction of local communities. He found that oil and gas companies' initiative to develop local communities have the potential to reduce the local poverty and thus develop the economy. However, the empirical study found that those companies' initiatives have limited impact on the local economies.

Cavalcanti et al. (2016) studied the impact of oil extraction on Growth in Brazil. In their research, the author found a positive impact of oil field discoveries and later production on urbanization as well as an increase in GDP for services, companies size and GDP for services output per worker. However, this study applies only to Brazil and has limited application in the US.

Loe and Kelman (2016), in their research on the Artic (Hammerfest, Norway) petroleum's community impacts, realized a single-case study. They interviewed twelve males and six females from the local community (Hammerfest, Norway). The interview focused on four themes. From the discussions with the interviewees, they found that they were differences in the way that the population perceives the effect of oil and gas industry and the responsibilities of oil and gas companies. Moreover, the authors found that the population is in alignment with Friedman (1970) original vision that considers companies contributions (in this case oil and gas) to create and maintain jobs and general welfare is adequate as their responsibilities to society.

Later development of Friedman's original view of corporate social reasonability suggests that companies are expected to contribute actively to society's well-being, and protection of the environment (for example Aguinis (2012), Brammer (2012), and Piercy (2011)) are not reflected in the views of the local population.

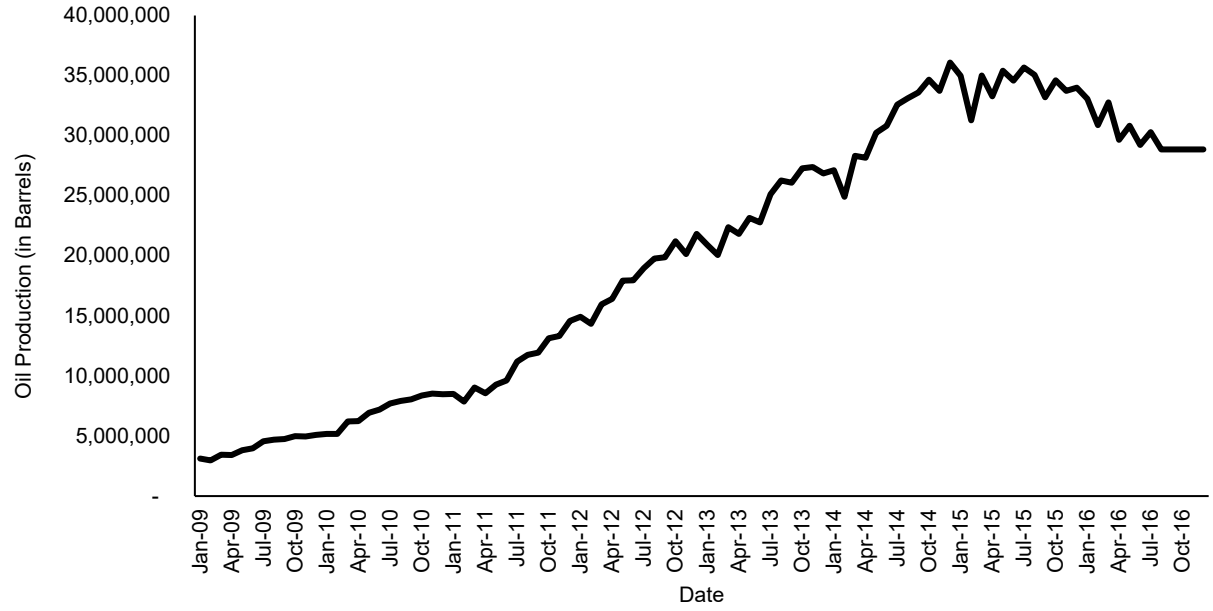
The results help in the filling of missing parts of the gap that was described by Sovacool (2014). In those parts, researchers speculate what energy policy is important compared to what policymakers and communities think while also comparing it to the reality. Business people, authorities, and others were interviewed in Hammerfest. Their perspective, needs, and interests are different from non-locals. Their advice and recommendations on how the petroleum sector should work are also different. Although their opinions are different from the experts, it does not mean that they are indifferent about the risks of development of Arctic petroleum. Their priorities are different. Taking in consideration different views is important in understanding the full picture of the Arctic petroleum debate.

Various articles give an estimated timeline of the rise and fall of the Bakken Oil Boom. Articles from the American Oil & Gas Historical Society (n.d.), the New York Times (Davey, 2008), and Reuters (Scheyder, 2016) all agree the boom really took off between 2007 and 2008. This all had to do with combining the practices of horizontal drilling and hydraulic fracking. The previous standard of vertical drilling was not nearly as effective as this new practice and the 3 to 4.3 billion barrels of oil estimated to be available in the Bakken Formation by a U.S. Geological Survey was now able to be extracted.

Oil production was on the rise and the boom kept growing. That is, until oil prices peaked in 2014 and suddenly began dropping. According to an article from the Federal Reserve Bank of Minneapolis, the price of oil rose to about $105 in June of 2014, then dropped drastically. By December of 2014, the oil price was down to about $53 a barrel (Crude oil historical prices). Production has also steadily been slowing down since 2014. Monthly Bakken oil production was at its summit in December 2014 at approximately 36 million barrels. Most recently reported, production is down to about 30 million barrels in July of 2016.

North Dakota's Department of Mineral Resources provides historical amounts of monthly oil production as seen in Figure 1. A noticeable hill can be seen showing the rise, crest, and fall of oil production, a similar pattern to that of the auto parts store's monthly sales.

Figure 1: Monthly Oil Production in the Bakken



This figure shows the progression of Bakken oil production over time.

Because of this boom in oil activity, an influx of people flocked to the area looking to make a fortune, and because production was so high, the number of oil jobs that opened up were looking to be filled. The Federal Reserve Bank of Minneapolis states there were about 110,000 jobs in the Bakken region at the end of 2014, the peak of the boom (Grunewald, 2016).

Census data of xyz alone portrays an upward trend in the population rising from about 4,700 people in 2007 to about 6,500 in 2014 ("xyz demographics", n.d.). A Forbes article states multiple other cities have experienced economic booms and busts over the years such as Pittsburgh with its steel production. Because of the drastic change in an exchangeable good, like oil, population grows and other industries are affected as well, such as retail stores (Millsap, 2016).

Furthermore, according to research done by professors at the University of Georgia and Oklahoma State University, the extraction of oil is directly linked to the increase or decrease of employment and income. The local economy will see "spillover effects" that the oil industry creates and local businesses will be able to see a positive, strong correlation between high sales and economic boom, as well as a strong, positive correlation between lowering sales and economic bust (Munasib & Rickman, 2014).

A similar event occurred in the same region during the 1980s: an oil boom and bust. Businesses all over the Bakken were hit with an increased demand for goods and services when oil came to town. Wages across all sectors increased as did employment opportunities, and region population according to an article from the Economic Journal (Jacobsen & Parker, 2014). Then, once the boom was over, businesses saw their profits declining back to what they once were as if the boom had never occurred.

Taking all of this into consideration, the next step was to answer the question: is there a relationship between the sales of an auto parts store and oil production and price?

This paper proceeds as follows. Section 2 presents a brief overview of literature. Section 3 presents database and methodology. Section 4 presents results. Section 5 concludes.

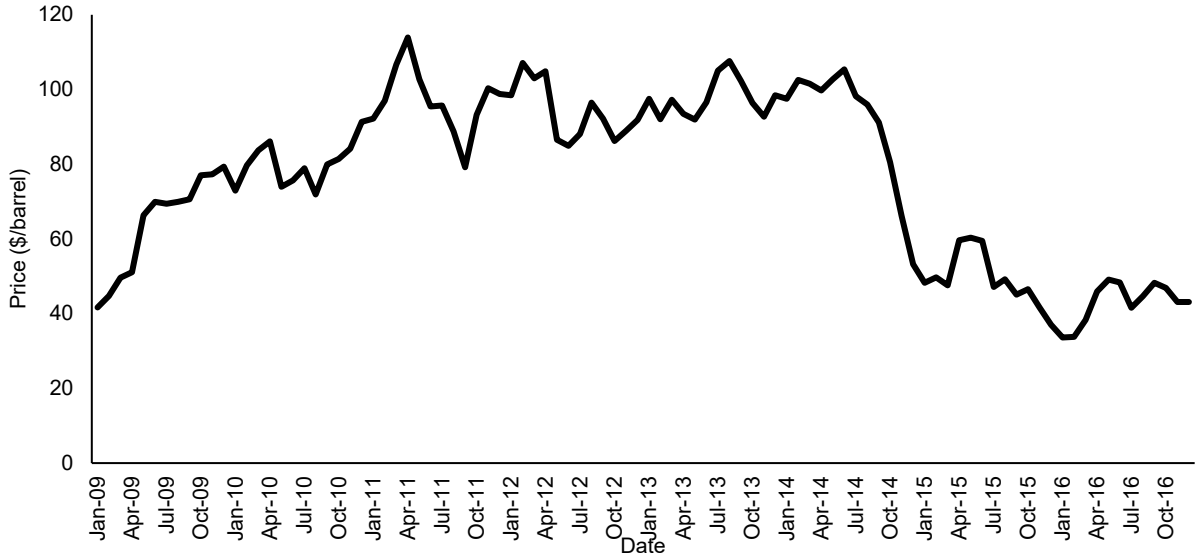
DATA AND METHODOLOGY

For the business in question, some sales information simply was not possible to obtain. Although it has been established that the oil boom took off sometime between 2007 and 2008, the data from those two years was not readily available and unable to be included in the analysis. Furthermore, the study only includes information seen at an auto parts store in xyz. Sales revenues from businesses of other industries or other towns within the Bakken region were not able to be examined. In fact, we couldn't have access to other businesses data.

This analysis relies on the use of a sample of an auto parts business's monthly sales dating back to January of 2009 to July 2016. Furthermore, the amounts of monthly oil production from the Bakken and the fluctuating oil price for the same period were able to be obtained as well. With this information, statistical testing was utilized based on the large sample sizes. Hypothesis testing was conducted with dependent samples to compare the difference between two means of two populations: sales with the Bakken oil production and then sales with oil price.

The first step of this research analysis was to gather relevant data. Since it is to be proven that oil production and oil price drive the sales of a small business, those numbers have been obtained and graphed. As already seen, the oil production can be found in Figure 1, and the oil price and the business's sales can be seen in Figures 2 and 3 respectively.

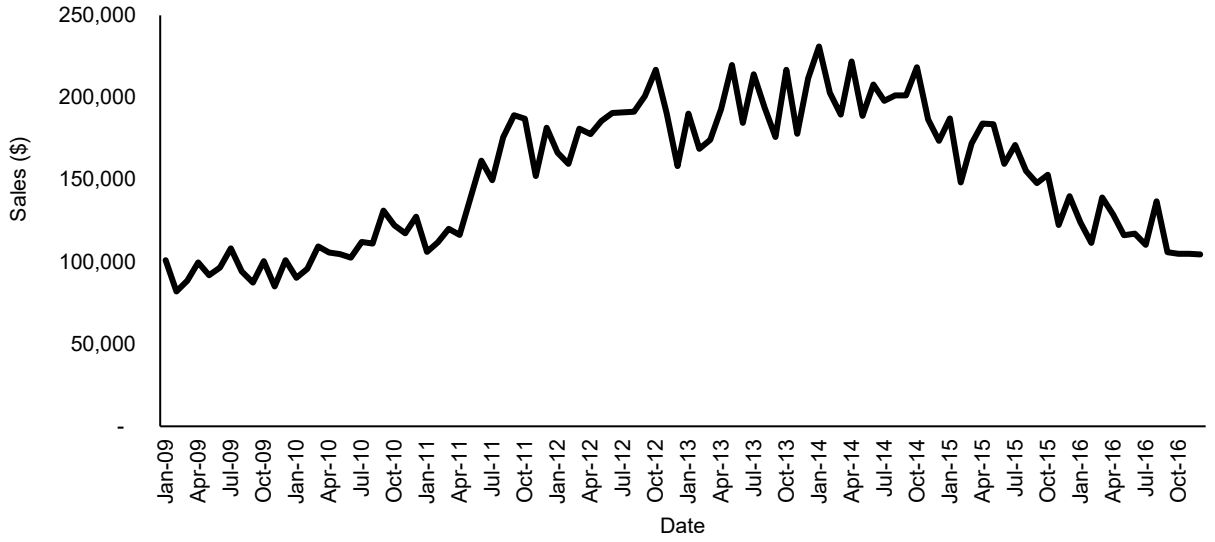
Figure 2: Monthly Oil Price in the Bakken



This figure shows the over-time progression of oil prices.

As it can be seen in all three graphs, there is a definite rise, peak or plateau, and subsequent decline all occurring throughout the same time period. Oil price, production, and businesses sales were all on the rise until 2014 hit. Around that time the three populations see a decrease. From here, correlation coefficients were calculated between sales with production and sales with oil price. The term found between sales and production came out to be an extremely strong, positive correlation of 0.6108 and the correlation between sales and oil price was not as high, yet still came out to be a strong number of 0.4522. Although correlation does not necessarily imply causation, this serves as a basis for thinking the oil boom had such a large impact on not only its own economic sector, but others like the auto parts company's as well.

Figure 3: Monthly Sales Revenue



This figure shows the over-time progression of sales revenue.

The empirical validation of the relationship between sales, oil price, and oil production requires the measurement of the relationship between Y value or monthly sales of xyz and the two variables (X_1 and X_2) intended to reflect the oil price and the oil production:

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \varepsilon \quad (1)$$

Where:

Y: represents the monthly sales of xyz;
X_1: represents the oil price;
X_2: represents the oil production;
ε: represents the error term.

Our model can be written as follows:

$$sales = \alpha_0 + \alpha_1 oprice + oprod \quad (2)$$

The coefficient of correlation (R^2) is used to assess the intensity of the relationship between the sales and the oil price and production.

RESULTS

The next step was to actually look for causation through the use of statistical testing. First, because the sample sizes are so large, through the Central Limit Theorem, it is assumed the populations follow a normal distribution. Additionally, the amount of alpha was set at 0.05 for both tests. The null hypothesis states the auto parts company's sales are not dependent on oil price or oil production and the alternative states that those sales are dependent on oil price and production. This is determined to be a two-tailed test. Regarding all three variables, it has also been determined that the tests conducted must compare the differences between two means with dependent samples. Dependent samples are those in which observations from one sample, in this case oil production with sales and oil price with sales, can be matched, or paired up with, specific observations from the other sample. For this study, each amount of monthly oil price and oil price correspond with the monthly sales of the business.

For our analysis, we define sales as the monthly sales for xyz, oprice as the average monthly oil price per barrel and oprod as the monthly oil production in the Bakken region. Table 1 present the descriptive statistics for our variables (mean, standard deviation and number of cases) and the correlation between the variables.

Table 1: Descriptive Statistics for Variables of the Study

	Sales	**oprice (Oil Price)**	**oprod (Oil Production)**
Mean	151,474	77.021	19.991 (millions)
Standard Deviation	81,844	22.704	11.138 (millions)
Observations	96	96	96
Correlation			
sales	1		
oprice	0.4889	1	
oprod	0.5408	-0.2902	1

This table shows the mean, standard deviation, number of cases of the variables used in the study. It also shows the correlation between the variables.

Table 2 shows the paired two sample t-test for means for sales and oprice variables and the sales and oprod variables. The results for the paired two sample t-test for means for sales and oprice shows that the t-stat is equal to 35.4593 and the P(T<=t) is equal to 0, which leads us to reject the null hypothesis and conclude that company sales are dependent on oil price. In the same way, the results for the paired two sample t-test for means for sales and oprod shows that the t-stat is equal to -17.4878 and the P(T<=t) is equal to 0, which leads us to reject the null hypothesis and conclude that company sales are dependent on oil production in the Bakken region.

Table 2: Paired Two Samples T-Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1: sales - oprice	151,397	41,833	4,270	142,921	159,874	35.459	99	0.000***
Pair 2: sales - oprod	-19,839,686	11,115,677	1,134,489	-22,091,931	-17,587,440	-17.488	99	0.000***

*This table shows results of paired two-sample t-tests where ***, **, * indicate significance at the 1, 5 and 10 percent levels respectively.*

The results presented in Table 3 show that the variables included in the model, explain the monthly sales at 74.25% (adjusted R^2). This is a good value for a regression performed on a number of observations of 96 (96 months over 8 years).

Table 3: Regression Results of Sales to Oil Price and Oil Production

Model 1	Unstandardized Coefficients B	Standardized Coefficients Std. Error	Beta	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
						Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	-4,619	9,968		-0.463	0.644	-24,413	15,174					
Production (barrels)	0.003	0.000	0.745	13.701	0.000***	0.002	0.003	0.541	0.818	0.713	0.916	1.092
Oil Price	1,300	100.27	0.705	12.963	0.000***	1,101	1,499	0.489	0.802	0.675	0.916	1.092

This table shows regression results for the estimated equation $sales = \alpha_0 + \alpha_1 oprice + oprod.$ ****, **, * indicate significance at the 1,5 and 10 percent levels respectively.*

The percentage of the adjusted R^2 (74.25%) is significantly different from zero, which proves the existence of a relationship between sales, oil price, and oil production. Moreover, all the empirical studies in this direction proved the existence of a correlation between these variables (sales with oil price and sales with oil production). The coefficients of the independent variables are positive and significant at 1% which reinforce our previous conclusion that company sales are dependent on oil price and company sales are dependent on oil production in the Bakken region.

CONCLUSION

The purpose of this study was to examine possible factors that impacted this sales trend. The oil was such a huge part of the economy, it basically defined the region. Was it able to infiltrate small-town business revenues as well? If this is one of the driving factors for a small auto parts store, the oil economy may serve as an explanation for other businesses who might have seen a similar trend in their sales. With this information, these businesses could then plan accordingly and forecast what sales might look like in the future.

This study proved large economic changes can, and do, have an effect on business not directly related to the economic change. In both tests, the null, stating the oil boom was not a direct cause of the upside-down

U trend observed in the auto parts company's sales data, was able to be rejected. Observing similar trends from three sets of data as well as engaging in statistical testing and regression analysis were able to solidify the notion that oil in the Bakken did not just create opportunities in the oil and energy economic sectors. The "spillover" effect took place and businesses can use this information to explain any strange trends they may find in their own sales. Depending on the region and time period, the sales may not be dependent on oil in particular, but knowing that an economic change may be the cause is a good place to start.

Our analysis shows that, in our case, company sales are dependent on oil price and company sales are dependent on oil production in the Bakken region. Businesses within the eastern Montana-western North Dakota area may be able to follow the same procedures to analyze their own data and find similar results. Can a large economic development in one industry act as a driving force for the amount of revenue collected by small businesses across multiple industries? And, if so, those businesses can then prepare themselves for the next boom or bust.

Like any research our study has limitations. The first limitation is that the findings are based one case and not a panel data. The second limitation is related to the data period. We couldn't obtain the sales revenue before 2009. We think that if we had access to earlier sales data, such as 2005, our finding could be different. Finally, the third limitation is that we looked only at the sales generated by the oil boom in the Bakken region and we ignored all the environmental impact that may have created.

This study can be a start for future research. In fact, using the information found through observation and testing, some businesses may be able to use advanced statistical analysis to forecast future trends and plan accordingly for a boom, bust, or even just normal economic growth. Furthermore, other studied may focus not only on the direct monetary impact (sales, income, etc.) but also on the environmental and ecological impact

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NOTE

The authors list is ordered by last name.

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