

AMERICAN UNIVERSITY OF BEIRUT

THE IMPACT OF SHALE OIL AND GAS PRODUCTION ON
THE TEXAS HOUSING MARKET

by
JOHN SNIDER

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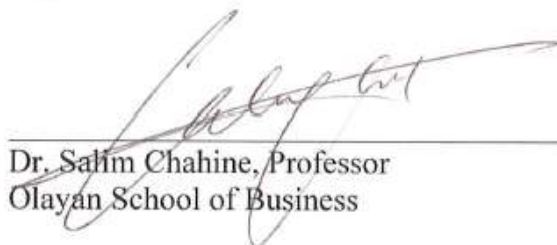
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Approved by:



Dr. Salim Chahine, Professor
Olayan School of Business
First Reader



Dr. Yusuf Sidani, Professor
Olayan School of Business
Second Reader

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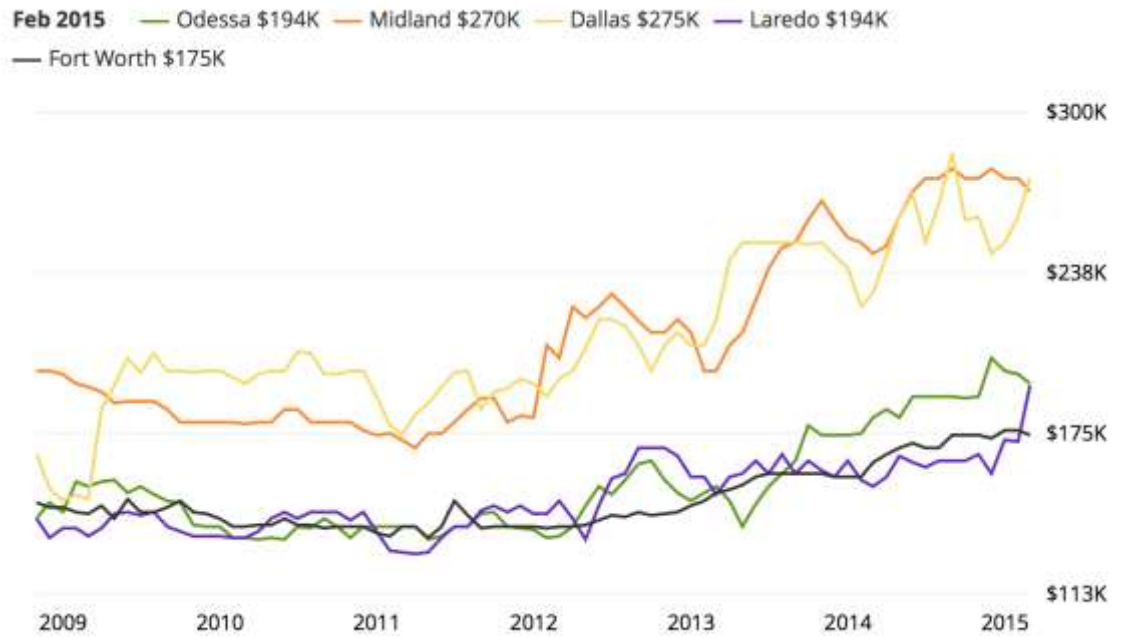
Recent technology advancements in horizontal drilling and hydraulic fracking has caused a gas and oil boom in parts of Texas and elsewhere in the United States. While such a boom has led some to believe in possible energy independence in North America by 2020, the overall result of drilling has many factors. Previous research suggests there can be positive and negative effects on the economy and environment due to shale production. Housing prices are also affected in positive and negative ways near areas where drilling takes place. This paper proposes to present the results of studying the effects of shale oil and gas production on the Texas housing market through the observation of price increases or decreases in areas proximate to shale production. I propose to discuss my hypothesis that homes within 1mi of drilling experience slight decreases in price, especially those relying on private water supply. However, homes 1mi+ experience price appreciation due to boom town effects and increases in jobs and income.

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Graph 1:



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Table 1:

Average Sales Price Per City								
<u>City</u>	<u>Shale Play</u>	<u>Jan 2010</u>	<u>Jan 2011</u>	<u>Jan 2012</u>	<u>Jan 2013</u>	<u>Jan 2014</u>	<u>Jan 2015</u>	<u>% Increase</u>
Odessa	Permian Basin	\$135,000	\$139,000	\$135,000	\$152,000	\$175,000	\$199,000	47.41%
Midland	Permian Basin	\$179,000	\$176,000	\$210,000	\$200,000	\$249,000	\$275,000	53.63%
Dallas	Barnett Shale	\$197,000	\$179,000	\$189,000	\$210,000	\$225,000	\$259,000	31.47%
Fort Worth	Barnett Shale	\$139,000	\$135,000	\$139,000	\$149,000	\$159,000	\$177,000	27.34%
Laredo	Eagle Ford	\$135,000	\$130,000	\$144,000	\$159,000	\$157,000	\$172,000	27.41%
Texas Average	N/A	\$132,000	\$130,000	\$129,000	\$132,000	\$139,000	\$141,000	6.82%

CHAPTER I

INTRODUCTION

For decades, shale formations have been a prized commodity, a source of natural gas often unable to be easily extracted, requiring the need to explore off shore pockets. In recent years however, the increased awareness of new technology like the use of horizontal drilling and hydraulic fracking has made once untouchable sources of shale gas a “new” booming industrial profit. For the purposes of this paper, we are specifically looking at the three major shale plays found in Texas: Permian Basin, Eagle Ford and Barnett. The Permian Basin represents the largest oil field in North America. Midland and Odessa are located in the Permian Basin. Barnett Shale is located underneath and to the west of Ft Worth and Dallas. Eagle Ford is mostly rural, but Laredo would be considered the closest city. These shale plays have subsurface shale, which in Eagle Ford in 2008 created the need for the first use of hydraulic fracking for its extraction. So, while in the past shale drilling was considered too high of an investment to be proven economically advantageous, researchers are now seeing the possibilities a large source of natural gas could afford our economy and environment for decades to come.

In an era that has been awakened to our environmental impact, for some, shale mining is becoming the hope for future energy. Researchers are recognizing the

correlation between shale production and the “boom town” effect, which includes effects on the real estate market, economic development, and community impact. With the ability to explore more natural gas deposits within the U.S., some believe we are more also likely to see in the future, “energy independence and a clean future because of its domestic sourcing and, compared with coal and petroleum derivatives, its smaller carbon footprint.”¹ This means that shale gas and oil production long-term could produce a self-sufficient U.S. and dramatically effect several areas of our daily living on a micro and macro-level. As we will also see in our collected data, while it is clear that many factors contribute to increased house prices, including potential energy independence long-term as one, the shale production only increased the housing value even more. However, though shale mining may have short term positive effects, this paper will also be examining the negative long-term effects on the environment and the house prices specifically on houses within a close radius to the mines.

¹ 1 Muehlenbachs, Spiller and Timmins. “The Housing Market Impacts of Shale Gas Development.” 2014

CHAPTER II

PREVIOUS LITERATURE/RESEARCH

In order to understand the extent of shale oil and gas production on the Texas housing market prices, we must first have a basic knowledge of the terms that will be used in this discussion. Shale formations are typically considered unconventional gases because of the difficulty of extraction, having been found so far below the surface. As mentioned in the introduction, due to the difficulty of its extraction, for decades the industry believed that off-shore exploration was the only way to obtain the gas and oil our economy needed.

However, in the Barnett plays of Texas, hydraulic fracking was first discovered as a viable method of extraction. Hydraulic fracking is a process meant to create space for shale gas to be released. This release of shale gas is created by, “fracturing shale and releasing natural gas to the surface uses large volumes of water, often between 2 million and 8 million gallons per well, mixed with additional chemicals”² It is these chemicals, put under pressure, that create pockets of space for the gas to escape and be collected. Often fracking drills go into already existing holes in the ground and expands them to allow more gas lower beneath the surface to escape. This partnered with horizontal

² 2 Gopalakrishnan and Klaiber. “Is the Shale Boom a Bust for Nearby Residents?” 2012

drilling, where drills break up thick shale formations through a different angle of the drill, is what makes shale production viable today.

Once the process of collection of gas and oil is clarified, it is easy to see the amount of labor that goes into the industry, and thus the positive effect such oil and gas production may have on the job market. Not only will the use of machinery naturally cause a need for workers but also, “the speed of this exploration will likely be driven by the price of natural gas [currently \$4.04 per million British Thermal Unit}]”³. This means that there will also be a natural increase in profit on shale gas and oil due to its more positive effects on greenhouse emissions. Natural gas through shale then quickly becomes more desirable because of both how it is domestically distributed as well as it having a smaller carbon footprint than other sources. The presence/ ability of extraction, and at such a fast rate, will increase the need for permanent structures to transport the oil and gas. This would require the constant presence of pipes, lines, roads to extraction sites, and other means to accomplish the process of extraction. In short, tax revenue would have to be taken to provide the money for such necessary infrastructures.

Another benefit of extraction would be the boom- town effect where “local areas facing shale development see increases in population, employment, business activity, and government revenues”⁴. The influx in shale oil and gas production would

³ Throupe and Simons. “A Review of Hydro “Fracking” and it’s Potential Effects on Real Estate.” 2013

⁴ Muehlenbachs, Spiller and Timmins. “The Housing Market Impacts of Shale Gas Development.” 2014

draw workers in to collect it and thus effect the population, employment, and business transactions in healthy ways. Also, having natural gas become more prominent in the industry would allow more governmental tax and revenue as the extractions become more popular and the demand for the benefits shale produces also increase. Along with these benefits, workers who were completing jobs within the process that required more skill, would be more likely to see wage increases. The idea of energy independence also has more ground to stand on when we see that “increased the value of oil and gas trapped in shale formations, provid[ed] local institutions in some states with property tax windfalls”⁵. These tax windfalls could allow the government to invest more money into education and community welfare. In order to survive, energy independence not only requires the energy sources to be both local and available, but also energy independence needs to be accepted by the population; making the positive effect of public welfare advances important. At what cost then does hydraulic fracking and horizontal drilling have the potential, with U.S. workers and economic benefits, to produce energy independence?

While hydraulic fracking does create a boom-town effect, what are the results on real estate and the environment? Hydraulic fracking runs the risk of water contamination and other effects on soil and environment. What makes fracking

⁵ Weber, Burnett, Xiarchos. “Shale Gas Development and Housing Values over a Decade: Evidence from Barnett Shale”. 2014

particularly harmful is, “chemicals involved in the shale gas development process, such as the fracking itself, benzene, and methane, may enter the environment through various media.”⁶ This means there can be a negative affect for families who are on well water, or ground water, and are nearby drilling sites. It is unknown how far any leaked fracking chemicals can go, because it is likely to travel through natural water springs deep underground. Another negative effect of fracking is not just the contamination of water, but the actual viability of the presence of water. As Lipscomb suggests, “current water supplies and the water required for shale gas development activities could become a real issue”⁷ . Looking back to our earlier discussion of what fracking is, we note the large range of gallons of water it requires. It is natural then to be concerned that with such a high water need, the residents would be wary about having an adequate water supply. Lipscomb also proposes that “ It is possible that environmentally affected soil correlates to property value diminution, though the impact likely will vary by contaminant, exposure pathways, and quantity.”⁸ This means that the extent to which contamination affects a household depends on the particular contaminants that have leaked into the water and the quantity of water present to transport it through natural springs to wells. Also, an indirect effect of the water purification and water abundance

⁶ Lipscomb, Wang, Kilpatrick. “Unconventional Shale Gas Development and Real Estate Valuation Issues.” 2013

⁷ Lipscomb, Wang, Kilpatrick. “Unconventional Shale Gas Development and Real Estate Valuation Issues.” 2013

⁸ Lipscomb, Wang, Kilpatrick. “Unconventional Shale Gas Development and Real Estate Valuation Issues.” 2013

concerns are the impacts such concerns have on the real estate value of the property using the well.

The question lies then: do the negative effects of hydraulic fracking raise concerns that it makes certain neighborhoods less attractive? While we will continue to parse out these negative and positive effects in our methodology and data section, it is clear that fracking negatively effects residency. Shale production dramatically increases traffic and residential noise. According to Lipscomb’s research, “Rural areas may be affected even more from increased noise impacts due to the already quiet natural surroundings and low background noise levels.” So, for areas like Eagle Ford, which is a hot spot for shale and yet is a ruralized area, it is important to understand the long term risks of being dependent on fracking for future energy independence. By introducing shale extraction in areas like Eagle Ford, you are taking the risk real estate wise of experiencing potential house buyers who go elsewhere or refuse to pay full value due to the sacrifice drilling creates. Another concern is that such fracking will require, “degradation of roads and bridges would require public spending for restoration”⁹. This means that the government will have to budget effectively for negative effects like road damage, air pollution, and the need for space between shale exploration zones and housing. Added to that, tax revenue increases will have to be able

⁹ Weber, Burnett, Xiarchos. “Shale Gas Development and Housing Values over a Decade: Evidence from Barnett Shale”. 2014

to cover the added expense of road construction due to the created need of getting trucks to and from drilling sites with water and other hazardous chemicals.

Though fracking may cause a short-term boom, it will be necessary to be aware and able to combat the long-term pitfalls that are set up for housing prices and residency. These briefly negative effects on neighborhoods and real estates addressed above, will set us for a more in-depth discussion in future sections on the role of distance from the drilling.

A. Our Hypothesis

As mentioned in the abstract, this paper will discuss the association between shale mining and real estate prices. In the following sections I will lay the foundation for the proposed hypothesis that shale mining has a positive affect on real estate prices further than 1mi from the drilling site, but has a negative effect on pricing for properties within 1 mi., as well as, those dependent on well water.

The first section, which will lay the foundation for such association between shale and real estate will discuss previous literature, terms of use, how the shale oil and gas mining process works, and how the research was gathered. Following such crucial foundation will be the methodology, which was used to determine how the hypothesis stands up to the research. This methodology section includes the continued conversation of how the research was gathered and results were compiled as it relates to the shale and real estate association. Section three will be in two parts: first the data

compiled and then the results discussed and concluded. The entire paper will then conclude with a summary and research conclusions.

CHAPTER III

METHODOLOGY

As a VP and Mortgage Banker at Oak Mortgage Group, a small mortgage company headquartered in Dallas, TX, I am aware of the trends between shale production and housing prices. Due to my background, I have access to internal company data and industry data not widely available related to house prices. This data, combined with the Zillow Housing Value Index and Case-Shiller Index allows a thorough observation of house prices proximate to shale developments.

Based on previous research, we proposed to answer these questions: Are house prices influenced by shale oil and gas production? Do the negative effects of hydraulic fracking raise concerns that make certain neighborhoods less attractive? Do positive affects outweigh the negative? While some of these questions are being addressed by our analysis of previous research, more development will be added to the conversation as we look into the data and overall results.

I propose that homes within 1mi of drilling experience slight decreases in price, especially those relying on private water supply. This, as you will see later in the data section, is supported by the Zillow Index graph. However, I propose homes 1mi+ aware from drilling areas experience price appreciation due to boom town effects and increases in jobs and income. In essence then, one can conclude is not whether the shale production or hydraulic fracking is good or bad, as I propose it presents a geographical area with both effects, but whether or not one outweighs the other.

A. 3 Methods: Zillow Home Index Value, Case-Shiller, Hedonic Method

Generally, three data sources are consulted when reviewing the effect shale mining has on real estate prices. These three sources are historically: the Zillow Home Index Value, the Case-Shiller Property Value Index, and the Hedonic Method. For the purpose of this paper, I chose to consult my own company's internal data, Case-Shiller, and Zillow. However, when collecting internal data from my current company, I knew sales were mostly concentrated in Dallas, Waco and Austin. The Case-Shiller Index was also used as an additive to my data as it is a well-known source of pricing data. However, the largest compilation of pricing data that seemed most relevant to our study was the Zillow Housing Value Index (ZHVI) and its vast data collected on home sales in cities that are proximate to current shale production.

I chose to rely more heavily on Zillow than the other two methods because it's, "a hedonically adjusted price index that uses information about properties collected from public records, including sale price and home characteristics."¹⁰ Unlike the Case-Shiller Home Price index, Zillow includes a much more detailed analysis of real-estate factors within the home, ones that are likely to change with each selling period. This makes Zillow the leading source of real estate pricing because it is important to consider

¹⁰ Weber, Burnett, Xiarchos. "Shale Gas Development and Housing Values over a Decade: Evidence from Barnett Shale". 2014

how housing characteristics are likely to change during different selling periods when determining the sustainability of shale mining and its long-term effects on real estate prices. Zillow's data also better avoids bias in its data because it includes an estimate sale price for every home in an area, not just the homes that have previous sell history.

In understanding the value of the data gathered from Zillow, and our secondary data Case-Shiller, the hedonic method must be understood as well. Since 1974 the hedonic pricing method has become an ever growing tool to determine the value or cost of environmental factors in housing prices. The hedonic method, "decomposes the value of a residential property...including property characteristics such as lot size, number of bedrooms and bathrooms, the age of the property".¹¹ Knowing this, it is important to note that by using Zillow we are not excluding the popular hedonic method. Zillow, as mentioned before, is a hedonically adjusted index, meaning it considers the environmental factors that influence real estate and thus has been an element in the discussion on real estate value for decades. The benefit of using ZHVI instead of just the Hedonic Method or Case-Shiller method alone, is that those methods usually required you to pay for data—limiting one's research to their pocketbook. However, the data found on Zillow is a public data base and is free to use. Before Zillow, researchers were compiling data on their own and because of that method there was a much higher risk of bias. Now however, ZHVI is a one-stop database that has one calculated focus:

¹¹ Gopalakrishnan and Klaiber. "Is the Shale Boom a Bust for Nearby Residents?" 2012

how certain characteristics effect real estate pricing, one of those characteristics in our case being environmental shale drilling.

CHAPTER IV

DATA

As you can see from Table 1, the areas of shale production has had a positive increase on housing prices particularly from 2013-2015. Some may ask, were the housing prices just naturally appreciating on a macro level due to low interest rates and a stronger general economy? Yes, the table shows the average sales price in the state of Texas appreciated by 6.82% between 2010-2015. However, the cities located near active shale plays appreciated to a much stronger degree, over 3x more than the state-wide average. This table also supports Weber's research of consistent growth in nearby cities where shale was found. According to Weber's research, "By 2013, shale zip codes retained a roughly five percent advantage in housing values."¹² This data gathered from highly populated cities more than 1 mile away from drilling, shows that the "boom town" effect could have influenced the demand for housing in the area and thus contributed to housing prices. It is also important to note that with the tax base change that occurs when shale production occurs in a city, "Appreciation closely followed changes in the oil and gas property tax base, with each \$1 per student increase in tax

¹² Weber, Burnett, Xiarchos. "Shale Gas Development and Housing Values over a Decade: Evidence from Barnett Shale". 2014

base causing a \$0.43 increase in the value of the typical home.”¹³ This means that another factor that influences the housing price increase is the fact that the natural gas industry created a lower income tax and can funnel that money into public arenas like education. When the value of the community welfare increases there is likely an increase for families to populate the area and thus benefit from the boom-town effect and keep the housing market steady and profitable. Another benefit to consider is “direct income to large landowners who have leased land to the oil and gas companies.”¹⁴ If homeowners were leasing land to gas and oil companies, not only would families benefit, but the property value for the land which contains shale would also increase. So the boom-town affect has both micro-level and macro-level benefits if it is able to be sustained long-term.

According to the first table, as well as illustration 1, each city experienced at least 27% price appreciation from 2010 to 2015. It is difficult to determine how much of that increase is due solely to shale oil and gas production. In addition, it is difficult to compile data that shows how proximate these homes are to the actual wells. This means that in our discussion we must take into account that harmful effects of shale production hit areas more dependent on well water. Take Midland for example, where it’s common that their city water comes from underwater springs. If chemicals in fracking were

¹³ Weber, Burnett, Xiarchos. “Shale Gas Development and Housing Values over a Decade: Evidence from Barnett Shale”. 2011

¹⁴ Gopalakrishnan and Klaiber. “Is the Shale Boom a Bust for Nearby Residents?” 2012

funneled and distributed to the city through contaminated underground water sources, illness and destruction of resources, like crops that are dependent on clean water, would occur. It also isn't uncommon This also brings up the question of natural disasters. What would occur if something like an earthquake hit an area of fracking? Logically speaking, a crack in the earth could cause a quicker spread of contamination.

Also on the opposing end of direct family income, those properties bought on drilled land that also use well water, experience negative effects of property value short-term. Gopalakrishnan and Klaiber's research suggests, "households relying on wellwater...within 0.75 miles of an active well site for which the drilling permit was acquired within 6 months experience a decrease in home values of 21.7%."¹⁵ This affirms the conclusion that living within a mile of an active site would have a negative effect on housing prices, particularly in Texas where it is typical to use well water. So how feasible is it really to propose energy independence by 2020, when the population and residency may be so adversely affected by the fracking that drilling may cease?

A. How the Data Affects the Proposed Model

By pulling zip codes around the shale mining sites, we can clearly show the price difference and determine in what zip codes fracking could be beneficial, whether within 1 mi. of the drill site or further out. This graph and table provide us with clear

¹⁵ Gopalakrishnan and Klaiber. "Is the Shale Boom a Bust for Nearby Residents?" 2012

and testable data in which to compare real estate pricing and proximity to shale.

Looking at this collected data in both zip codes within a mile of the site and further out, we see that price appreciation occurs regardless of the real estate's proximity to the drill site.

This does not however prove the proposed correlation hypothesis that within 1 mi. of shale production real estate depreciations, and further than 1 mi. it appreciates, entirely false. This is because though I expected to see prices flatline or decrease in areas closer to the mining, I suspect in the future those who attempt to sell their homes closer to the sites will see less demand. I have come to this conclusion, because as was mentioned earlier in the previous research, many factors can affect housing prices and one great factor that can't be tracked or predicted in this data is unforeseeable environmental changes. If things like earthquakes happen near these sites, being energy independent in 2020 may no longer even be an option because of the vast land typography changes. My real-estate knowledge coupled with previous research that resulted in "... properties [being] adversely affected by proximate gas exploration sites/wells and that this [positive] effect dissipates with time and distance"¹⁶ backs up my hypothesis that the price appreciation could shift to depreciation over time because of less real estate demand. While the presented table and graph contained in this paper

¹⁶ Lipscomb, Wang, Kilpatrick. "Unconventional Shale Gas Development and Real Estate Valuation Issues." 2013

show consistent appreciation, rather than the depreciation or flatline expected, Lipscomb's research proves my conclusion about association. His research, taken over a longer period of time, showed that the real estate dependent on well water, and close to the shale sites, were negatively effected.

CHAPTER V

RESULTS

After extensive examination into the history of shale gas and oil, as well as the current effects it has on real estate housing prices how do our initial questions fare? It is clear that housing prices are effected by shale production. It is very important to note that the extent of that affect is a direct result of location. If you are looking at housing prices within a mile of the active site, and even more so if you are examining a rural area of Texas where well water is commonly used, you will see a negative effect long-term. In terms of real estate sells, you will be fighting against a lower property value as soon as a drilling agreement is signed. This answers the negative effects of hydraulic fracking on a neighborhood. As we've seen this is likely because of the environmental and communal effects of the drilling. There is much conversation over the concerns with not being able to ensure clean drinking water, and of course having little control over environmental factors like earthquakes that can increase the spread of affected water if it were present. While it also unknown just how many wells are present in any given area, the common knowledge of well water usage that I have gained in being a Texas resident, makes the concern of contamination a viable threat to individual and environment.

However, if you are looking at how shale effects housing prices positively, you will look at results outside of the 1 mile radius around an active site. These are the results that match the data findings in the graphs above. As you look at the effects shale

has on housing prices there we see the more positive community and welfare benefits of production. This includes the increase need for workers to meet the demands of the fracking process. Jobs like piping, extracting, trucking in materials, building roads, all which are a positive result underneath the boom-town effect. Also, cities away from the exploration experience other positive housing effects, like an increased drive to populate an area due to oil revenues funding schools and other public means.

The final question was do the positive effects outweigh the negative? While it is hard to come up with one clear answer, because the housing market data does not include the house proximity to a well or an active site, it depends on what area of effects of the mining the researcher or interpreter of data finds more important. For the purposes of this paper, and the examination on the housing market, the positive effects for the housing market outside of the radius seem to be consistently beneficial at this point. Whether or not fracking can remain a viable and consistent source of shale production to the extent that it will become, and then remain, the reason for U.S. energy independence will only be determined by time.

A. Summary

In summary, the effect of shale production on housing prices can not be as easily determined as initially hoped, due to the lack of clarity in the data on the proximity of the houses to wells and active exploration sites. However, my initial proposal still stands to the data and previous research, that within homes within 1mi of

drilling there is a slight decrease in price, especially those relying on private water supply. This has been determined true because of two factors. The first factor is that potential homebuyers within a mile of production, would experience interruptions to everyday life because of an increase in noise, road usage, and other daily living disturbances. The second factor that negatively affects housing prices is the environmental factor of water supply. With so much water being taken to sustain the fracking process, along with the potential leakage of chemicals into the soil and natural springs, those on private water supply would experience a much larger negative effect.

However, the second half of my proposal also holds up with the research. The second half of my proposal was that homes 1mi+ experience price appreciation due to boom-town effects and increases in jobs and income. The data section of neighboring major cities supports this. With drilling, came the need for workers and gave surrounding cities the added benefit of extra tax revenue to use on public means. Without the negative effects of water pollution, surrounding cities not on well water, could experience better schools, lower gas prices, and more employment opportunities.

CHAPTER VI

CONCLUSION

While many factors are involved in determining the effects of shale production on housing prices. The research provided here gives a larger understanding of the extent of negative and positive effects shale production has. While in a perfect world energy independence due to on-shore shale production is a possibility because of hydraulic fracking and drilling, its long-term sustainability amidst its negative effects is still to be determined.

Governments will have many battles ahead of them in the pursuit of energy independence when it comes to shale production. First, they will have to insure the residential needs of a consistent supply of clean drinking water in a state where private supplies are more common. In addition, they will also have to be aware of tax revenue spending so that they can allocate funds towards noise reduction and road maintenance near active sites. Then, only if they are able to address the needs of residents near the active sites, they may be able to entice buyers to purchase closer despite lower market values. Of course, all this will have to be addressed while still maintaining the benefits that occur in public welfare and with housing prices outside the close proximity to the active site, and hoping no uncontrollable environmental disaster occurs in the meantime. It's a tall order for shale gas and oil production to meet.

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