FINAL REPORT*

Assessing the Impact of Shale Energy Boom on Ohio Local Housing Markets

By

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March 12, 2013

*We thank the Ohio Housing Finance Administration (OHFA) for partial support in funding the research. The results presented here do not reflect the views of the OHFA. We thank Holly Holtzen at OHFA for her help with this report.

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Executive Summary

This report was commissioned by the Ohio Housing Finance Agency to investigate local housing market effects in Pennsylvania due to the boom in shale gas drilling and extrapolate the findings to the shale gas and oil drilling that is beginning in Ohio. We examine the first five years (inclusive) of Pennsylvania's boom period (2007-2011) and then extrapolate this to what we expect to occur in Ohio during the first five years of its drilling (2012-2016). Because Pennsylvania's drilling region shares many similarities to the rural Eastern Ohio counties that will experience significant drilling, this provides the best guidance into what Ohio should expect in its first few years of shale development.

When shale development is booming, it brings new workers into the area. The housing needs of these workers vary from temporary to permanent. This increase in housing demand is met largely through hotels, apartments, or houses. The strain on the housing market depends on the extent of the shale boom and the community's ability to meet the increased housing demand. The ability of a community to meet housing demand is determined by a number of factors including the level of surplus housing stock and whether significant numbers of workers in-migrate, placing demands on local housing. Shale development in Ohio and neighboring Pennsylvania is mostly occurring in rural counties with low levels of surplus housing stocks to absorb new workers. Additionally, many of the counties involved are part of the Appalachian region which often has more substandard housing compared to a typical rural county. This means that the local area's vacant housing might not be of sufficient quality to house even temporary workers. Many of the counties are also remote. Workers in remote counties are less likely to commute from nearby communities, which would alleviate some of the strain on the housing market.

One of the primary questions facing these communities is whether the adjustment in the housing market will occur through higher housing prices, expansion of new home construction, or a mix of the two effects. With the most pronounced shale boom in the United States, Williston, ND has experienced a significant strain on its housing market. This is because the Williston region has a limited housing stock due to its very sparse population and its remoteness makes commuting challenging. There have also been media reports from Pennsylvania that the surge in shale gas drilling and its accompanying workforce has driven up demand for local housing to the point that market rents have doubled and even tripled. In this report, we quantitatively analyze the correlation of increases in energy employment and shale gas wells drilled in Pennsylvania with several county-based measures of housing availability and affordability listed below. Specifically, we utilize both two-way fixed effects estimators and Difference-in-Difference regression analysis on a panel dataset spanning from 1997-2011 using multiple forms of the dependent and independent variables to gain as much explanatory power as possible. We estimate three model specifications for each dependent variable by including the following variables separately in the model: employment in shale development-related sectors, shale wells drilled during the contemporaneous year, and shale wells drilled during the previous year. In general we find that:

- **Population**: A 1% increase in total employment directly linked to the oil and gas sector is associated with a 0.5% increase in county population. Thus, shale drilling places some population pressures for new housing in counties with high levels of drilling. For comparison, we expect Carroll County, OH to experience a similar shale development pattern as Bradford County, PA, which has seen the highest intensity of shale drilling in Pennsylvania. Our analysis suggests that Bradford County experienced an additional 1.75% population growth due to energy development over the 2007-2011 period.
- **Fair Market Rent**: The Fair Market Rent (FMR) reported by the Department of Housing and Urban Development is positively associated with numbers of shale wells only in the most intensely drilled counties such as Bradford County, PA. Our analysis suggests that Bradford County (for example) experienced about 3.6% higher FMR due to its shale development over the 2007-2011 period. Yet, changes in oil and gas sector employment are not statistically associated with changes in the FMR, supporting the notion that FMR is not greatly affected by this development.
- **Housing Construction Permits**: Increases in total employment linked to oil and gas sector employment are not statistically associated with the number of new residential construction permits, but each new shale gas well drilled is statistically related to more than 2.5 additional housing permits**.** Yet, we take this as evidence that housing construction is positively affected by drilling activity.
- **Median Home Value**: Shale development, as measured by the oil and gas sector employment share of total employment and the number of shale wells drilled, is not statistically linked to median home values as measured by the Census Bureau —possibly because housing starts respond to drilling activity. Yet, our shale employment measure is strongly related to the median home resale price using data provided by the CoreLogic consulting company. Specifically, a one percent increase in direct oil and gas employment is associated with a 0.2-0.4% increase in median resale prices. However, due to data availability problems for the CoreLogic price series, our statistical results using the CoreLogic data should be viewed cautiously.
- **Vacancy Rate**: Shale development had no discernible statistical impact on a county's vacancy rates.

The Pennsylvania Housing Finance Agency approved funding for 25 housing projects in 19 counties totaling $7.6 million to improve availability and affordability of housing in the Marcellus shale region (Pittsburgh Post-Gazette, 2013). There are reports in Ohio that the impact on temporary housing is already evident (Hoover, 2013). Despite this, our data analysis shows that shale development is generally not associated with significant adverse effects on housing affordability and availability. Recent newspaper articles tell a very different story, however. For example, Williamsport, PA in Lycoming County was named one of the top ten housing markets where prices rose during the Great Recession (Stockdale & McIntyre, 2011). *The Daily Review* reported in January 2010 that the average rent in Bradford and Lycoming counties had doubled or tripled (Loewenstein, 2010). The Executive Director of

the Bradford County Progress Authority confirmed via phone interview that for a period of time, the area had indeed experienced steep housing price increases (Anthony Ventello, personal communication, Jan. 30, 2013). There have even been reports of displaced renters sleeping under bridges in Towanda, the county seat of Bradford County (Falcheck, 2012). Nonetheless, expansions in the housing stock due to market forces and construction of hotels may be sufficient to meet the expected housing demand in most counties. This has already started to happen in Bradford and Lycoming counties, where a number of hotels are under construction (Anthony Ventello, personal communication, Jan. 30, 2013).However, the data does show that counties experiencing significant drilling activity such as Bradford, Lycoming and Tioga counties in Pennsylvania did experience more notable housing market effects associated with shale development.

It is important for shale development counties in Ohio to monitor the housing availability and affordability in their communities. This vigilance will be most important in Carroll, Harrison, Jefferson and Columbiana counties in Ohio, which are poised to see the most drilling over the next few years. Carroll (which houses 35% of the current or permitted shale wells in the state) and Harrison counties may be especially vulnerable to the housing impacts of shale development. They are more rural than Bradford and Tioga counties in Pennsylvania (Pennsylvania's most impacted counties) in terms of population, though less remote for commuting purposes (which mitigates housing impacts). Monitoring housing availability and affordability in these counties will help ensure these counties can appropriately respond to housing needs before the strain on the housing market becomes severe. However, housing experiences from Pennsylvania suggest that Ohio will generally not experience significant adverse effects, especially if hotels are constructed and new housing is not constrained through excessive regulations.

Introduction

Recent shale development in the U.S. has raised concerns about the impacts on communities from shale oil and gas extraction. Innovations in hydraulic fracturing and microseismic technology have spurred shale development in the Marcellus and Utica shale regions, which broadly cover Ohio, Pennsylvania, New York, West Virginia, and Virginia, as well as elsewhere in the U.S. The resulting boom in shale oil and gas production has impacted various aspects of these communities, including the environment, public infrastructure, and local economy. Pennsylvania provides an excellent example to predict the impacts of shale development in Ohio as it is further along in the shale development process but is very similar to Ohio in important respects, such as traditional industry structure and the Appalachian nature of the most intense drilling region. It is important for policymakers and residents to have an accurate estimate of the economic impacts on local communities as they weigh these and other benefits against the costs of extraction.

There are many of the costs are associated with the boom and bust nature of resource extraction. Short term costs include increased traffic and road use, as well as additional strain on other public services and utilities directly resulting from drilling. Public services also experience increased pressure from population growth due to oil and gas workers moving into the area. The long term costs are less obvious as they pertain to the 'natural resource curse' caused by the distorting economic effects of the boom.

In Williston, ND, where the national shale boom is most pronounced, the flood of workers into the small and remote region has placed a serious strain on housing availability and cost. The rental price for a two bedroom apartment reportedly rose from $350 to $2,000 (Oldham, 2012)—though Williams County (Williston's) Fair Market Rent as determined by the U.S. Department of Housing and Urban Development only rose by 59% for a single bedroom apartment between 2003 and 2013 (the average national growth in FMR (1-bedroom) over this same period was 34%). Five hotels are in the process of being built in Williston as well as other means of alleviating the strain on housing demand, such as "mancamps" and campgrounds. The increased strain on housing also burdens public services and utilities. Higher rental rates will also affect longtime residents, especially low income households, the elderly, and the disabled. Additionally, rural areas, such as Williston and many of the counties across the Marcellus/Utica shale regions, do not have the surplus housing or development capacity to meet demand. Public policy intervention may be warranted depending on the severity of the problem and the housing market's ability to adapt.

This report examines whether shale gas drilling had measurably impacted housing markets in the Marcellus region of Pennsylvania over the 2007-2011 period. We then extrapolate these effects to form our expectations for Ohio in the 2012-2016 period, assuming development proceeds at a similar pace in Ohio. (i.e., this corresponds to the first five years of shale drilling activity in each state). In what follows, we first describe how drilling activity may affect local housing markets before turning to some background on Marcellus drilling. We then provide some descriptive data showing rents and housing prices in the region, before turning to more in-depth statistical analysis. We conclude with policy analysis and some final thoughts.

As just noted, the bulk of the analysis for this report is statistical in nature, using multiple federal and state data sources. The data was augmented by proprietary private data in some cases. In addition, we interviewed key stakeholders and engaged in an extensive search of media reports about housing in Ohio and Pennsylvania, as well as North Dakota. This qualitative analysis helps inform the interpretation of our statistical analysis and provides context when our analysis deviates from conventional wisdom.

Stages of Shale Development

The impact of shale development on housing is inextricably linked to the stages of oil and gas extraction and employment. The stage of shale development determines the number and type of new workers coming into the area. This in turn drives the shift in housing demand.

The initial stage of shale development involves a significant amount of drilling site selection and land leasing activities before a drill pad can be constructed. Workers filling these roles will often come from elsewhere, although legal, real estate, surveying, and other services may be hired locally. Once the site is selected, it typically takes between 1 to 2 months to prepare the site and construct the drilling pad. Following construction of the drilling pad, there is about 1 month of rig work, which includes drilling the well and encasing it in concrete. Figure 1 shows a well being drilled in Lycoming County, PA. Large quantities of water are either trucked in to the drilling site or siphoned from nearby waterways and stored in large containment ponds for later use in hydraulic fracturing. The hydraulic fracturing process takes just 2 to 5 days to inject a mixture of 1 to 8 million gallons of water, sand and chemicals.[1] This injection fractures the shale, allowing the oil and gas it contains to escape. About half the water comes back up as wastewater and must be stored onsite until it is transported to long-term disposal sites in containment vessels or injection wells. Basic construction and trucking needs may be met by local contractors, but during the initial stages of development, many of the high-skilled drilling crews will come from elsewhere (Kelsey et al., 2011).

[1] Paleontological Research Institute. http://www.museumoftheearth.org/files/marcellus/Marcellus_issue6.pdf

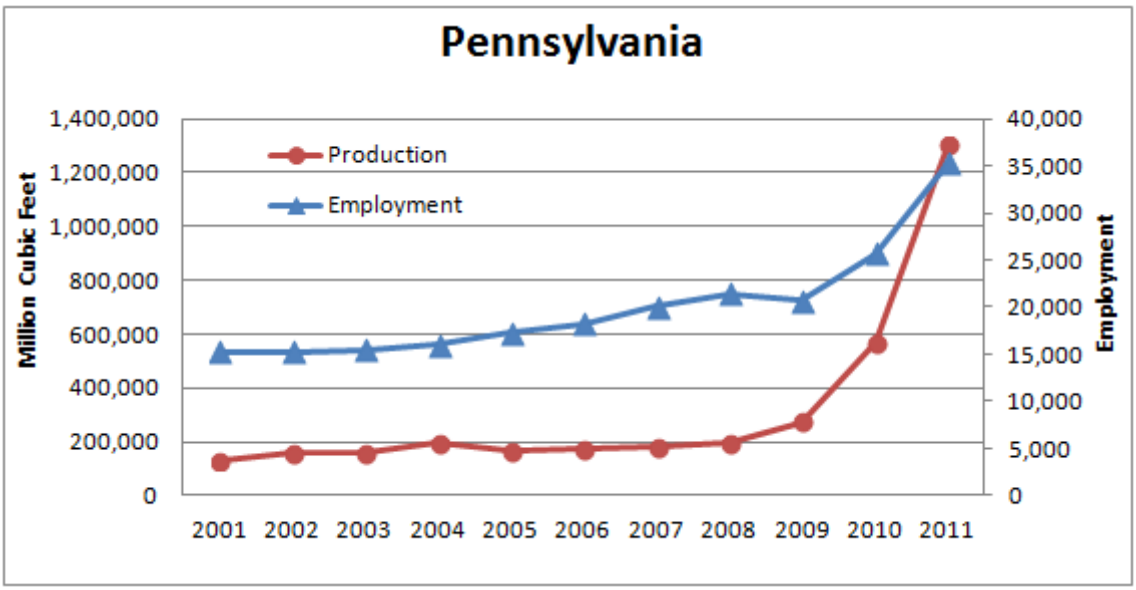
Source: Wikimedia[2]

Figure 1: A Horizontal Drilling Rig in Lycoming, PA

After the fracturing, gathering lines are constructed to feed the gas to compressor stations and metering sites nearby, which are then connected to larger pipelines to bring the gas to market. Although some estimate that a well can continue to flow for up to 30 years, the highest flow rates of natural gas are in the first weeks and decline over time.[3] Once the well has been fractured, its employment needs decline significantly. Thus, the level of shale gas employment is more directly related to the number of recently drilled wells rather than the amount of natural gas extracted. Figures 2 and 3 below illustrate the increase in oil and gas employment in Pennsylvania relative to the number of shale wells drilled and the production of natural gas. For example, Figure 4 shows that 2007 is the beginning of tangible drilling activity in the Pennsylvania Marcellus region. Between 2007 and 2011, Pennsylvania natural gas production increased by over 650%, whereas shale development-related employment only increased about 75%.

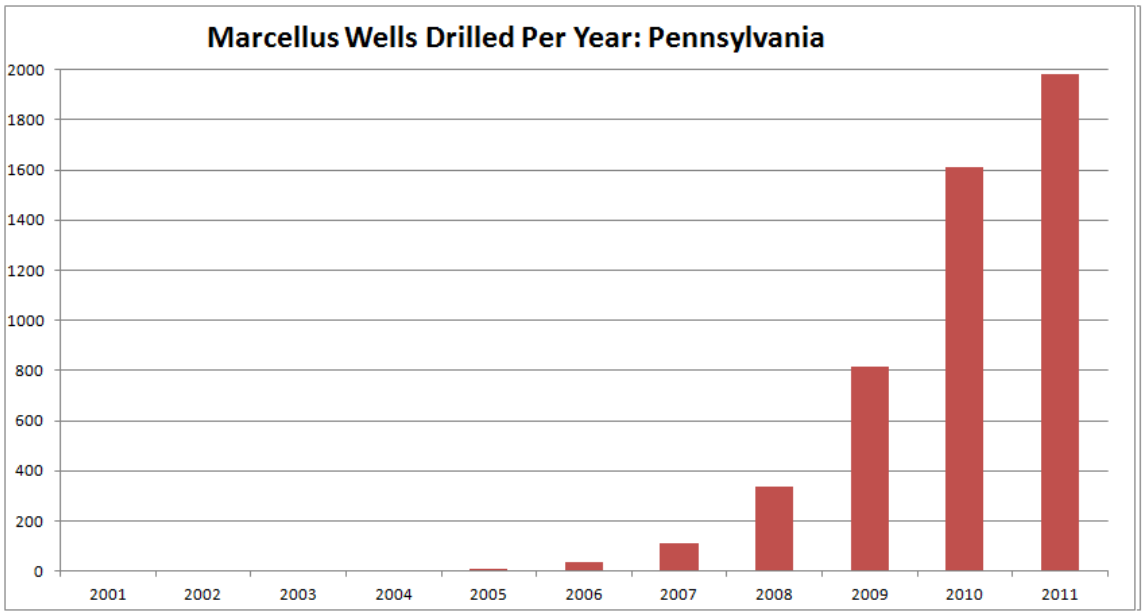
[2] Retrieved 12 Feb. 2013. http://commons.wikimedia.org/wiki/File%3AMarcellus_Shale_Gas_Drilling_Tower_1_crop.jpg

[3] Paleontological Research Institute. http://www.museumoftheearth.org/files/marcellus/Marcellus_issue6.pdf



Source: EIA production data and U.S. BLS employment data.

Figure 2: Natural Gas Production and Employment in Related Industries [4]

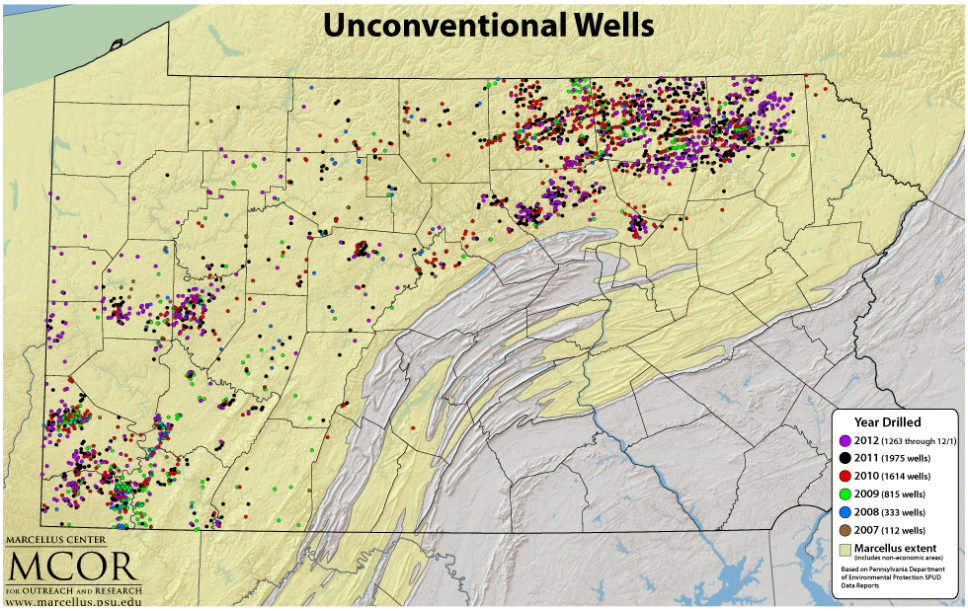


Source: Pennsylvania Department of Environmental Protection

Figure 3: Marcellus Well Activity

[4] The following industries are used: 21111-Oil and gas extraction 213111 - Drilling Oil and Gas Wells 213112 - Support Activities for Oil and Gas Operations 541360 - Geophysical Surveying and Mapping Services 238912 - Nonresidential Site Preparation Contractors 333132 - Oil and Gas Field Machinery and Equipment Manufacturing 486210 - Pipeline Transportation of Natural Gas 237120 - Oil and Gas Pipeline Construction

Shale development will typically occur on a regional basis as energy companies seek to minimize the costs of moving their drilling assets. Figure 4 shows unconventional wells drilled across Pennsylvania over time. Northeastern Pennsylvania (Bradford, Tioga, Lycoming, and Susquehanna counties) has experienced the largest boom in shale development. This can also be seen in Table 1 which shows population and employment comparisons over time between the primary drilling counties in Ohio and Pennsylvania.



Source: Penn State Marcellus Center for Outreach & Research (MCOR)

Figure 4: Pennsylvania Unconventional Wells over Time

Comparison of Primary Shale Drilling Counties in Ohio and Pennsylvania

County	Year: 2000			Year: 2007			Year: 2011			
	Population	Total Employment	Oil & Natural Gas Employment Share	Population	Total Employment	Oil & Natural Gas Employment Share	Population	Total Employment	Oil & Natural Gas Employment Share	Total Shale Wells Drilled as of 2011
Bradford, PA	62,756	30,657	1.36%	62,343	31,129	2.11%	62,917	33,823	5.63%	962
Tioga, PA	41,309	18,570	1.61%	41,371	18,843	2.09%	42,419	19,123	3.23%	689
Washington, PA	203,008	93,841	3.39%	206,259	103,494	4.18%	208,282	107,803	5.36%	562
Lycoming, PA	119,851	66,538	1.39%	116,524	67,376	1.87%	116,747	66,987	3.84%	464
Susquehanna, PA	42,260	15,000	1.76%	43,310	16,532	2.34%	43,192	17,886	4.94%	454
Greene, PA	40,591	15,515	3.02%	39,096	17,738	8.06%	38,623	19,647	10.07%	409
Carroll, OH	28,851	11,186	3.18%	29,062	11,973	4.89%	28,782	11,366	4.97%	-
Columbiana, OH	112,048	47,057	2.20%	109,153	44,990	3.17%	107,570	42,965	2.94%	-
Harrison, OH	15,854	5,220	1.79%	15,901	4,971	3.23%	15,850	4,645	2.07%	-
Jefferson, OH	73,663	31,631	1.65%	70,114	32,187	2.13%	68,828	29,664	2.01%	-

Source: U.S. Bureau of Economic Analysis, Economic Profiles, and EMSI Employment data.[5]

Table 1: Population and Employment Comparisons in Primary Drilling Counties over Time

[5] The specific industry codes we utilized with the EMSI data to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Shale Worker Housing Demand

Shale development affects local employment and earnings, which in turn affects the demand for housing by affecting local incomes and net migration patterns. The initial phase of development requires mainly temporary workers, many of whom will be from outside the region and even outside of the state, especially those in jobs requiring specialized training. One estimate finds that more than half of Chesapeake's Marcellus workers are from outside the state (Rubinkam, 2010). Kelsey et al. (2011) also estimate that approximately 37% of all Marcellus workers are from outside the state, although this percentage is expected to decrease over time as more local area workers are trained. Out-of-state workers will increase local housing demand more than employing local workers whose housing needs have already been met. This first wave of temporary workers will require short term housing, such as hotels, RVs and campgrounds. However, temporary workers may prefer hotels over other housing options, as they provide additional amenities without the inconvenience of long-term leases.

As drilling activity expands, many companies will open small offices and regional headquarters, which will require more permanent workers. Regional headquarters are more likely to be located in counties that are the most advanced in shale development. These counties will experience the largest increase in employment and the greatest increase in housing demand. For example, Chesapeake Energy's regional headquarters is located in Bradford County, PA while Lycoming County, PA is home to the regional headquarters for both Anadarko Petroleum and Range Resources (Williamson and Kolb, 2011). This expansion brings about another wave of workers that are more permanent and have more diverse housing needs. Long-term workers will typically prefer to rent apartments and homes or to purchase homes rather than live in hotels. Their preferences are also dependent on their demographic characteristics. For example, younger workers, unmarried workers, workers without dependents, or those who do not plan on moving their family with them generally prefer to rent rather than buy a house. Much of this depends on how long the worker plans on staying in the new location.

Oil and gas workers may prefer to commute from larger cities with higher quality housing, hotels, or other local amenities. For example, workers and their families may prefer to live in neighborhoods with better school districts or near larger selections of shopping areas, restaurants, and entertainment venues than what is available near some of the rural drilling areas. Housing costs may also be lower in surrounding communities, further incentivizing commuting. Commuting workers will limit the impact on housing demand in drilling areas but may also place additional demands on nearby areas with minimal or no drilling activity.

Drilling activity will affect housing demand through an increase in oil and gas employment, but also by changing the value of land directly through mineral rights. Demand for real estate in drilling areas may increase as buyers expect that large leasing and royalty payments may accompany land purchases. However, drilling may also have moderating effects on the demand for housing. Concern about water quality and other negative environmental amenities associated with drilling may reduce the desire for housing in drilling areas (Gopalakrishanan and Klaiber, 2012). Previous research has shown that negative environmental amenities such as pollution or presence of a nuclear power plant have a negative impact on real estate values, whereas positive environmental amenities such as forests, open

land, and waterways have a positive effect on housing values (Simon and Saginor, 2006; McGranahan, 2008). Thus, it is possible for drilling to have a net negative impact on housing demand in an area. The net change in housing demand will be largely dependent on the pace and scale of drilling in an area.

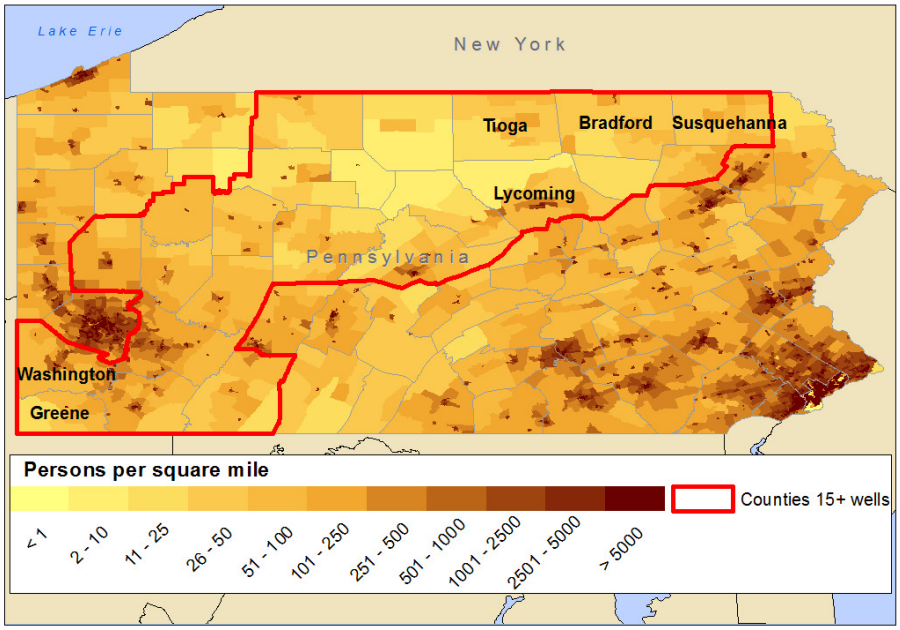
Shale County Housing Stock

The response of the housing market to the change in housing demand will be largely dependent on the characteristics of the county itself and its housing stock. Counties that are better able to accommodate the increase in housing demand with hotels, rentals, available housing stock, or other means will not experience as large an increase in housing prices.

The counties experiencing the highest drilling activity in the Marcellus and Utica shale region are typically rural counties in Appalachia. Rural counties with small populations are not likely to have a large stock of housing and especially not a large reserve of vacant housing units to meet increased housing demand. Figures 7 and 8 show the population distribution in Pennsylvania and Ohio in the year 2000, before the boom period. In Figure 5 (and most of the remaining map figures), we place an outline around the section of Pennsylvania with greater intensity of drilling. In Figure 6, we note the four Ohio counties that have experienced the most intensive drilling to date: Carroll, Columbiana, Harrison, and Jefferson.

A comparison of Figure 5 with the intensity of drilling in Figure 7 verifies that drilling is mainly occurring in rural counties. Houses in Appalachian Ohio are typically older, smaller, and lower-valued. According to some reports, Ohio's Appalachian region has a higher share of substandard housing and unconventional rental units such as mobile homes and RVs. Additionally, the housing stocks of many Appalachian counties in Ohio are already lacking affordable housing (Vogt Santer Insights, 2012). Therefore, rural housing stock may be inadequate in terms of both the quantity and quality of housing.

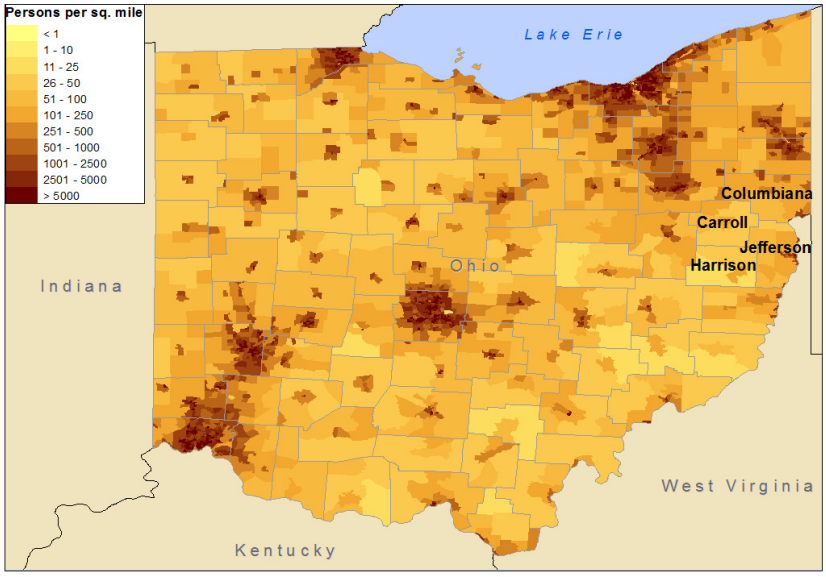
Pennsylvania Population Density Prior to Shale Development



Source: U.S. Census Bureau, 2000 Decennial Census.

Figure 5: Pennsylvania Population before Shale Development (2000)

Ohio Population Density Prior to Shale Development

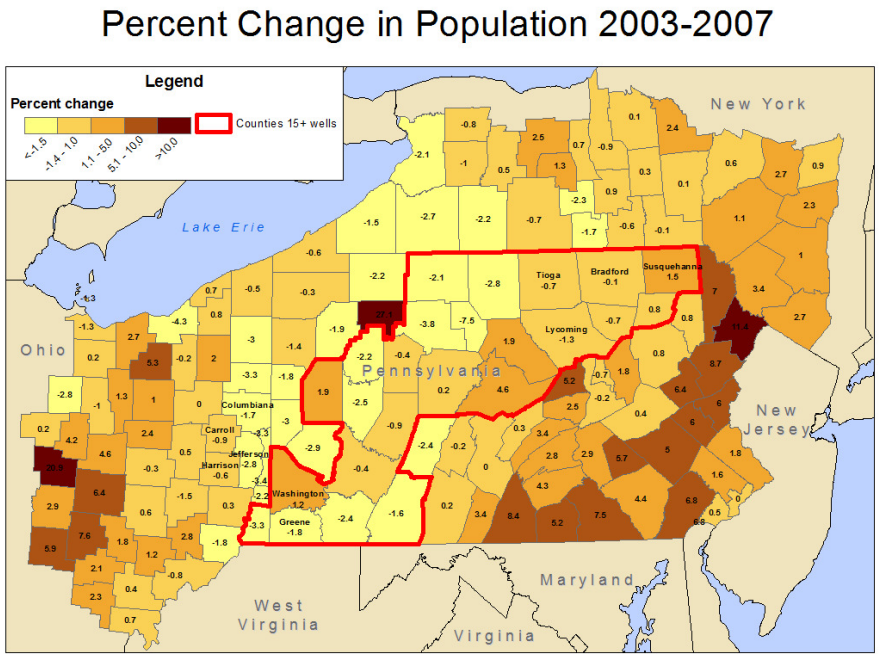


Source: U.S. Census Bureau, 2000 Decennial Census.

Figure 6: Ohio Population before Shale Development

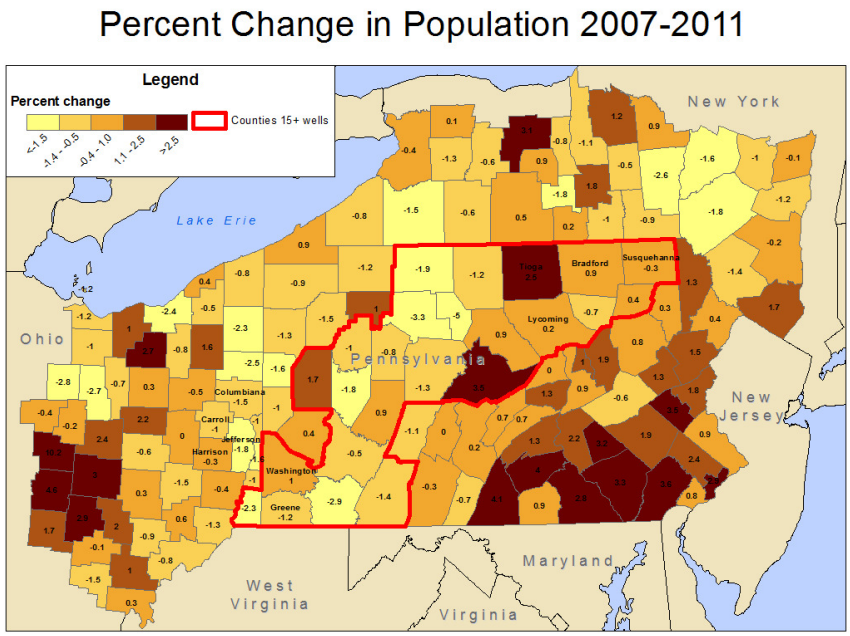
On the other hand, many rural counties in the Appalachian region have been experiencing population declines and out-migration, which leaves more housing available. Figure 7 shows the change

in population by county for the study region before the shale boom while Figure 8 shows the time period during shale development. Figure 9 confirms that population declines have contributed to increased vacancy rates in the area. Although out-migration could free up housing in these areas, the homes made available may be substandard.



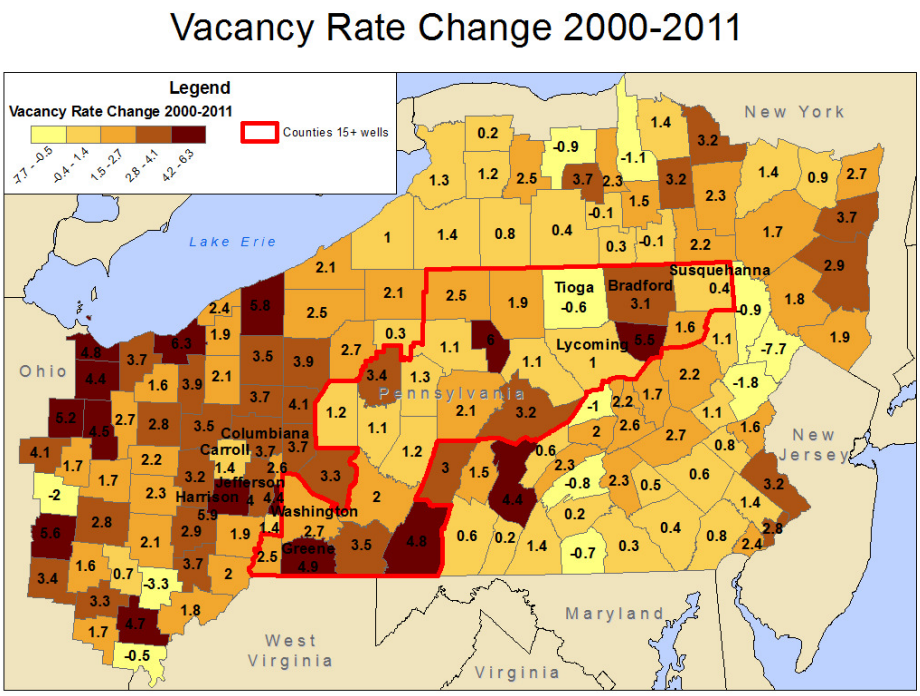
Source: U.S. Bureau of Economic Analysis, Economic Profiles 2003, 2007.

Figure 7: Population Change Immediately Prior to the Shale Boom



Source: U.S. Bureau of Economic Analysis, Economic Profiles 2007, 2011.

Figure 8: Population Change during the Shale Boom



Source: U.S. Census Bureau, 2000 Decennial Census and 2011 American Community Survey 5-Year Estimates.

Figure 9: Change in Housing Vacancy Rates

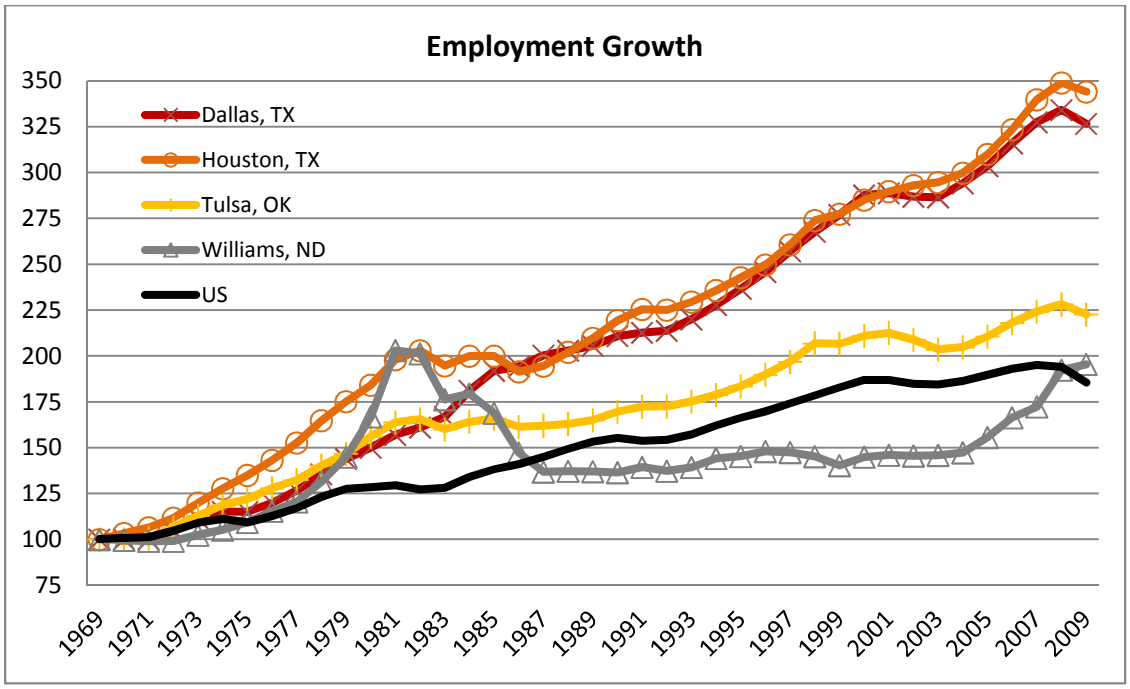
Less remote counties can rely on the housing stock of neighboring counties to make up for any lack in housing availability. Drilling counties in southwest Pennsylvania such as Greene and Washington can rely on nearby Pittsburgh and Allegheny County to help supply housing to their energy workers. More remote counties, such as those in northern Pennsylvania and eastern Ohio, are less likely to be able to rely on the housing stock of neighboring counties.

Rural counties with a small and inadequate housing stock may still be able to meet the increase in housing demand by building hotels, apartments, houses, and mobile home parks. County building and zoning regulations can have a substantial effect on the ability of the local housing market to respond to shifts in demand. Counties with fewer barriers to construction are able to respond to increases in housing demand through residential construction rather than higher housing prices and rents (Saks, 2008). However, rural counties, especially those declining in population and not accustomed to significant amounts of new construction are unlikely to have the local construction capacity to respond quickly to an increased demand for housing. In addition, there will be competition for construction assets with the energy sector (The Institute for Public Policy & Economic Development, 2011). Local utilities and public services may also be unprepared for new population and residential construction. As evidence of the building capacity in these rural counties, even the county with the most wells drilled, Bradford County, Pennsylvania had no new subdivisions under construction as of 2011 (The Institute for Public Policy & Economic Development, 2011). On the other hand, four hotels have been built in Lycoming County (Schwartz, 2012).

Some counties have turned to more creative ways of meeting housing demand. For example, a school in Washington County, Pennsylvania was converted into 1 bedroom units (Williamson and Kolb, 2011). In some cases, the drilling industry itself helps ensure that their workers have adequate housing. Chesapeake built a $7 million residential complex and training center to house up to 280 workers in Bradford County, Pennsylvania (Rubinkam, 2010).

Resource Booms and Housing Markets

Previous natural resource booms provide insights into the local economic impact of the ensuing shale boom. The 1970s oil boom and the subsequent bust in the 1980s can be seen using employment data in Figure 10. Particularly important is the example of rural Williams County, ND (Williston) versus the larger cities shown – rural areas generally do not keep the gains in employment/population they experience during the boom and regress back to their pre-boom levels. Because the larger cities are home to headquarter operations, they retain more employment after the boom.



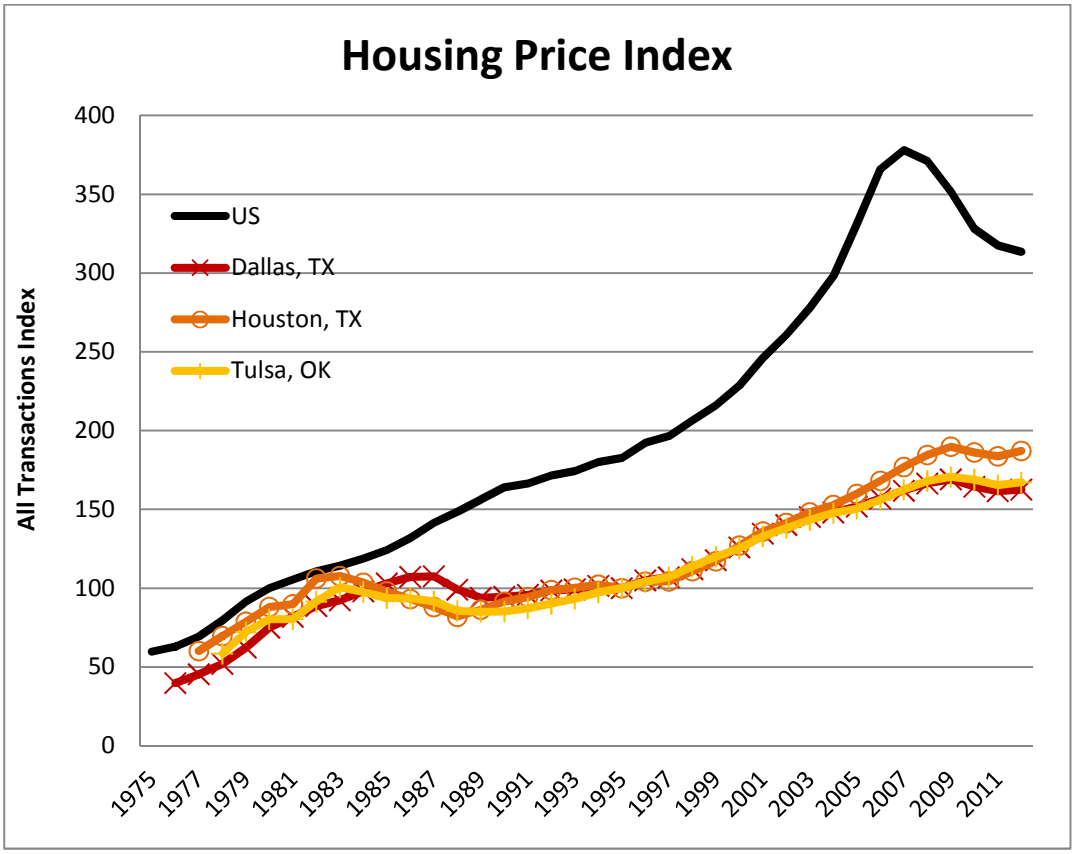
Source: U.S. Bureau of Economic Analysis

Figure 10: Total Employment and Previous Oil Booms in the U.S. for Selected Cities[6]

Figure 11 shows the housing price index for these cities during the same time period (Williams County data is unavailable). Housing prices generally increased during the energy boom periods of the late 1970s to the early 1980s and after 2005. Yet, the general story is that even in these relatively fast growing metropolitan areas, housing prices lag the U.S. average growth, showing that lax land-use

[6] Reproduced from Farren, Weinstein, and Partridge (June, 2012).

restrictions found in Texas and Oklahoma can greatly dampen price increases in affected markets. Conversely, Boxall (2005) finds that residential property values in Alberta, Canada were negatively impacted by gas development (measured by the number of gas wells located within 4 kilometers). The impact on housing prices in Alberta seems to reflect the change in the value of local environmental amenities.



Source: Federal Housing Finance Agency

Figure 11: Housing Price Index for Selected Cities

Previous Studies on the Housing Impact in Marcellus Drilling Counties

Economic theory and previous experiences have conflicting implications for the potential impact of shale development on housing prices. Kelsey et al. (2012) provides a descriptive analysis of the impact on housing market values using assessed valuations for tax purposes. Although there is no clear pattern at the county level, Kelsey et al. (2012) find that drilling activities increase total market values in townships or boroughs with drilling activity. Municipalities with more than 20 wells are associated with a 15.8% increase from 2007 to 2009 in market value compared with a state average of 12.2% (Kelsey et al., 2012). Because these increases are only partially translated into the total assessed value, the increase in total market value most likely reflects an increase in housing demand and improvements to properties. However, Kelsey et al. (2012) warn that these results do not necessarily reflect the impact to

individual properties, some of which may actually experience a negative impact of drilling due to their proximity to noisy gas compressor stations or other shale gas-related factors.

Combining real estate data with shale well data, Gopalakrishnan and Klaiber (2012) are able to examine the impact of Marcellus drilling wells on individual houses in Washington County, PA from 2008 to 2010. They find that households are negatively impacted by shale drilling, with each additional shale well being associated with a 1.5% decrease in housing price. The impacts are more severe for houses with a private water well and those surrounded by agricultural lands, presumably because farmland is more likely to be drilled. In a similar analysis on Washington County, Muehlenbachs, Spiller, and Timmins (2012) find even larger negative effects on housing values with a 24% decrease in value attributable to the risk of groundwater contamination, which more than offsets the positive impact of an 11% increase in value attributable to other economic factors, such as lease payments.

Statistical Analysis of the Drilling Impacts on Housing Markets

Our investigation into the effects of shale gas drilling on factors affecting housing availability and price utilized a wide variety of data sources and methods of analysis.[7] The region covered by the analysis are the counties in Ohio, Pennsylvania, New York, and West Virginia which overlie portions of either the Marcellus or Utica shale with oil or gas resources, as indicated by maps produced by the Marcellus Center at Penn State University and the Ohio and U.S. Divisions of Geologic Survey. The map, shown in Figures 14, 15 and others, displays the study region. The only counties of West Virginia included in the analysis belong to the Northern Appalachia region and constitute the northern panhandle of the state, making them comparable to most of the other Ohio, Pennsylvania and New York counties included in the analysis. Thus, our study provides a broader look at the impact of shale development on housing in the region than previous studies.

To measure the effects of shale gas drilling, two measures of shale gas drilling intensity are utilized: the number of wells drilled each year (as reported by the various state departments of environmental protection/natural resources) and oil and gas drilling employment as a share of total employment in each county (as calculated by EMSI). Six specific housing-related metrics are utilized to compare areas with intensive drilling efforts against those without drilling activity in order to determine pressures on local housing markets:

1) Population
2) Fair Market Rent (FMR) and Median Rental rate

[7] The data utilized for the analysis was obtained from the U.S. Census Bureau, the 2000 Census and 2011 Annual Community Survey (ACS) (5-year estimates, 2007-2011), the U.S. Department of Housing and Urban Development, the U.S. Bureau of Economic Analysis, the U.S Energy Information Agency, the Pennsylvania and West Virginia Departments of Environmental Protection, the Ohio Department of Natural Resources, EMSI (Economic Modeling Specialists Intl.), an economic data clearinghouse and consulting firm, www.emsi.com.

3) Residential construction permits issued
4) Median home value
5) Vacancy rate

Because oil and gas workers might not necessarily live in the same counties in which they are drilling wells, we consider the effect of both the number of wells drilled within a county and total county employment in the oil and gas industry on housing cost and availability. Our dependent variables include county-level measures of population, fair market rent, the median rental rate, new home construction permits, vacancy rate, and median home values. We use several linear regression techniques to ensure the robustness of our results. We first use a two-way fixed effects estimator applied to county-level panel data from 1997-2011 to determine the effect of the number of wells drilled and changes in oil and gas employment on our county-levels measures of housing cost and availability. As expected, changes in oil and gas employment had different effects on the housing measures than the number of wells drilled. Next, we use instrumental variable regression to account for omitted variables that are possibly affecting housing outcomes and associated with shale gas development. We use a Difference-in-Difference (DiD) estimator to determine whether changes in housing measures over the boom period are different in shale drilling counties compared non-drilling counties. The advantage of Difference-in-Difference methods is they control for many unobservable factors that could potentially affect our statistical results. Lastly, when we are prevented by data limitations from using the previous analysis methods, we use first-difference estimators to compare the trends over time in drilling and non-drilling counties. Analyzing the data using several statistical methods helps assess the robustness of our results.

In addition to subjecting the data to several statistical methods, we address several possible concerns with the models. First, it is possible the number of wells drilled and changes in oil and gas employment might have a non-linear relationship with our housing measures– that is, the numbers of shale wells drilled might have a larger effect for counties with large numbers of wells drilled than counties with relatively few shale wells drilled. If a non-linear relationship exists, the effect of the variables of interest may change once the number of wells reaches a certain threshold. We did find evidence of non-linear effects in many instances, indicating that small numbers of shale wells drilled generally had a negative association with the housing measures, but a positive association with the housing measures in counties with very large numbers of shale wells drilled—though this did not hold in all cases.

Lastly, we control for county differences in economic structure, demographic conditions, and geographic locations. It is particularly important to control for differences in county industry composition. Doing so allows us to isolate the effects on housing from changes in oil and gas employment from county-wide employment changes over time in order to isolate what happened due to energy development from what would have occurred without energy development.[8] We also include the following variables: county population, personal income per capita and the percent of the population below the poverty level. Lastly, we include variables to account for the specific county-based

[8]To do this we include a variable that accounts for the change in employment in the county, assuming that each industry in the county grew at its national growth rate.

and year-based differences in the data – in this way (for example), we are not mistakenly treating Alleghany County, Pennsylvania (home to Pittsburgh) in the same manner as a more isolated, rural county like Bradford County. Also, our approach accounts for the business cycle effects of the Great Recession, so that they do not confound our results. We describe our regression results below. Appendix 5 presents various predicted outcomes for our variables based on low-, medium-, and high-drilling scenarios for the Ohio counties that will be most impacted by drilling over the 2012-2016 time span.

1) Population

Shale gas drilling activities generally require drilling rig workers with specialized training from outside the region, at least until a local labor pool can be developed. Therefore, there may be a connection between the drilling activities in a county and population increases. An initial examination of population changes during the shale boom period (Figure 8) compared to Figure 7 suggests that shale boom counties are modestly increasing in population relative to their pre-boom path.

Our regression results indicate that a 1% increase in total employment directly related to the oil and gas energy sector employment is associated with a 0.5% increase in county population, all else equal.[9] To give an upper range for this effect, Table 1 shows that between 2007-2011, Bradford County experienced about a 3.5% increase in total employment directly linked to the oil and gas industry, which is one of the largest increases in energy industry employment share. Thus, we expect about a 1.75% (0.5 × 3.5) increase in Bradford County population associated with energy development, all else equal. However, the number of shale gas wells is not strongly linked to population growth, suggesting that the links found above are somewhat tenuous.

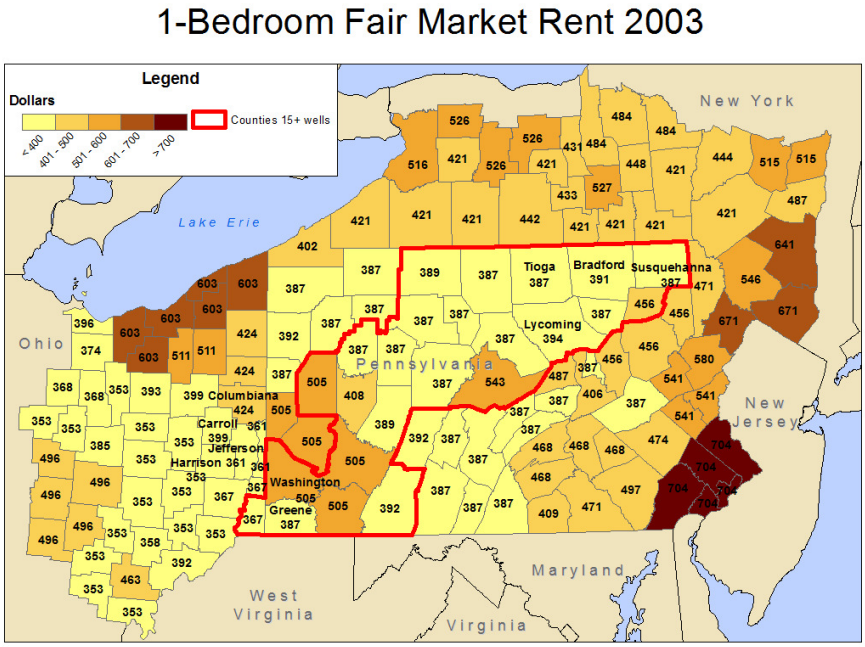
2) Fair Market Rent and Median Rental rate

As the number of shale gas workers increases the demand for short-term housing, including hotel rooms and rental units, will also rise. Increases in rent will be reflected in the Fair Market Rent calculated by the U.S. Dept. of Housing and Urban Development (HUD).[10] The strength of using FMR is that it is reported annually across the U.S. One weakness of using FMR is that HUD does not fully survey every county every year. In those cases, HUD assumes an annual FMR growth rate depending on the rent changes in the nearest major city or region of the country in which the county is located. This could

[9] Partridge et al. (2012) review the long literature on the relationship between employment growth and population growth. They find that a 1% increase in jobs in a regional economy is associated with about 0.8% population growth before 2000. After 2000, 1% job growth is only associated with 0.2-0.25% population growth, suggesting more jobs are going to locals. In our case, this suggests more energy jobs went to outsiders compared to typical growth across all sectors.

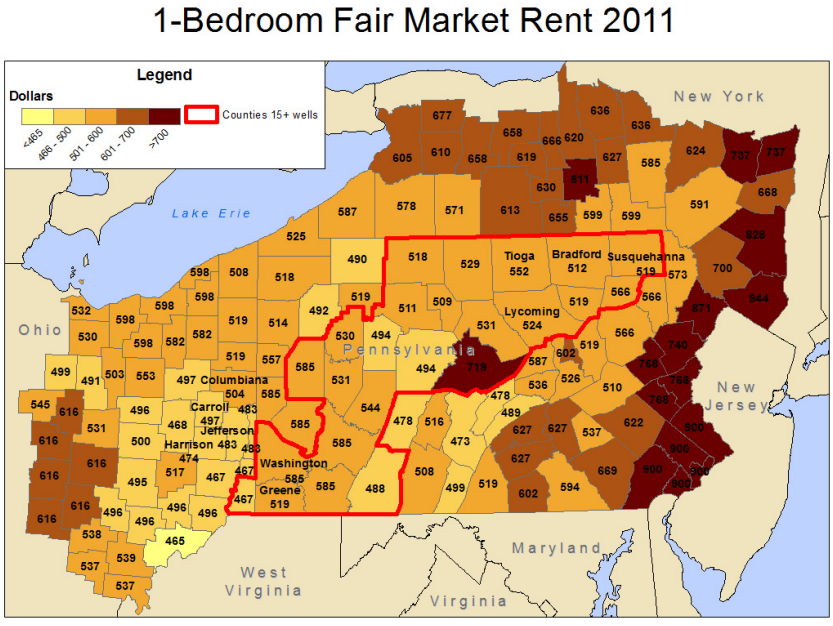
[10] The FMR is generally defined as the level of rent which is above 40% of the rental values in the housing market and below the other 60% (the actual proportions vary by county and for a few counties, the numbers are 50%, in which case the FMR is equal to the median rental cost).

affect some of the results in our rural sample. Figure 11 and Figure 12 show FMR in 2003 and 2011 for 1 bedroom units.



Source: U.S. Department of Housing and Urban Development.

Figure 12: 2003 Fair Market Rent



Source: U.S. Department of Housing and Urban Development.

Figure 13: 2011 Fair Market Rent

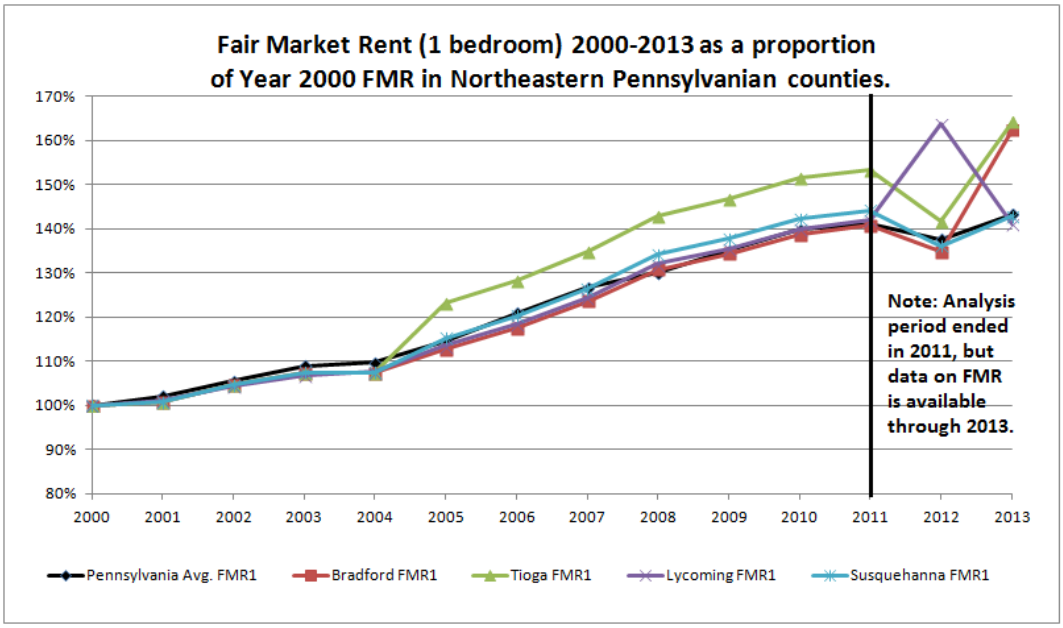
We find that increases in total employment associated with greater energy sector employment are statistically associated with smaller increases in the FMR, which was unexpected. The number of shale gas wells is negatively associated with FMR for low numbers of wells drilled each year, but the relationship becomes positive for higher numbers of wells. Thus, the county with the most wells drilled—Bradford—actually experienced an increase in FMR. The estimated breakeven point, where the number of wells drilled per year has no effect on FMR, ranges from between 340 and 430 wells (or between 785 and 910 wells over the entire shale boom time period), suggesting that Bradford County's FMR increased by about 3.6% due to drilling activity. For comparison, 377 and 397 wells were drilled in Bradford County during 2010 and 2011 respectively. Tioga County, the county experiencing the second most intense drilling activity, had 276 and 273 wells drilled during this time period.[11] In sum, we find no strong statistical link between FMR and drilling activity.

Figure 14 shows that in general, the growth patterns of the counties with the most drilling have been comparable with the state as a whole over the 2007-2011 period. When examining two years after the regression sample period (2012 and 2013), there were volatile movements in the Fair Market Rent for Bradford, Tioga and Lycoming counties – the same counties which have been the center of shale drilling (Bradford and Tioga experiencing large increases and Lycoming holding flat over the time).

Given the data concerns with the FMR measure, we also considered an alternative median rent measure provided in the 2000 Census of Population and the 2011 American Community Survey (ACS) in which renters are asked their rental rate. A shortcoming with the 2011 ACS is that if one wants data for all counties regardless of population, they have to use the five-year average over the 2007-2011 period. These alternative regression results show a strong positive relationship with the median rental rate at low drilling intensity, but a negative effect for large numbers of drilled wells, which is the exact opposite pattern as found for the FMR.[12] Together, we conclude that drilling activity likely only has a modest impact on FMR.

[11] During the entire shale development time period in our sample, there were a total of 962 wells drilled in Bradford County while there were 689 wells drilled in Tioga County.

[12] This pattern is likely caused because Bradford County experienced a much smaller percentage change in median rents over the period than other counties, creating an outlier that affects the general results. Graphs displaying this result and illustrating the generally scattered nature of the data are provided in Figures 23-26 in Appendix 3.



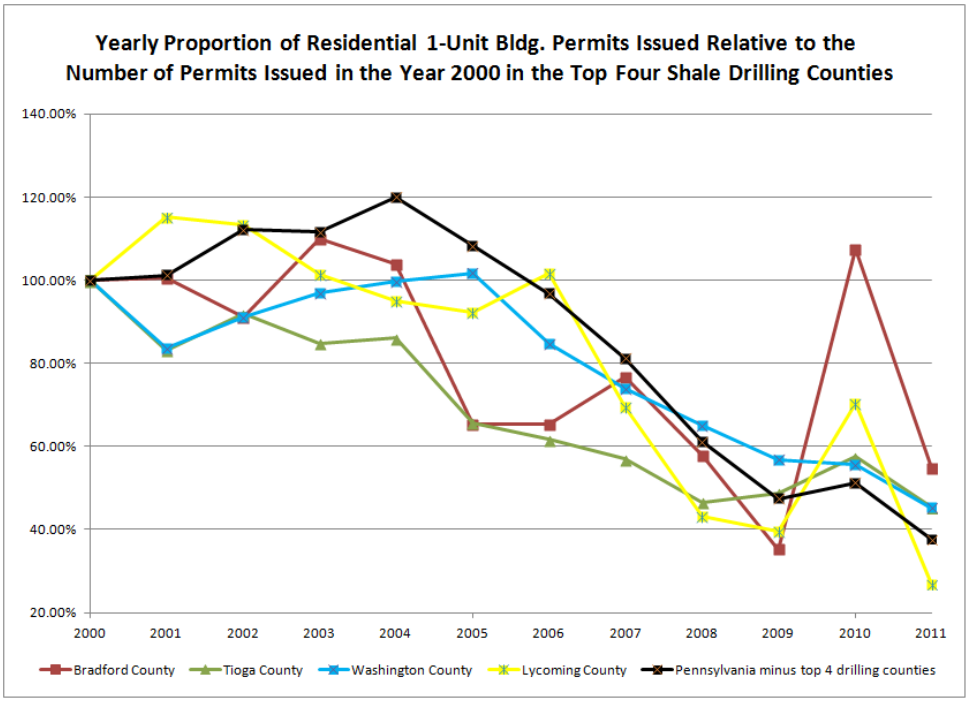
Source: U.S. Department of Housing and Urban Development.

Figure 14: Pennsylvania Rental Market Changes

3) Housing Permits

As the supply of available rental and housing properties dries up, an increase in the construction of residential buildings would help meet the increased housing demand. Yet, an increase in residential building permits may indicate that local residents enriched from leasing and royalty payments are building new homes, which would do little to alleviate a housing shortfall.

Our results suggest that an increase in energy sector employment and the number of wells drilled is generally associated with an increase in the number of residential building permits. On average, each new shale gas well drilled is associated with about 2.5 additional housing permits. Figure 15 shows the proportion of residential building permits approved each year relative to the year 2000 for the four counties in Pennsylvania experiencing the largest boom in shale development. The graph shows a substantial spike during the years of greatest drilling intensity. These results present some encouraging findings that housing markets are appropriately responding to the increased demand for housing by building new units.



Source: U.S. Census Bureau, Residential Construction Branch.

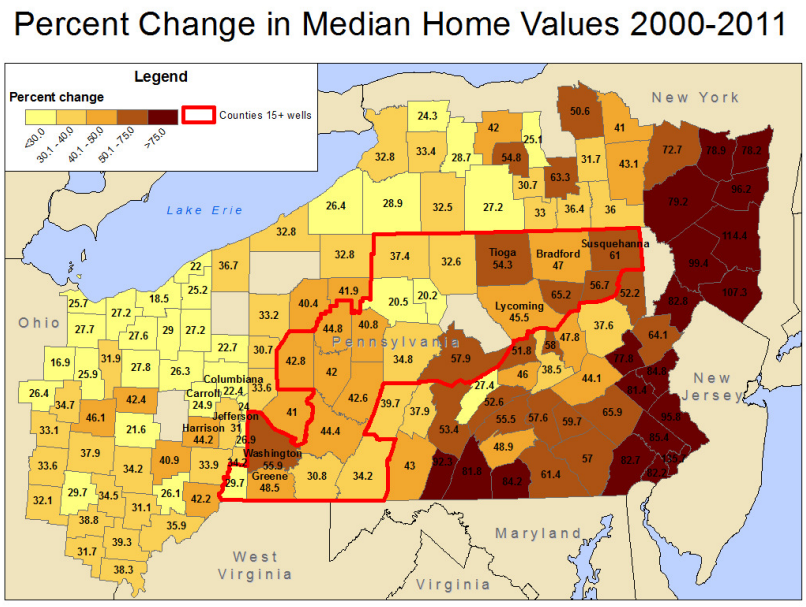
Figure 15: Pennsylvania Housing Permits

4) Median Home Values

If shale development is affecting housing markets, then the effects would also likely appear in changes in housing values. To examine this, we use the median housing value reported in the 2000 Census of Population and the 2011 ACS. One shortcoming of this data is that it is self-reported by the home owner. Another is that for the 2011 ACS, it again reflects the 2007 to 2011 five-year average value. Figure 16 shows the percent change in median home values from 2000 to 2011. Figure 17 shows the median home value in 2011. Our regression analysis estimates the relationship between the percentage change in median housing value and energy sector employment or the number of wells drilled over the 2007-2011 period. The analysis shows that shale gas and oil development had inconsistent effects on the median housing value that tended to be statistically insignificant.

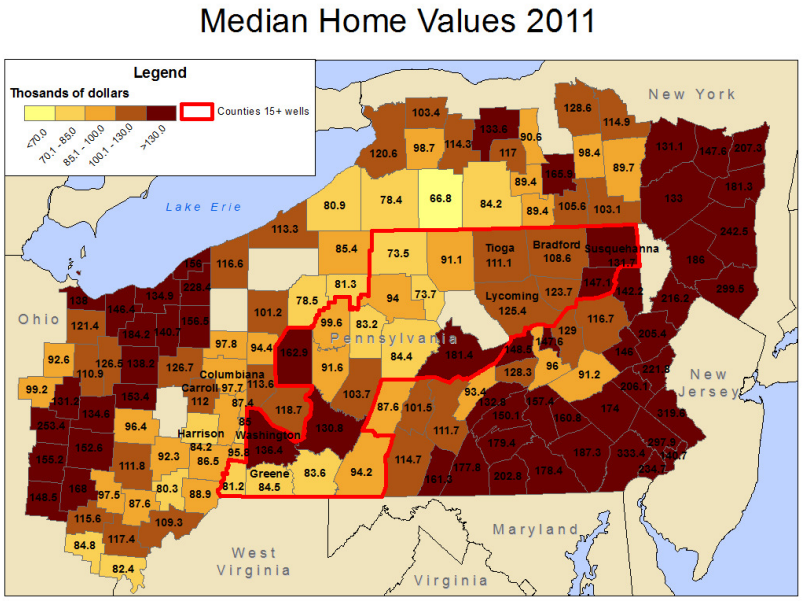
We then conducted sensitivity analysis using median home price data from Core Logic consulting company. However, as described in Appendix 4, the Core Logic data misses key drilling counties in Pennsylvania, which reduces our confidence in those results. Yet, these results show consistent statistical effects of shale development on existing housing in the fixed effects panel regression results. The results suggest that a 1% increase in shale development employment share is associated with a 0.2%-0.4% increase in median home resale prices. Using the midpoint of 0.3, these results suggest that median home prices increased about 1.1% in Bradford County over 2007-2011, which supports the previous results that median home prices are only modestly affected. Conversely, the difference-in-difference regressions show nearly opposite patterns compared to the fixed effects panel regression analysis. Increases in shale development employment is negatively associated with the

median resale price (in most cases) while low numbers of shale gas wells drilled have a strong positive relationship with the median resale value, though the influence becomes negative for counties with more than 340 wells drilled between 2007-2011.



Source: U.S. Census Bureau, 2000 Decennial Census and 2011 American Community Survey 5-Year Estimates.

Figure 16: Percent Change in Median Home Values



Source: U.S. Census Bureau, 2011 American Community Survey 5-Year Estimates.

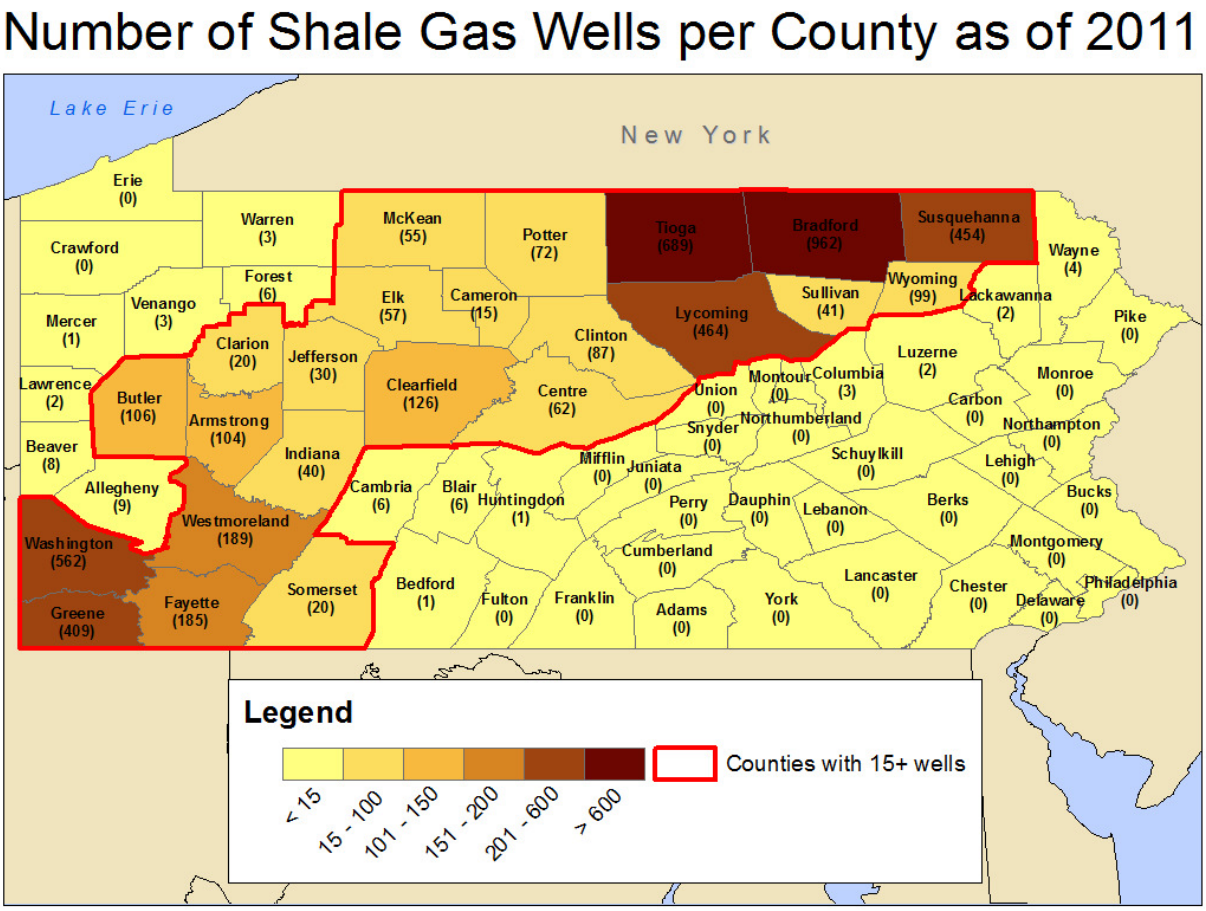
Figure 17: Median Home Values in Thousands of Dollars

5) Vacancy Rates

We expect the influx of energy sector workers into shale boom counties to drive down the vacancy rate of residential units in the county as housing demand increases. Our statistical analysis suggests that energy sector employment and the number of wells drilled are associated with a decrease in vacancy rates, though the results are not statistically significant. Figure 9 shows the vacancy rate changes from 2000-2011, illustrating that counties with intense shale development do not show consistent vacancy rate decreases. Our results provide some evidence that the vacant housing stock in many of these rural areas is not being used by incoming workers, perhaps because it is substandard. Thus, oil and gas workers may be turning to other housing sources rather than filling vacant houses.

Bradford, Susquehanna, and Tioga Counties

Our results generally show that the impact of shale development on housing affordability and availability is small until drilling activity becomes sufficiently large in a handful of counties, though home building seems to respond drilling activity. In the Marcellus region, Bradford County and Tioga County have experienced the most pronounced increased in shale development (see Figure 18). These counties are most likely to experience pressures on their housing markets. Bradford, Tioga and Susquehanna counties were part of the focus of our Dec. 2010 policy brief, where their experience of the shale gas boom was compared with three similar counties outside the drilling area (Union, Carbon and Columbia). An updated comparison between these groups focusing on housing measures is provided in Table 2.



Source: Pennsylvania Department of Environmental Protection, Office of Oil and Gas Management.

Figure 18: Total Wells Drilled in Pennsylvania

Average Performance of Selected Counties during the Pre-Drilling and Drilling Periods of the Shale Gas Boom for Factors Affecting Housing Availability and Affordability			
Pre-Drilling Period	Average Percent Growth of Shale Drilling Counties[1] (2003-2007)	Average Percent Growth of Non-Drilling Comparison Counties[1] (2003-2007)	Difference in Percent Growth between Drilling Counties and Non-Drilling Counties (2003-2007)
Population	0.22%	4.50%	-4.28%
Employment	1.10%	3.51%	-2.42%
Shale Drilling Employment	0.44%	0.11%	0.33%
FMR (1-bedroom)	19.33%	12.73%	6.59%
Single Unit Res. Bldg. Permits[2]	0.59%	1.11%	-0.51%
Drilling Period	Average Percent Growth of Shale Drilling Counties[1] (2007-2011)	Average Percent Growth of Non-Drilling Comparison Counties[1] (2007-2011)	Difference in Percent Growth between Shale Energy Counties and Comparison Counties (2007-2011)
Population	1.06%	1.07%	-0.01%
Employment	6.11%	-0.03%	6.14%
Shale Drilling Employment	2.73%	-0.15%	2.88%
FMR (1-bedroom)	13.89%	11.12%	2.76%
Single Unit Res. Bldg. Permits[2]	0.40%	0.52%	-0.12%
Census-based Data[3]	Average Percent Growth of Shale Drilling Counties[1] (2000-2011)	Average Percent Growth of Non-Drilling Comparison Counties[1] (2000-2011)	Difference in Percent Growth between Drilling Counties and Non-Drilling Counties (2000-2011)
Population	1.72%	8.03%	-6.31%
Employment	10.85%	6.62%	4.23%
Shale Drilling Employment	3.56%	0.16%	3.40%
Median Rent	44.88%	43.71%	1.17%
Median Home Value	54.09%	59.15%	-5.06%
Vacancy Rate	0.99%	0.60%	0.38%
[1] - These are the counties experiencing heavy shale drilling in northeastern Pennsylvania and the counties outside the drilling region that were selected as good comparison cases from our Dec. 2010 policy brief, 'The Economic Value of Shale Natural Gas in Ohio.' The shale drilling counties selected were Bradford, Tioga and Susquehanna. Their counterparts were Union, Carbon and Columbia.			
[2] - This is the average annual percent growth in single unit residential building permits approved relative to the total housing stock in the county recorded by the 2000 Decennial Census.			
[3] - Median Rent, Median Home Value and Vacancy Rate data were only available from the 2000 Decennial Census and the 2011 American Community Survey 5-Year Estimates (2007-2011), so these parameters were not available for the specific Pre-Drilling and Drilling periods.			

Sources: U.S. Census Bureau, 2000 Decennial Census, 2011 American Community Survey 5-Year Estimates, and Residential Construction Branch, U.S. Bureau of Economic Analysis, Economic Profiles, U.S. Dept. of Housing and Urban Development, and EMSI Employment data[13]

Table 2: Comparison of Housing Measures between Drilling and Non-Drilling Counties

Focusing on the "Drilling Period" in the middle panel of Table 2, we see that population growth and building permits are about equal across the drilling and non-drilling counties, but employment growth, shale drilling employment, and FMR rose faster in the drilling counties (the third column shows

[13] The specific industry codes we utilized with the EMSI data to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

the difference in results across the two groups). Comparing the 2007-2011 drilling period to the 2003-2007 pre-drilling period, the drilling counties made significant gains relative to the non-drilling counties for population growth, employment growth, shale drilling, and building permits. Yet, FMR actually grew much faster in drilling counties compared to non-drilling counties during the **pre**-drilling period. Similarly, considering median house prices (from the Census Bureau) over the entire decade in the bottom panel, prices rose about 5 percent faster in non-drilling counties. This comparison further illustrates that even when considering the most-intense drilling counties, housing prices and FMRs were fairly well contained, even though drilling counties experienced faster economic growth.

Bradford and Tioga, the most prominent Pennsylvania shale drilling counties, are rural, Appalachian counties with populations of 62,622 and 41,981 (in 2010), respectively. They are more remote than other heavy drilling counties in the Southwest portion of Pennsylvania near Pittsburgh. During their shale development between 2007-2011, Bradford and Tioga have experienced population gains of 0.9% and 2.5%, which is larger than their respective losses of 0.1% and 0.7% between 2003 and 2007 (refer to Figures 6 and 10). These modest population increases may have led to housing shortages and housing price increases in Bradford and Tioga. Yet, the FMR for single bedroom apartments for these counties seem to grow at around the same rate as the state average (Figure 14). (Though our results suggest that these counties would have experienced even lower growth in FMR had shale development not took place.) Meanwhile, the number of new single-unit residential home permits approved nearly tripled in Bradford County in a single year (2010) during the height of the shale drilling boom. It seems that in those counties most affected by shale development, the housing market is responding to the increase in rent and decrease in availability by building more houses.

Policy Implications

Because shale development doesn't seem to substantially increase rental values in most counties, the need for policy intervention is more moderate. The existing housing stock, especially hotels for temporary workers, may be sufficient to meet the increased demand in housing. Despite the small impact on rental values, housing markets also seem to be appropriately responding to the increase in housing demand and any housing shortages through new housing development. However, our results do suggest that there may be an increased need for policy intervention once shale drilling reaches a high threshold.

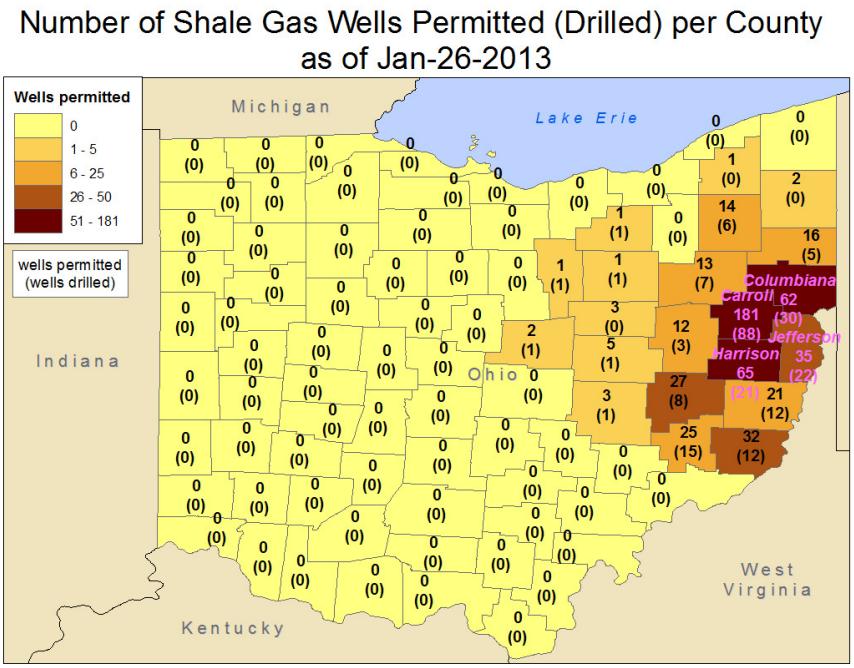
In those counties experiencing the largest increase in drilling activity, policy intervention may be warranted especially if the county is rural, lacking in amenities, and relatively distant from larger cities that could provide housing for commuters. These counties may see a significant increase in rental rates and housing prices. Survey respondents from the drilling counties Bradford, Lycoming, Greene, and Sullivan reported shortages in available rental properties and rents that had doubled or even tripled in some cases (Williamson and Kolb, 2011), though our data did not support these stories as being a widespread phenomenon. Oil and gas workers are prepared to pay higher prices for housing, but local residents may not be. In extreme cases, local residents may be evicted from their homes as rental rates

increase and may be forced into substandard housing, or even become homeless. Those households on the economic fringe, such as low income households, the elderly, and the disabled, are the most vulnerable. In response, Tioga County has opened its first homeless shelter (Reddy, 2012). Towanda, PA in Bradford County recently opened Grace House, offering transitional housing for the homeless (Falchek, 2012).

These may be isolated incidents, but it may also indicate that housing markets take some time to respond and to build more housing, especially when the shale development is sudden and large. Thus, it is important that drilling counties in Ohio monitor the pace and scale of drilling and how it is affecting the affordability and availability of local housing, especially for those most vulnerable to these effects. Pennsylvania has already responded to the housing needs in counties with extensive shale activity. The Pennsylvania Housing Finance Agency has a grant to build 40 low-income housing units in Bradford County (Falchek, 2012). The Pennsylvania Housing Affordability and Rehabilitation Enhancement (PHARE) Fund and impact fees are available to improve housing for low income households. These funds will address housing shortages by funding construction, rehab, and rental assistance (Housing Alliance of Pennsylvania, 2012). Because many of the shale workers are temporary, focusing on temporary housing such as hotels will be especially effective in addressing the housing impacts. A recent Ohio University report suggested developing apartment complexes, mobile homes, and other temporary housing. The report also suggested rehabbing abandoned homes which would also reduce neighborhood blight (Ohio University, 2013).

The counties in Ohio most likely to face such issues include Jefferson, Harrison, Columbiana and especially Carroll. As of January 19, 2013, Carroll County had 181 shale wells either drilled or permitted, which is nearly triple the number of wells in nearby counties and accounts for 35% of the 522 total wells drilled or permitted statewide (Ohio Department of Natural Resources, 2013). Figure 19 shows the number of wells permitted and drilled per county in Ohio. Carroll and Harrison counties may be especially vulnerable to housing market concerns since their populations are even lower than Bradford and Tioga counties. This vulnerability may be mitigated by the relative closeness of larger nearby cities, such as Canton, New Philadelphia, Steubenville and Wheeling, WV for commuting.[14]

[14]The 2011 populations of Bradford and Tioga counties are 62,917 and 42,419 , respectively, compared to Jefferson (68,828), Harrison (15,850), Columbiana (107,570), and Carroll (28,782) (Bureau of Economic Analysis, Economic Profiles, 2011).. The county seat of Carroll County (Carrollton) is about 25 miles from both Canton and New Philadelphia while the county seat of Harrison County (Cadiz) is about the same distance from Steubenville and Wheeling, WV (Mapquest, 2013).



Source: Ohio Department of Natural Resources, Division of Mineral Resources Management – Oil and Gas. (Downloaded file dated 26 Jan. 2013)

Figure 19: Total Wells Drilled in Ohio

Conclusion

Shale boom counties in the Pennsylvania region have experienced a substantial increase in drilling, but at a different pace and scale than the shale oil drilling near Williston, ND. Although many shale boom counties are rural like Williston, they are not as remote. Thus, we would expect the impact of Pennsylvania and Ohio shale development to be more moderate than Williston and the Bakken region of North Dakota. Although Pennsylvanian counties such as Bradford and Tioga have already experienced a sizeable shale boom with measurable impacts on its housing market, our analysis suggests that the impact on housing markets in most Pennsylvania shale counties is fairly small. We expect the same pattern to develop in Ohio over two to three years.

The impact on population in most drilling counties in Pennsylvania was small, though counties with the highest level of drilling activity did experience population increases because of the influx of workers. In terms of housing prices, shale drilling is correlated with a reduction in Fair Market Rent in most counties. Again, only those counties with the most shale drilling activity (Bradford and Tioga) experienced increases in Fair Market Rent due to shale development. Regardless of the minimal impacts on housing prices, housing markets in shale counties seem to be responding to the increased housing demand or expected increase in housing demand from shale workers by building single-unit residential housing. The increase in housing development could also be in response to the increase in earnings or income from lease and royalty payments.

Many counties in the Utica and Marcellus shale region can rely on the housing stock of neighboring counties if necessary, whereas hotels can fill the needs of the temporary workforce. In fact, commuting should be a more viable option in Ohio drilling regions, reducing pressures on local housing markets. Until the intensity of drilling increases, major public intervention in the housing market in Ohio seems unnecessary. Yet, policymakers should support the development of hotels, modest increases in low-income housing, and the facilitation of home building through streamlined regulations and financing.

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Appendix 1: Statistical Methodology

In our statistical analysis, we primarily use fixed effects panel regression and difference-in-difference (DiD) estimators. We also estimated first-difference regressions when limited by data availability. Our shale gas well data is from the Department of Environmental Protection Office of Oil and Gas Management in Pennsylvania and West Virginia, and contains the 'spud date' or the beginning of well drilling for Pennsylvania wells and the well completion date for West Virginia wells between 2000 and 2011. Because it is annual data, and the process of well drilling in general only takes a matter of weeks, the start date and completion date occur in the same year for the vast majority of our observations and so combining these two datasets does not raise serious concerns. The other states included, Ohio and New York, had not commenced significant shale well drilling activities before 2012 and so no drilling data is available for them. Because much of the drilling activity did not start in Pennsylvania until 2007, we use that year as the separation between when pre- and post-shale development effects would be evident. We note that some preliminary drilling and other preparations did occur before 2007, but because so few wells were drilled, we believe they have little effect on our housing market results.

We also utilized high-quality employment data from EMSI (Economic Modeling Specialists Intl.), an economic data clearinghouse and consulting firm, as another measure of shale development activities. We used four-digit North American Industry Classification System (NAICS) codes to classify which industries are directly impacted by shale development.[15] The benefit of using this data is that it is not constrained by privacy restrictions in the same way as publicly available data. In order to protect employer privacy, the U.S. Bureau of Labor Statistics (BLS) does not report employment information for counties where only a few employers exist within a certain industry. This often means many small rural counties have incomplete data for more specific industries, such as the ones we use in our analysis. The EMSI employment data accounts for this limitation and provides an imputed employment level for each industry.

We investigate how nearby shale development might affect a number of metrics related to the local housing market. First, we use population changes and vacancy rates to determine whether shale gas development is bringing people to the area and whether those new migrants are occupying existing housing. Since shale development requires importation of specialized workers into the county for relatively short durations, we also examine the median rental rate, available from the U.S. Census Bureau, and the Fair Market Rent (which most often corresponds to the 40th-percentile rent), calculated by the U.S. Department of Housing and Urban Development. Shale development also creates long term employment. Accordingly, we also analyze how the median home value changed and whether an effect could be seen in the number of new residential housing construction permits approved. Both the median home value data and the construction permit data are from the U.S. Census Bureau.

[15] The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

We also used high-quality housing price data from CoreLogic Inc. CoreLogic is an industry leader in housing market data collection and analysis and offers data products that are unavailable from any other source. Their data allowed the estimation of dependent variables representing the county-level median resale price.[16] This data is available from 2000-2011 on an annual basis and is based on actual home sales, which represents an improvement over the Census median home value data. The Census data uses homeowners' appraisal of their home's value and is only available for the years 2000 and for the average of 2007 to 2011. However, the Corelogic data is missing in many key cases, greatly reducing its reliability.

To control for other primary factors affecting the local housing market, we also control for county population, median per-capita income, poverty rate, and expected economic growth based on a county's initial industry composition. We obtained annual county-level data from the U.S. Bureau of Labor Statistics regarding population and median per-capita personal income. The poverty data is from the U.S. Census Bureau via the Small Area Income and Poverty Estimates (SAIPE) program. Expected economic growth is calculated using EMSI data by multiplying the employment share of each four-digit industry in the county by the industry's national growth rate and summing across all industries in the county. This provides the expected percentage increase in employment assuming that the county's four digit industries all grew at the national rate. Accounting for expected employment growth is important so that we can decompose what would have happened in the county if there was no drilling as compared to what did happen with drilling. We also control for the level of urbanization as well as other cultural and geographical effects by including dummy variables for whether a county was part of a Metropolitan Statistical Area (MSA), as defined by the U.S. Census Bureau, and whether it belonged to the Appalachian region, as defined by the Appalachian Regional Commission.

The data from the U.S. Census Bureau for median rent, median home value, and vacancy rate is only available in the decennial Census and the recently implemented American Community Survey (ACS). Since many of the counties included in the analysis have low populations, county-specific ACS data is only available in the form of 5-year moving average. Therefore we analyzed how these measures changed between the 2000 U.S. Census and the 2011 ACS 5-year estimates (which span 2007-2011, centered on 2009). This provides us with a pre-shale development measure and an averaged mid-development measure. The limited data is likely a large part of the reason why these regressions show the least statistical significance for our shale development metrics.

Each model is estimated with the dependent and explanatory variables in levels, logs and percent change. We use two specifications for each model: one which included shale wells drilled as the key explanatory variable and one which included shale-related employment as the key explanatory variable. The results from the regression of levels show how the values of the dependent variable are correlated with the key explanatory variables. When the dependent and explanatory variables are in natural logarithm form, the results should be interpreted as showing whether the housing measures and

[16] Median total home sale price includes sales of existing and newly constructed homes, as well as distressed sales. We focus on existing home sales and new construction sales because distressed sales may exhibit highly variable prices.

the explanatory variables are proportionally related – for example, if shale development employment increases by 1%, what is the corresponding expected percentage increase in the Fair Market Rent. We also estimate models of the percent change in the dependent and explanatory variables.

Panel Data Analysis

The two-way fixed-effects regressions used data from 1997-2011, the years for which data covering all variables was available, providing a balanced dataset of 2,160 observations across the 144 counties in the sample.

Our panel data regression utilized the following structure:

$$X = \alpha + \beta_1 * \eta + \beta_2 * \eta^2 + \delta * \Phi + \rho * \Lambda + \tau * \Theta + \sigma * \Omega + \varepsilon$$

where:

X: The measure of housing availability or affordability under consideration (ie: population, Fair Market Rent, median home sale price, and residential building permits approved).

η, η^2: The shale development metric of interest (i.e.,: the number of shale wells drilled or jobs associated with shale development). The squared value is used as an additional explanatory variable because of possible non-linear effects.

Φ: A set of additional explanatory variables controlling for the effects of population, per-capita income, percent of the population in poverty, and expected economic growth based on industry composition. For the regressions using the natural logarithms or the percentage growth of housing measures as dependent variables, the population and per-capita income are also used with the same transformation. The poverty and economic growth variables are not altered as they are already in percentage format.

Λ: A set of dummy variables controlling for whether the county is in a Metropolitan Statistical Area or is part of the Appalachian region.

Θ: A set of dummy variables controlling for time fixed effects.

Ω: A set of dummy variables controlling for county-specific fixed effects.

ε: The regression error term.

α, β_1, β_2, δ, ρ, τ, σ: The regression constant and linear regression parameters to be estimated.

Difference-in-Difference Analysis

Difference-in-difference (DiD) estimators are useful in situations where the data arise from a natural experiment. It also has the advantage of differencing out unmeasured fixed effects that could affect growth in a county. In our case, the Pennsylvania shale gas boom occurred very rapidly in areas that contained shale gas reserves. The time period just prior to the boom provides a good estimate of housing market behavior in counties with shale drilling to compare to housing market behavior after the boom, providing us with a test of whether changes in the housing market are influenced by shale gas drilling. The mechanical implementation of the DID estimator is as follows:

$\underline{DiD:}$ $\quad FMR_{DiD} = \{FMR_{2011} - FMR_{2007}\} - \{FMR_{2007} - FMR_{2003}\}$

The FMR_{DiD} value for a county represents the difference in the change in FMR between 2003-2007 (the pre-shale development period) and 2007-2011 (the period during which most shale wells were drilled). This method uses a single observation for each county in the dataset, limiting our analysis to 144 observations. Despite this, DiD is very good at controlling for several different kinds of statistical concerns from unobservable factors that could possibly affect our results. The natural logarithm of the dependent and explanatory variables and their relevant proportional changes are also analyzed. The structure of these equations is as follows:

$\underline{DiD_{log}:}$ $\quad FMR_{DiDlog} = \{log(FMR_{2011}) - log(FMR_{2007})\} - \{log(FMR_{2007}) - log(FMR_{2003})\}$

$\underline{DiD_{\%\Delta}:}$ $\quad FMR_{DiD\%\Delta} = \{\%\Delta FMR_{2007\text{-}2011}\} - \{\%\Delta FMR_{2003\text{-}2007}\}$

where,

$$\%\Delta FMR_{2007\text{-}2011} = \{FMR_{2011} - FMR_{2007}\} / FMR_{2007} * 100\%$$

The DiD estimator is described by the follow equation:

$$X = \alpha + \beta_1*\eta + \beta_2*\eta^2 + \delta*\Phi + \rho*\Lambda + \gamma*\Psi + \varepsilon$$

where:

X: *The DiD, DiD_{log}, or $DiD_{\%\Delta}$ measure of housing availability or affordability under consideration (ie: population, Fair Market Rent, median home sale price, and residential building permits approved).*

η, η^2: *The DiD, DiD_{log}, or $DiD_{\%\Delta}$ in shale development-related employment. We only considered shale wells drilled during 2007-2011for the difference-in-difference analyses so this metric is kept in level form rather than using its log or percent change for the DiD_{log} and $DiD_{\%\Delta}$ regressions. Also, this value is squared and*

used as an additional explanatory variable because of possible non-linear effects.

Φ: *A set of additional explanatory variables controlling for the differenced effects of population, per-capita income, poverty and expected economic growth based on the county's initial industry composition. For the regressions using the* DiD_{log} *or* $DiD_{\%\Delta}$ *housing measures as dependent variables the population and per-capita income are also used in* DiD_{log} *and* $DiD_{\%\Delta}$ *format. The poverty and economic growth variables are not altered as they are already in percentage format.*

Λ: *A set of dummy variables controlling for whether the county is in a Metropolitan Statistical Area or is part of the Appalachian region.*

Ψ: *A set of explanatory variables controlling for initial values in the year 2000 (logged values of the dependent variable, population, and median per-capita income, as well as the percent of population in poverty).*

ε: *The regression error term.*

$\alpha, \beta_1, \beta_2, \delta, \rho, \gamma$: *The regression constant and linear regression parameters to be estimated.*

First-difference Analysis

Our regressions involving U.S. Census-specific data were limited to using observations from the 2000 Census and 2011 ACS 5-Year Estimates. The metrics for shale development utilized were the total number of shale wells drilled in each county from 2007-2011 and the increase in shale development employment between 2006 and 2011.[17] Differencing between the year 2011 and year 2000 observations was used to control for county-specific effects. This differencing makes this analysis similar to the difference-in-difference analysis, but because of the data limitations, there is no way to compare the 'before' and 'after' effects of shale development on a county – only the 'between-county' effects can be estimated. Differencing in this way limits the analysis to one observation for each county. We also use the first-difference in the natural logarithm and the percent change in the relevant measures in supplemental regressions. The following is an example of the structure of the variables used in the first-difference regressions:

<u>*Differenced:*</u> $MedianRent_{Diff} = MedianRent_{2011} - MedianRent_{2000}$

<u>$Diff_{log}$:</u> $MedianRent_{logDiff} = log(MedianRent_{2011}) - log(MedianRent_{2000})$

[17] By using 2006 as the base year, the increase in shale development jobs between 2006-2007 is incorporated into the regression, making the time period of the employment analysis equivalent to that of the wells analysis.

$\underline{Diff_{\%\Delta}}$: $MedianRent_{\%\Delta Diff} = \%\Delta MedianRent_{2000\text{-}2011}$

where,

$$\%\Delta MedianRent_{2000\text{-}2011} = \{MedianRent_{2011} - MedianRent_{2000}\} / MedianRent_{2000} * 100\%$$

Our first-difference regression utilized the following structure:

$$X = \alpha + \beta_1 * \eta + \beta_2 * \eta^2 + \delta * \Phi + \rho * \Lambda + \gamma * \Psi + \varepsilon$$

where:

X: *The differenced, $Diff_{log}$, or $Diff_{\%\Delta}$ measure of housing availability or affordability under consideration (ie: Median Rent, Median Home Value or Vacancy Rate).*

η, η^2: *The difference, $Diff_{log}$, or $Diff_{\%\Delta}$ in shale development-related employment between 2006-2011. We only consider shale wells drilled during 2007-2011for the difference analyses so this metric is kept in level form rather than using its log or percent change for the $Diff_{log}$ and $Diff_{\%\Delta}$ regressions. Also, this value is squared and used as an additional explanatory variable because of possible non-linear effects.*

Φ: *A set of additional explanatory variables controlling for the differenced effects of population, per-capita income, poverty and expected economic growth on the housing measure studied. For the regressions using the $Diff_{log}$ or $Diff_{\%\Delta}$ housing measures as dependent variables the population and per-capita income were also used in $Diff_{log}$ and $Diff_{\%\Delta}$ form. The poverty and economic growth variables were not altered as they are already in percentage format.*

Λ: *A set of dummy variables controlling for whether the county is in a Metropolitan Statistical Area or is part of the Appalachian region.*

Ψ: *A set of explanatory variables controlling for initial values in the year 2000 (logged values of the population, per-capita income, median rent and median home value, as well as the percent of population in poverty and the vacancy rate).*

ε: *The regression error term.*

α, β_1, β_2 , δ, ρ, γ: *The regression constant and linear regression parameters to be estimated.*

Robust standard errors were calculated in our regression and are provided in Appendix II. In general, the number of shale wells drilled provide stronger and more statistically significant results than changes in oil and gas employment. In the two-way fixed effects models, both the wells drilled in the current year as well as the wells drilled in the previous year are used to determine if the lagged effects differ from the contemporary effects on housing measures. Our results show that the lagged wells drilled variable had nearly the same effect as the contemporaneous wells drilled variable.[18] We are most confident in the results obtained from the DiD models and the two-way fixed effects models.

[18] Since the number of wells drilled per year per county only increases in most of the cases from 2007-2011 we are not able to determine the effect on housing measures when drilling activity slumps after the peak of the boom.

Appendix 2: Regression Results

Table 1a: Two-Way Fixed Effects Regression; Shale Development Employment (Levels)

Explanatory Variables[1]	Population	Res. Bldg. Permits (1 Units)	Res. Bldg. Permits (2 Units)	Res. Bldg. Permits (3-4 Units)	Res. Bldg. Permits (5+ Units)
Shale Dev. Empl.	4.664 (5.563)	.1331 (.0805)	-5.3e-04 (.0023)	.0034 (.0033)	.0048 (.0038)
Shale Dev. Empl. Squared	2.0e-05 (1.7e-05)	1.1e-06 (8.2e-06)	5.7e-08 (8.8e-08)	-2.1e-08 (2.3e-07)	-7.9e-08 (3.5e-07)
Population		-.0101** (.0049)	-3.5e-05 (9.0e-05)	-2.4e-04 (2.1e-04)	-2.3e-04 (2.2e-04)
Per-capita Income ($)	.282 (.7623)	-.0407*** (.0153)	-1.3e-04 (4.9e-04)	-2.4e-04 (3.3e-04)	-9.1e-04*** (3.4e-04)
Poverty (%)	146.2 (483.3)	-4.772 (9.463)	-.4225 (.3823)	-.4412 (.4478)	-.8128 (.5257)
Expected Empl. Growth (%)	-1142*** (415)	50.38*** (12.24)	1.603* (.8812)	.6226** (.2655)	.0851 (.3438)
Year (1998)	180.4 (823)	85.79*** (23.5)	-.6257 (.9447)	.4315 (.5888)	.6039 (.7002)
Year (1999)	-946.9 (1193)	178.2*** (37.35)	-1.268 (1.565)	-.8384 (1.321)	3.066 (2.44)
Year (2000)	-233.2 (1910)	189.7*** (50.43)	-2.452 (1.742)	-.3533 (1.166)	.84 (1.164)
Year (2001)	-3309 (2587)	327.9*** (70.51)	1.666 (3.489)	.5644 (1.5)	2.571 (2.092)
Year (2002)	-2366 (2862)	412.1*** (83.17)	3.58 (3.989)	1.527 (1.82)	3.004 (2.397)
Year (2003)	-1295 (3147)	405.8*** (84.2)	.6046 (2.325)	1.792 (1.606)	3.587* (2.12)
Year (2004)	-675 (3696)	406.1*** (89.58)	-.9848 (2.324)	.8575 (1.611)	3.583** (1.698)
Year (2005)	-1108 (4212)	341.9*** (95.63)	-1.881 (2.737)	1.345 (1.89)	6.084*** (2.239)
Year (2006)	-1655 (5123)	323.1*** (111.3)	-1.502 (3.393)	.0873 (2.23)	4.993** (2.253)
Year (2007)	-1865 (6105)	318.7** (128.9)	-2.202 (4.004)	-.4368 (2.56)	6.915** (2.979)
Year (2008)	-4409 (7430)	387** (158.5)	.136 (5.311)	.5476 (3.054)	7.593** (3.696)
Year (2009)	-5557 (7682)	500.7*** (172.2)	5.043 (7.051)	2.543 (3.284)	7.126 (4.969)
Year (2010)	-2166 (8079)	415.5** (171.6)	1.298 (5.885)	1.45 (3.589)	8.34* (4.741)
Year (2011)	-1907 (8952)	356.7* (186.2)	-.5188 (6.2)	1.43 (3.984)	10.76** (5.195)
Constant	2.2e+05*** (1.8e+04)	2598*** (668.3)	18.49 (19.3)	47.14 (36.82)	65.95* (35.6)
R-squared	0.653	0.382	0.040	0.118	0.075
Adjusted R-squared	0.650	0.376	0.031	0.109	0.067
F	129190.3	12.77	3.360	3.068	3.895
Observations	2175	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 1b: Two-Way Fixed Effects Regression; Shale Development Employment (Levels)

Explanatory Variables [1]	FMR (0 Bedrooms)	FMR (1 Bedrooms)	FMR (2 Bedrooms)	FMR (3 Bedrooms)	FMR (4 Bedrooms)
Shale Dev. Empl.	-.005 (.0058)	-.011** (.0047)	-.0127** (.0051)	-.0182*** (.0066)	-.0298*** (.0091)
Shale Dev. Empl. Squared	1.1e-07 (1.7e-07)	2.2e-07* (1.3e-07)	2.6e-07* (1.5e-07)	4.1e-07** (2.1e-07)	7.9e-07** (3.3e-07)
Population	3.0e-04* (1.7e-04)	4.8e-04*** (1.5e-04)	6.2e-04*** (1.6e-04)	6.5e-04*** (1.9e-04)	5.2e-04** (2.3e-04)
Per-capita Income ($)	.0073*** (.0015)	.0059*** (.0011)	.007*** (.0011)	.0052*** (.0014)	.0036* (.0019)
Poverty (%)	-.9036 (1.239)	1.116 (1.016)	-.0046 (1.093)	-1.112 (1.553)	-5.407** (2.648)
Expected Empl. Growth (%)	-.5375 (2.333)	-.5918 (1.443)	-2.367 (1.704)	-4.918** (2.451)	-2.815 (3.616)
Year (1998)	-1.968 (1.91)	1.796 (1.53)	2.575 (1.623)	8.263*** (2.037)	11.66*** (2.807)
Year (1999)	-3.464 (3.679)	3.865 (2.819)	3.298 (3.144)	10.12** (4.014)	15.43*** (5.343)
Year (2000)	-8.171 (5.226)	3.131 (4.026)	2.658 (4.494)	14.09** (5.579)	19.55** (7.644)
Year (2001)	-5.331 (8.499)	7.973 (5.754)	5.823 (6.49)	17.05** (8.332)	33.36*** (11.05)
Year (2002)	2.989 (9.588)	19.92*** (6.465)	19.82*** (7.27)	35.35*** (9.294)	54.46*** (12.45)
Year (2003)	7.674 (8.929)	27.28*** (6.18)	30.58*** (6.841)	53.85*** (8.532)	76.53*** (11.43)
Year (2004)	2.962 (9.304)	23.72*** (6.67)	29.12*** (7.215)	58.68*** (8.883)	84.14*** (12.24)
Year (2005)	54.43*** (11)	41.18*** (7.622)	44.27*** (8.103)	74.92*** (10.62)	82.83*** (14.64)
Year (2006)	62.65*** (13.28)	52.08*** (9.608)	56.75*** (9.957)	96.66*** (12.78)	112.3*** (17.29)
Year (2007)	70.7*** (15.35)	64.61*** (10.99)	71.83*** (11.27)	121.3*** (14.44)	142.9*** (19.71)
Year (2008)	88.68*** (18)	86.35*** (12.58)	95.75*** (12.45)	154.5*** (16.45)	191.4*** (22.86)
Year (2009)	106.6*** (20.63)	103*** (13.44)	111.2*** (13.58)	166.4*** (19.09)	213.6*** (27.05)
Year (2010)	116.4*** (19.04)	114.6*** (12.98)	131.2*** (12.94)	202.9*** (17.58)	252.8*** (24.81)
Year (2011)	109.6*** (20.76)	110.6*** (14.88)	129.2*** (14.96)	209*** (19.74)	261*** (27.62)
Constant	131.7*** (44)	191.5*** (36.28)	254.6*** (35.18)	449.3*** (43.53)	652.8*** (61.66)
R-squared	0.871	0.881	0.874	0.854	0.774
Adjusted R-squared	0.870	0.880	0.873	0.852	0.772
F	295.4	445.0	445.1	441.7	299.7
Observations	2160	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 1c: Two-Way Fixed Effects Regression; Shale Development Employment (Levels)

Explanatory Variables [1]	Median Housing Sale Price	Median Home Resale Price	Median New Construction Sale Price
Shale Dev. Empl.	3.308 (3.698)	-.9238 (3.285)	7.186 (13.68)
Shale Dev. Empl. Squared	9.3e-05 (1.4e-04)	1.5e-04 (1.4e-04)	3.3e-05 (3.2e-04)
Population	.6374*** (.1389)	.7005*** (.1606)	.2813** (.1215)
Per-capita Income ($)	3.896*** (.7506)	3.867*** (.6885)	5.049** (2.434)
Poverty (%)	-802.1 (539.1)	-703.1 (480.9)	12.85 (2267)
Expected Empl. Growth (%)	-1805** (754.2)	-2373*** (721.5)	-1.1e+04** (4576)
Year (2001)	-1359 (1884)	-2510 (1755)	-2.6e+04** (1.2e+04)
Year (2002)	211.2 (2135)	-1739 (1945)	-1.6e+04 (1.2e+04)
Year (2003)	5314*** (1966)	4450** (1735)	577.5 (1.1e+04)
Year (2004)	9089*** (2541)	9010*** (2267)	2.8e+04*** (9116)
Year (2005)	1.4e+04*** (3297)	1.4e+04*** (3019)	4.5e+04*** (1.2e+04)
Year (2006)	1.2e+04*** (4375)	1.3e+04*** (3937)	4.6e+04*** (1.5e+04)
Year (2007)	6677 (5326)	8519* (4804)	3.9e+04** (1.7e+04)
Year (2008)	-5551 (6677)	-2002 (5890)	2341 (2.2e+04)
Year (2009)	-1.3e+04* (7248)	-1.0e+04 (6344)	-3.7e+04 (2.7e+04)
Year (2010)	-1.0e+04 (7337)	-5477 (6455)	-1.9e+04 (2.4e+04)
Year (2011)	-1.5e+04* (8291)	-8996 (7419)	-1.0e+04 (2.8e+04)
Constant	-1.3e+05*** (3.5e+04)	-1.4e+05*** (3.3e+04)	-7.1e+04 (8.8e+04)
R-squared	0.567	0.637	0.451
Adjusted R-squared	0.563	0.633	0.438
F	31.18	41.85	17.43
Observations	1547	1545	781

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 2a: Two-Way Fixed Effects Regression; Shale Wells Drilled (Levels)

Explanatory Variables [1]	Population	Res. Bldg. Permits (1 Units)	Res. Bldg. Permits (2 Units)	Res. Bldg. Permits (3-4 Units)	Res. Bldg. Permits (5+ Units)
Shale Wells Drilled	-76.58** (35.73)	2.529*** (.956)	.0239 (.0296)	.0073 (.0204)	.0085 (.026)
Shale Wells Drilled Squared	.1952** (.0987)	-.0057** (.0027)	-5.7e-05 (7.9e-05)	-1.5e-05 (5.3e-05)	-1.4e-05 (6.4e-05)
Population		-.0091 (.0056)	-3.4e-05 (9.2e-05)	-2.2e-04 (2.1e-04)	-2.1e-04 (2.2e-04)
Per-capita Income ($)	.5788 (.6969)	-.0337** (.0142)	-1.1e-04 (4.0e-04)	-7.7e-05 (2.9e-04)	-7.3e-04* (4.4e-04)
Poverty (%)	-12.94 (552.3)	-6.397 (11.18)	-.4135 (.4216)	-.5056 (.5375)	-.8884 (.6458)
Expected Empl. Growth (%)	-798.9* (409.9)	55.83*** (12.79)	1.562* (.8628)	.8127*** (.2747)	.338 (.4581)
Year (1998)	-396.2 (749.3)	76.25*** (20.13)	-.6564 (.8792)	.2069 (.6356)	.3725 (.7106)
Year (1999)	-1175 (1184)	173.3*** (35.42)	-1.336 (1.559)	-.9308 (1.551)	3.038 (2.065)
Year (2000)	-1258 (1925)	173.9*** (48.35)	-2.522 (1.684)	-.7426 (1.615)	.4746 (1.111)
Year (2001)	-3129 (2515)	329.5*** (68.26)	1.481 (3.479)	.7358 (1.68)	2.968 (2.056)
Year (2002)	-3247 (2689)	400.2*** (77.16)	3.348 (3.929)	1.427 (2.11)	3.105 (2.197)
Year (2003)	-2429 (2993)	391.5*** (76.52)	.379 (2.221)	1.597 (1.994)	3.586* (1.844)
Year (2004)	-1794 (3592)	387.4*** (81.91)	-1.172 (2.128)	.4844 (1.942)	3.356 (2.071)
Year (2005)	-1512 (4153)	330.5*** (87.93)	-2.077 (2.547)	1.131 (1.826)	6.074*** (2.276)
Year (2006)	-1983 (5078)	310.9*** (104.3)	-1.739 (3.186)	-.1212 (2.217)	5.035* (2.766)
Year (2007)	-2441 (6040)	299.2** (121.7)	-2.48 (3.713)	-.7918 (2.642)	6.818** (3.235)
Year (2008)	-4360 (7382)	371.6** (149.7)	-.2819 (5.109)	.4891 (3.305)	7.937* (4.214)
Year (2009)	-5905 (7607)	480.9*** (157.2)	4.411 (6.857)	2.769 (3.501)	7.88 (5.06)
Year (2010)	-3636 (7866)	369.2** (150.5)	.6924 (5.421)	1.012 (3.414)	8.264* (4.482)
Year (2011)	-3295 (8768)	302.8* (164.6)	-1.108 (5.61)	.751 (3.708)	10.41** (4.892)
Constant	1.5e+05*** (1.9e+04)	2555*** (768)	17.74 (19.53)	46.78 (37.24)	66.19* (34.56)
R-squared	0.045	0.359	0.039	0.104	0.066
Adjusted R-squared	0.037	0.353	0.030	0.096	0.057
F	2.245	10.52	3.381	2.742	3.382
Observations	2160	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 2b: Two-Way Fixed Effects Regression; Shale Wells Drilled (Levels)

Explanatory Variables [1]	FMR (0 Bedrooms)	FMR (1 Bedrooms)	FMR (2 Bedrooms)	FMR (3 Bedrooms)	FMR (4 Bedrooms)
Shale Wells Drilled	-.2789* (.1467)	-.3256** (.1306)	-.5098*** (.1459)	-.7095*** (.2009)	-1*** (.2904)
Shale Wells Drilled Squared	4.3e-04 (3.8e-04)	8.5e-04** (3.7e-04)	.0012*** (4.4e-04)	.0017*** (6.2e-04)	.0026*** (8.5e-04)
Population	2.6e-04 (1.6e-04)	4.1e-04*** (1.3e-04)	5.3e-04*** (1.3e-04)	5.3e-04*** (1.6e-04)	3.3e-04 (2.3e-04)
Per-capita Income ($)	.0074*** (.0014)	.0058*** (.001)	.0069*** (.0011)	.0051*** (.0013)	.0034* (.0018)
Poverty (%)	-1.095 (1.258)	1.126 (1.039)	-.1161 (1.095)	-1.274 (1.529)	-5.48** (2.617)
Expected Empl. Growth (%)	-.3849 (2.317)	-.8672 (1.438)	-2.495 (1.672)	-5.109** (2.4)	-3.418 (3.59)
Year (1998)	-2.129 (1.804)	1.948 (1.433)	2.569* (1.508)	8.215*** (1.905)	11.64*** (2.613)
Year (1999)	-3.861 (3.644)	3.512 (2.805)	2.694 (3.122)	9.206** (4.02)	13.95*** (5.292)
Year (2000)	-8.822* (5.097)	3.042 (3.916)	2.086 (4.323)	13.19** (5.368)	18.34** (7.343)
Year (2001)	-5.854 (8.437)	6.76 (5.763)	4.364 (6.458)	14.86* (8.326)	29.37*** (11.14)
Year (2002)	2.693 (9.442)	19.29*** (6.412)	19.01*** (7.176)	34.04*** (9.236)	51.72*** (12.39)
Year (2003)	7.084 (8.761)	26.54*** (6.121)	29.45*** (6.748)	52.08*** (8.465)	73.26*** (11.29)
Year (2004)	2.078 (9.091)	23.03*** (6.557)	27.81*** (7.032)	56.67*** (8.65)	80.78*** (11.82)
Year (2005)	53.23*** (10.81)	39.87*** (7.576)	42.18*** (7.931)	71.81*** (10.3)	77.72*** (14.23)
Year (2006)	61.33*** (13.03)	50.52*** (9.559)	54.34*** (9.707)	93.07*** (12.34)	106.3*** (16.83)
Year (2007)	69.32*** (15.03)	63.18*** (10.9)	69.49*** (10.94)	117.7*** (13.92)	136.9*** (19.09)
Year (2008)	87.87*** (17.67)	84.68*** (12.58)	93.61*** (12.27)	151.2*** (16.13)	184.9*** (22.54)
Year (2009)	107.7*** (20.28)	102.2*** (13.39)	111.1*** (13.32)	165.9*** (18.73)	210.1*** (26.87)
Year (2010)	117.9*** (18.51)	115.1*** (12.72)	132.5*** (12.49)	204.3*** (17.04)	252.3*** (24.12)
Year (2011)	110.9*** (20.14)	111.1*** (14.56)	130.3*** (14.46)	210.1*** (19.09)	260.1*** (26.7)
Constant	131.9*** (42.52)	190*** (34.23)	253*** (32.08)	446.5*** (39.52)	645.3*** (59.29)
R-squared	0.872	0.881	0.875	0.855	0.775
Adjusted R-squared	0.871	0.880	0.874	0.854	0.772
F	282.8	428.1	424.2	383.2	285.1
Observations	2160	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 2c: Two-Way Fixed Effects Regression; Shale Wells Drilled (Levels)

Explanatory Variables [1]	Median Housing Sale Price	Median Home Resale Price	Median New Construction Sale Price
Shale Wells Drilled	-162.7 (104.6)	-227.2** (102.7)	-822.8*** (255.6)
Shale Wells Drilled Squared	.765** (.3753)	.9477** (.3758)	5.215*** (1.172)
Population	.6261*** (.1515)	.6769*** (.1448)	.2806* (.1486)
Per-capita Income ($)	4.289*** (.7538)	4.166*** (.6656)	5.697** (2.366)
Poverty (%)	-939.1 (584.7)	-802.2 (515.9)	-537.1 (2424)
Expected Empl. Growth (%)	-1500** (726.5)	-2235*** (701.1)	-9653** (4229)
Year (2001)	-543.7 (1871)	-2327 (1738)	-2.3e+04** (1.1e+04)
Year (2002)	520.6 (2144)	-1776 (1954)	-1.6e+04 (1.2e+04)
Year (2003)	5355*** (2029)	4124** (1794)	1936 (1.1e+04)
Year (2004)	8739*** (2637)	8365*** (2305)	2.9e+04*** (1.0e+04)
Year (2005)	1.4e+04*** (3393)	1.3e+04*** (3016)	4.6e+04*** (1.4e+04)
Year (2006)	1.1e+04** (4497)	1.1e+04*** (3968)	4.7e+04*** (1.7e+04)
Year (2007)	5813 (5418)	7087 (4784)	3.9e+04** (1.9e+04)
Year (2008)	-5993 (6796)	-3315 (5937)	4687 (2.5e+04)
Year (2009)	-1.2e+04* (7355)	-1.1e+04 (6441)	-3.2e+04 (2.9e+04)
Year (2010)	-1.1e+04 (7369)	-6575 (6428)	-1.8e+04 (2.6e+04)
Year (2011)	-1.7e+04** (8280)	-1.1e+04 (7308)	-1.0e+04 (2.9e+04)
Constant	-1.3e+05*** (3.7e+04)	-1.4e+05*** (3.2e+04)	-6.1e+04 (1.0e+05)
R-squared	0.563	0.639	0.450
Adjusted R-squared	0.558	0.635	0.438
F	33.11	53.78	66.83
Observations	1547	1545	781

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 3a: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Levels)

Explanatory Variables [1]	Population	Res. Bldg. Permits (1 Units)	Res. Bldg. Permits (2 Units)	Res. Bldg. Permits (3-4 Units)	Res. Bldg. Permits (5+ Units)
Prev. Year Shale Wells Drilled	-75.23** (37.21)	2.728** (1.119)	.0185 (.0281)	.0032 (.0232)	-.0021 (.0372)
Prev. Year Shale Wells Drilled	.2019* (.103)	-.0062** (.0031)	-4.6e-05 (7.5e-05)	-8.9e-07 (6.2e-05)	1.4e-05 (9.5e-05)
Population		-.0114* (.0068)	-2.6e-05 (8.2e-05)	-1.9e-04 (2.0e-04)	-3.1e-04 (2.8e-04)
Per-capita Income ($)	.3248 (.6267)	-.0361** (.0141)	-4.4e-06 (4.4e-04)	-6.7e-05 (3.0e-04)	-7.4e-04* (3.9e-04)
Poverty (%)	-250.2 (503.2)	-7.91 (11.97)	-.292 (.4134)	-.386 (.4564)	-1.002 (.8141)
Expected Empl. Growth (%)	-881.9** (390.8)	52.26*** (12.71)	1.429 (.9383)	.6955** (.2707)	.1932 (.4619)
Year (1999)	-788.1* (456)	96.01*** (18.62)	-.7867 (1.245)	-1.161 (1.323)	2.524 (2.141)
Year (2000)	-648.4 (1149)	100.9*** (31.46)	-1.987 (1.368)	-.8753 (1.402)	.0024 (.8354)
Year (2001)	-2411 (1657)	251.7*** (51.6)	1.587 (3.407)	.2735 (1.466)	2.269 (2.062)
Year (2002)	-2537 (1815)	322.5*** (60.49)	3.406 (3.939)	.9547 (1.999)	2.36 (2.153)
Year (2003)	-1398 (2046)	320.2*** (59.55)	.4346 (2.087)	1.167 (1.825)	3.064* (1.756)
Year (2004)	-262.6 (2565)	324.2*** (63.87)	-1.153 (1.889)	.1009 (1.785)	3.105* (1.591)
Year (2005)	509.9 (3044)	273.5*** (69.57)	-2.194 (2.33)	.6757 (1.474)	6.06*** (2.281)
Year (2006)	428.6 (3855)	258.3*** (84.34)	-2.065 (3.009)	-.6555 (1.919)	5.086** (2.361)
Year (2007)	310.2 (4723)	251.7** (100.9)	-2.964 (3.587)	-1.342 (2.42)	6.914** (2.94)
Year (2008)	-1316 (5897)	324.8** (128.1)	-1.242 (5.343)	-.3729 (3.124)	7.882* (4.045)
Year (2009)	-3206 (6111)	425.7*** (136.9)	3.046 (7.478)	1.471 (3.228)	7.501 (5.435)
Year (2010)	-223.4 (6293)	327.4** (128.9)	-.4771 (5.717)	-.0338 (3.005)	8.462* (4.809)
Year (2011)	769.2 (7067)	266.3* (141.5)	-2.326 (5.762)	-.2011 (3.217)	10.86** (5.27)
Constant	1.6e+05*** (1.7e+04)	3076*** (979.8)	12.14 (19.86)	41.59 (32.97)	84.89* (49.05)
R-squared	0.044	0.384	0.033	0.093	0.090
Adjusted R-squared	0.035	0.378	0.024	0.085	0.081
F	1.803	11.49	3.148	2.827	3.489
Observations	2016	2016	2016	2016	2016

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 3b: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Levels)

Explanatory Variables [1]	FMR (0 Bedrooms)	FMR (1 Bedrooms)	FMR (2 Bedrooms)	FMR (3 Bedrooms)	FMR (4 Bedrooms)
Prev. Year Shale Wells Drilled	-.4351** (.1739)	-.413** (.1642)	-.6469*** (.1771)	-.8955*** (.219)	-1.188*** (.2986)
Prev. Year Shale Wells Drilled	8.7e-04** (4.2e-04)	.0011** (4.6e-04)	.0016*** (5.1e-04)	.0022*** (6.4e-04)	.0033*** (8.9e-04)
Population	3.1e-04 (1.9e-04)	4.7e-04*** (1.5e-04)	6.0e-04*** (1.7e-04)	5.9e-04*** (2.0e-04)	3.5e-04 (3.0e-04)
Per-capita Income ($)	.0074*** (.0015)	.0054*** (.0011)	.0064*** (.0012)	.0043*** (.0015)	.0024 (.002)
Poverty (%)	-1.173 (1.317)	.753 (1.094)	-.6409 (1.136)	-2.154 (1.515)	-6.468** (2.622)
Expected Empl. Growth (%)	-.4539 (2.332)	-.818 (1.439)	-2.496 (1.707)	-4.64* (2.463)	-2.733 (3.71)
Year (1999)	-1.848 (2.828)	1.61 (2.245)	.1217 (2.617)	1.345 (3.506)	3 (4.634)
Year (2000)	-6.849* (3.957)	1.31 (3.165)	-.2492 (3.665)	5.558 (4.601)	7.843 (6.079)
Year (2001)	-4.012 (8.001)	5.529 (5.487)	2.567 (6.42)	9.176 (8.442)	21.55* (11.44)
Year (2002)	4.466 (9.066)	18.05*** (6.161)	17.18** (7.195)	28.48*** (9.433)	44.2*** (12.77)
Year (2003)	8.905 (8.168)	25.58*** (5.741)	28.05*** (6.661)	46.87*** (8.468)	66.16*** (11.27)
Year (2004)	4.009 (8.317)	22.56*** (6.044)	27.17*** (6.822)	52.22*** (8.429)	74.59*** (11.32)
Year (2005)	55.25*** (10.11)	39.99*** (7.03)	42.39*** (7.618)	68.53*** (9.94)	72.92*** (13.42)
Year (2006)	63.28*** (12.44)	51.13*** (9.007)	55.19*** (9.422)	91.03*** (11.96)	103.2*** (16)
Year (2007)	71.18*** (14.62)	64.17*** (10.44)	70.8*** (10.8)	116.5*** (13.71)	135.1*** (18.48)
Year (2008)	89.41*** (17.48)	86.21*** (12.12)	95.47*** (12.16)	152*** (15.87)	185.8*** (22.23)
Year (2009)	108.9*** (20.23)	103.7*** (13.06)	112.7*** (13.45)	167.8*** (18.72)	212.5*** (27.39)
Year (2010)	119.6*** (18.5)	117.4*** (12.5)	135.4*** (12.66)	206.9*** (16.97)	255.5*** (24.18)
Year (2011)	113.4*** (20.2)	114.5*** (14.29)	134.8*** (14.53)	214.7*** (18.95)	265.5*** (26.52)
Constant	122.6** (51.59)	194*** (40.98)	260.8*** (40.8)	471.6*** (48.64)	687.6*** (69.4)
R-squared	0.865	0.874	0.868	0.847	0.760
Adjusted R-squared	0.864	0.873	0.866	0.845	0.758
F	288.9	443.9	432.7	373.0	286.9
Observations	2016	2016	2016	2016	2016

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 3c: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Levels)

Explanatory Variables [1]	Median Housing Sale Price	Median Home Resale Price	Median New Construction Sale Price
Prev. Year Shale Wells Drilled	-86.91 (86.12)	-139.6* (83.34)	-793*** (263.5)
Prev. Year Shale Wells Drilled Squared	.3579* (.2129)	.4732** (.2187)	6.26*** (1.218)
Population	.6292*** (.152)	.6811*** (.1465)	.285* (.1489)
Per-capita Income ($)	4.228*** (.7591)	4.094*** (.6746)	5.486** (2.34)
Poverty (%)	-943.7 (587.4)	-799.9 (518.3)	-477.9 (2433)
Expected Empl. Growth (%)	-1568** (756.9)	-2336*** (732.8)	-1.0e+04** (4247)
Year (2001)	-652.6 (1920)	-2508 (1786)	-2.4e+04** (1.1e+04)
Year (2002)	410.7 (2202)	-1963 (2011)	-1.7e+04 (1.2e+04)
Year (2003)	5344*** (2033)	4070** (1784)	1507 (1.1e+04)
Year (2004)	8871*** (2644)	8501*** (2312)	2.9e+04*** (1.0e+04)
Year (2005)	1.4e+04*** (3408)	1.4e+04*** (3037)	4.7e+04*** (1.4e+04)
Year (2006)	1.1e+04** (4517)	1.2e+04*** (3995)	4.7e+04*** (1.7e+04)
Year (2007)	6107 (5454)	7395 (4830)	4.0e+04** (1.9e+04)
Year (2008)	-5838 (6863)	-3239 (6006)	4843 (2.5e+04)
Year (2009)	-1.2e+04* (7473)	-1.1e+04* (6545)	-3.3e+04 (2.9e+04)
Year (2010)	-1.1e+04 (7445)	-6461 (6499)	-1.8e+04 (2.6e+04)
Year (2011)	-1.7e+04** (8319)	-1.0e+04 (7362)	-9724 (2.9e+04)
Constant	-1.3e+05*** (3.7e+04)	-1.4e+05*** (3.3e+04)	-5.6e+04 (1.0e+05)
R-squared	0.561	0.637	0.451
Adjusted R-squared	0.556	0.633	0.438
F	29.67	37.12	79.60
Observations	1547	1545	781

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 4a: Two-Way Fixed Effects Regression; Shale Development Employment (Logs)

Explanatory Variables [1]	log(Population)	log(Res. Bldg. Permits) (1 Units)	log(Res. Bldg. Permits) (2 Units)	log(Res. Bldg. Permits) (3-4 Units)	log(Res. Bldg. Permits) (5+ Units)
log(Shale Dev. Empl.)	.0477 (.0933)	.502 (.612)	1.09 (.832)	1.03* (.58)	1.3** (.504)
log(Shale Dev. Empl.) Squared	-.00087 (.00695)	-.0333 (.0453)	-.0746 (.0671)	-.0678 (.0472)	-.0972** (.041)
log(Population)		.705 (.568)	-.00063 (.812)	-.116 (.758)	-.945 (.848)
log(Per-capita Income)	-.383*** (.112)	2.52*** (.96)	1.82* (1.03)	1.8** (.747)	1.01 (.645)
Poverty (%)	-.00165 (.00218)	.00373 (.0154)	-.0128 (.0212)	.0116 (.0186)	.00147 (.0163)
Expected Empl. Growth (%)	-.00378 (.00243)	.0467* (.0275)	.0813** (.0373)	.0519* (.0281)	-.00871 (.0284)
Year (1998)	.023*** (.00623)	-.056 (.0635)	-.182** (.0747)	-.124* (.0729)	-.091 (.0716)
Year (1999)	.0327*** (.0109)	-.0848 (.0934)	-.309** (.121)	-.126 (.104)	-.159 (.0993)
Year (2000)	.0544*** (.0161)	-.298** (.138)	-.529*** (.163)	-.222* (.125)	-.288** (.124)
Year (2001)	.0575** (.0225)	-.207 (.194)	-.416* (.227)	-.235 (.156)	-.344** (.156)
Year (2002)	.0664** (.0256)	-.196 (.214)	-.325 (.247)	-.244 (.171)	-.373** (.166)
Year (2003)	.0825*** (.0269)	-.293 (.227)	-.402 (.246)	-.27 (.168)	-.313* (.178)
Year (2004)	.104*** (.0296)	-.314 (.274)	-.492* (.267)	-.403** (.192)	-.37** (.184)
Year (2005)	.119*** (.0324)	-.619** (.301)	-.712** (.287)	-.532** (.214)	-.298 (.194)
Year (2006)	.138*** (.0381)	-.883** (.346)	-.835** (.341)	-.749*** (.256)	-.535** (.241)
Year (2007)	.158*** (.0438)	-1.15*** (.387)	-1.05*** (.388)	-.913*** (.292)	-.475* (.273)
Year (2008)	.17*** (.0522)	-1.48*** (.449)	-1.17** (.473)	-1.02*** (.358)	-.681** (.302)
Year (2009)	.156*** (.0561)	-1.61*** (.482)	-.976* (.519)	-.993*** (.377)	-.886*** (.328)
Year (2010)	.18*** (.0554)	-1.74*** (.473)	-1.22** (.505)	-1.17*** (.372)	-.916*** (.315)
Year (2011)	.201*** (.0586)	-2.25*** (.501)	-1.45*** (.536)	-1.28*** (.397)	-.854** (.346)
Constant	14.9*** (1.07)	-30.1** (13.8)	-21 (16.2)	-19.9 (12.6)	-2.57 (12)
R-squared	0.202	0.561	0.113	0.096	0.060
Adjusted R-squared	0.195	0.557	0.104	0.088	0.051
F	3.651	52.88	5.038	3.713	3.839
Observations	2175	2175	2175	2175	2175

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 4b: Two-Way Fixed Effects Regression; Shale Development Employment (Logs)

Explanatory Variables [1]	log(FMR) (0 Bedrooms)	log(FMR) (1 Bedrooms)	log(FMR) (2 Bedrooms)	log(FMR) (3 Bedrooms)	log(FMR) (4 Bedrooms)
log(Shale Dev. Empl.)	-.00266 (.122)	.185** (.0845)	.114 (.071)	.0821 (.0757)	.111 (.103)
log(Shale Dev. Empl.) Squared	.00035 (.0094)	-.0137** (.00642)	-.00879 (.00552)	-.00724 (.00589)	-.0106 (.00769)
log(Population)	.115 (.117)	.00361 (.0533)	.00465 (.055)	-.0203 (.0506)	-.104 (.0686)
log(Per-capita Income)	.218** (.105)	.114* (.0672)	.151** (.0608)	.0355 (.0727)	.0141 (.0933)
Poverty (%)	-.00117 (.00222)	.00268 (.00172)	.00011 (.00167)	-.0007 (.00215)	-.00479 (.00337)
Expected Empl. Growth (%)	.00328 (.00499)	.00249 (.00278)	-.00035 (.00261)	-.00232 (.00296)	.00107 (.00371)
Year (1998)	.00952 (.00595)	.016*** (.00396)	.014*** (.00364)	.0209*** (.00422)	.0217*** (.00535)
Year (1999)	.0198** (.00993)	.0318*** (.0062)	.0249*** (.00561)	.0342*** (.00675)	.0364*** (.00847)
Year (2000)	.0199 (.0147)	.04*** (.00934)	.0309*** (.00855)	.0466*** (.0101)	.0466*** (.0129)
Year (2001)	.0427** (.0209)	.0623*** (.0129)	.0475*** (.0117)	.0632*** (.0137)	.0743*** (.0167)
Year (2002)	.074*** (.0234)	.0966*** (.0144)	.0796*** (.0131)	.0956*** (.0153)	.106*** (.0186)
Year (2003)	.0893*** (.0235)	.114*** (.0146)	.0993*** (.0132)	.121*** (.0157)	.132*** (.0196)
Year (2004)	.0817*** (.026)	.11*** (.0163)	.0984*** (.0147)	.128*** (.0177)	.138*** (.023)
Year (2005)	.212*** (.0311)	.152*** (.0189)	.128*** (.0171)	.153*** (.02)	.139*** (.0255)
Year (2006)	.248*** (.0366)	.19*** (.0228)	.163*** (.0204)	.194*** (.0239)	.184*** (.03)
Year (2007)	.279*** (.0416)	.226*** (.0258)	.198*** (.023)	.234*** (.0271)	.226*** (.0343)
Year (2008)	.338*** (.0471)	.287*** (.029)	.252*** (.0254)	.291*** (.0308)	.293*** (.0393)
Year (2009)	.382*** (.0513)	.324*** (.0313)	.283*** (.0274)	.313*** (.0336)	.327*** (.0425)
Year (2010)	.395*** (.0493)	.339*** (.0305)	.307*** (.0268)	.349*** (.0329)	.357*** (.0428)
Year (2011)	.388*** (.0533)	.338*** (.0335)	.309*** (.0298)	.359*** (.0361)	.366*** (.0471)
Constant	2.24 (1.88)	4.09*** (1.11)	4.21*** (1.06)	6.04*** (1.1)	7.34*** (1.46)
R-squared	0.890	0.893	0.888	0.865	0.793
Adjusted R-squared	0.889	0.892	0.887	0.864	0.791
F	612.9	811.8	1011.7	859.6	545.6
Observations	2175	2175	2175	2175	2175

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 4c: Two-Way Fixed Effects Regression; Shale Development Employment (Logs)

Explanatory Variables [1]	log(Median Housing Sale Price)	log(Median Home Resale Price)	log(Median New Construction Sale Price)
log(Shale Dev. Empl.)	.439** (.213)	.417** (.179)	.954 (.829)
log(Shale Dev. Empl.) Squared	-.028* (.0169)	-.0288** (.014)	-.0617 (.0616)
log(Population)	1.62*** (.479)	1.49*** (.38)	.469 (.485)
log(Per-capita Income)	1.5*** (.221)	1.14*** (.184)	1.22** (.609)
Poverty (%)	-.00962** (.00462)	-.00857* (.00438)	.00233 (.0121)
Expected Empl. Growth (%)	-.0171** (.00717)	-.0194*** (.00657)	-.0593*** (.0223)
Year (2001)	-.00545 (.0201)	-.00092 (.0173)	-.163** (.0706)
Year (2002)	.00262 (.0213)	.00942 (.0182)	-.104 (.0763)
Year (2003)	.0474* (.0256)	.0703*** (.0207)	-.013 (.072)
Year (2004)	.0676** (.0326)	.108*** (.0275)	.131* (.077)
Year (2005)	.102*** (.0385)	.152*** (.0328)	.187** (.0896)
Year (2006)	.0611 (.0503)	.133*** (.0419)	.192 (.121)
Year (2007)	-.00938 (.0602)	.091* (.0497)	.135 (.144)
Year (2008)	-.136* (.0745)	.00135 (.0586)	-.0749 (.185)
Year (2009)	-.209*** (.0769)	-.0693 (.0602)	-.297 (.214)
Year (2010)	-.181** (.0792)	-.0242 (.0641)	-.191 (.206)
Year (2011)	-.241*** (.0881)	-.0515 (.0726)	-.164 (.227)
Constant	-24.1*** (6.75)	-18.8*** (5.53)	-9.77 (12.1)
R-squared	0.568	0.653	0.426
Adjusted R-squared	0.563	0.649	0.413
F	59.55	75.53	11.43
Observations	1547	1545	781

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 5a: Two-Way Fixed Effects Regression; Shale Wells Drilled (Logs)

Explanatory Variables [1]	log(Population)	log(Res. Bldg. Permits) (1 Units)	log(Res. Bldg. Permits) (2 Units)	log(Res. Bldg. Permits) (3-4 Units)	log(Res. Bldg. Permits) (5+ Units)
Shale Wells Drilled	-.00019 (.00017)	.00217 (.00163)	.00064 (.00444)	.00234 (.00192)	-.00383 (.00368)
Shale Wells Drilled Squared	6.1e-07 (4.5e-07)	-2.1e-06 (5.1e-06)	7.3e-07 (1.2e-05)	-4.5e-06 (5.4e-06)	1.4e-05 (1.1e-05)
log(Population)		.784 (.595)	.144 (.848)	.0641 (.751)	-.898 (.908)
log(Per-capita Income)	-.357*** (.116)	2.45** (.956)	1.8* (1.03)	1.78** (.729)	.998 (.636)
Poverty (%)	-.00215 (.00231)	.00601 (.0156)	-.012 (.021)	.0125 (.0188)	.002 (.0166)
Expected Empl. Growth (%)	-.00222 (.00266)	.0458* (.0256)	.0824** (.0366)	.0535* (.0289)	-.00972 (.0302)
Year (1998)	.0217*** (.0065)	-.0491 (.063)	-.179** (.0757)	-.12 (.0725)	-.0888 (.071)
Year (1999)	.0325*** (.0122)	-.073 (.0926)	-.302** (.122)	-.116 (.105)	-.158 (.0997)
Year (2000)	.0525*** (.0176)	-.26** (.137)	-.52*** (.165)	-.209* (.125)	-.285** (.123)
Year (2001)	.0609** (.0258)	-.186 (.19)	-.398* (.227)	-.21 (.157)	-.343** (.158)
Year (2002)	.0682** (.0288)	-.175 (.21)	-.309 (.248)	-.223 (.171)	-.371** (.168)
Year (2003)	.0844*** (.0302)	-.267 (.223)	-.38 (.246)	-.242 (.168)	-.307* (.177)
Year (2004)	.105*** (.0327)	-.283 (.272)	-.469* (.268)	-.374* (.192)	-.364** (.183)
Year (2005)	.12*** (.0357)	-.587* (.299)	-.688** (.287)	-.499** (.212)	-.295 (.193)
Year (2006)	.14*** (.0418)	-.85** (.345)	-.812** (.341)	-.717*** (.254)	-.537** (.241)
Year (2007)	.16*** (.048)	-1.11*** (.384)	-1.02*** (.389)	-.876*** (.29)	-.473* (.272)
Year (2008)	.175*** (.0579)	-1.45*** (.445)	-1.14** (.473)	-.984*** (.355)	-.679** (.304)
Year (2009)	.165*** (.0629)	-1.6*** (.472)	-.951* (.517)	-.962** (.375)	-.878*** (.334)
Year (2010)	.185*** (.0607)	-1.73*** (.465)	-1.2** (.505)	-1.15*** (.368)	-.907*** (.318)
Year (2011)	.204*** (.0637)	-2.24*** (.494)	-1.43*** (.537)	-1.26*** (.392)	-.847** (.347)
Constant	14.9*** (1.15)	-28.4** (12.9)	-18.6 (16.3)	-17.9 (12.2)	1.14 (12.5)
R-squared	0.174	0.566	0.111	0.094	0.058
Adjusted R-squared	0.167	0.562	0.102	0.085	0.049
F	3.786	57.03	4.997	3.645	3.652
Observations	2160	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 5b: Two-Way Fixed Effects Regression; Shale Wells Drilled (Logs)

Explanatory Variables [1]	log(FMR) (0 Bedrooms)	log(FMR) (1 Bedrooms)	log(FMR) (2 Bedrooms)	log(FMR) (3 Bedrooms)	log(FMR) (4 Bedrooms)
Shale Wells Drilled	-3.2e-06 (.00031)	-.00026 (.00021)	-.00041** (.0002)	-.00052** (.00022)	-.00082*** (.00031)
Shale Wells Drilled Squared	-4.4e-07 (7.6e-07)	8.1e-07 (5.8e-07)	1.0e-06* (5.5e-07)	1.3e-06* (6.5e-07)	2.4e-06*** (9.0e-07)
log(Population)	.125 (.117)	.0209 (.0504)	.0112 (.052)	-.0258 (.0479)	-.124* (.0661)
log(Per-capita Income)	.237** (.102)	.121* (.0661)	.161*** (.0584)	.0402 (.07)	.00585 (.0898)
Poverty (%)	-.00141 (.00226)	.00264 (.00175)	-3.3e-05 (.00168)	-.0008 (.00214)	-.00471 (.00336)
Expected Empl. Growth (%)	.00335 (.00495)	.00226 (.00278)	-.00052 (.00257)	-.00282 (.00292)	-8.4e-05 (.00384)
Year (1998)	.00858 (.00586)	.0161*** (.0039)	.0136*** (.00351)	.0208*** (.00406)	.0224*** (.00516)
Year (1999)	.0183* (.00991)	.0315*** (.00615)	.0239*** (.00553)	.0331*** (.00668)	.0355*** (.00839)
Year (2000)	.0174 (.0146)	.0398*** (.00923)	.0295*** (.00825)	.0455*** (.00971)	.0466*** (.0126)
Year (2001)	.0401* (.0209)	.0618*** (.0127)	.0455*** (.0116)	.0601*** (.0137)	.0702*** (.0169)
Year (2002)	.0712*** (.0233)	.0961*** (.0142)	.0777*** (.0129)	.0932*** (.0152)	.104*** (.0185)
Year (2003)	.0863*** (.0234)	.114*** (.0145)	.0976*** (.013)	.119*** (.0155)	.129*** (.0194)
Year (2004)	.0781*** (.0259)	.11*** (.0163)	.0963*** (.0145)	.125*** (.0174)	.137*** (.0224)
Year (2005)	.21*** (.0312)	.152*** (.019)	.125*** (.017)	.149*** (.0197)	.135*** (.0249)
Year (2006)	.245*** (.0367)	.189*** (.0227)	.16*** (.0201)	.19*** (.0236)	.18*** (.0294)
Year (2007)	.276*** (.0416)	.226*** (.0258)	.195*** (.0227)	.23*** (.0267)	.222*** (.0336)
Year (2008)	.334*** (.0471)	.286*** (.0289)	.249*** (.0253)	.287*** (.0306)	.288*** (.0389)
Year (2009)	.379*** (.0511)	.324*** (.0309)	.281*** (.0272)	.31*** (.0334)	.322*** (.0424)
Year (2010)	.392*** (.0491)	.34*** (.0302)	.306*** (.0265)	.347*** (.0325)	.356*** (.042)
Year (2011)	.385*** (.0531)	.339*** (.0334)	.308*** (.0295)	.358*** (.0356)	.365*** (.046)
Constant	1.99 (1.83)	4.48*** (1.03)	4.43*** (.991)	6.32*** (1.04)	7.94*** (1.37)
R-squared	0.897	0.898	0.894	0.871	0.798
Adjusted R-squared	0.896	0.897	0.893	0.870	0.796
F	973.6	1585.2	1934.1	1417.9	913.3
Observations	2160	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 5c: Two-Way Fixed Effects Regression; Shale Wells Drilled (Logs)

Explanatory Variables [1]	log(Median Housing Sale Price)	log(Median Home Resale Price)	log(Median New Construction Sale Price)
Shale Wells Drilled	-.00112 (.00109)	-.00134 (.00097)	-.00443*** (.00127)
Shale Wells Drilled Squared	6.4e-06 (4.0e-06)	6.8e-06* (3.7e-06)	2.6e-05*** (5.8e-06)
log(Population)	1.67*** (.483)	1.52*** (.378)	.473 (.47)
log(Per-capita Income)	1.54*** (.225)	1.17*** (.185)	1.29** (.593)
Poverty (%)	-.0098** (.00454)	-.00869** (.00426)	.00142 (.0125)
Expected Empl. Growth (%)	-.0145** (.00672)	-.0179*** (.00615)	-.0589*** (.0218)
Year (2001)	.00358 (.0193)	.00376 (.0164)	-.159** (.0719)
Year (2002)	.0102 (.0212)	.0136 (.0179)	-.104 (.0772)
Year (2003)	.0559** (.0252)	.0752*** (.0202)	-.0134 (.0732)
Year (2004)	.0718** (.0327)	.11*** (.0271)	.129 (.0777)
Year (2005)	.106*** (.0382)	.152*** (.032)	.184* (.0942)
Year (2006)	.0638 (.05)	.132*** (.0411)	.187 (.125)
Year (2007)	-.00669 (.0606)	.0901* (.0495)	.129 (.15)
Year (2008)	-.128* (.0752)	.00364 (.0591)	-.0802 (.194)
Year (2009)	-.194** (.0775)	-.0616 (.0611)	-.299 (.222)
Year (2010)	-.176** (.0797)	-.0218 (.0645)	-.195 (.21)
Year (2011)	-.238*** (.0883)	-.0515 (.0724)	-.171 (.23)
Constant	-23.5*** (7.15)	-18*** (5.62)	-6.9 (9.56)
R-squared	0.565	0.651	0.426
Adjusted R-squared	0.560	0.647	0.413
F	58.78	197.0	34.27
Observations	1547	1545	781

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 6a: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Logs)

Explanatory Variables [1]	log(Population)	log(Res. Bldg. Permits) (1 Units)	log(Res. Bldg. Permits) (2 Units)	log(Res. Bldg. Permits) (3-4 Units)	log(Res. Bldg. Permits) (5+ Units)
Prev. Year Shale Wells Drilled	-.0001 (.00019)	.00273 (.00195)	3.1e-05 (.00459)	.00212 (.00194)	-.0022 (.00406)
Prev. Year Shale Wells Drilled	5.1e-07 (5.4e-07)	-3.9e-06 (5.4e-06)	7.4e-07 (1.2e-05)	-4.4e-06 (5.8e-06)	8.4e-06 (1.2e-05)
log(Population)		.577 (.643)	.505 (.87)	.128 (.894)	-.982 (.882)
log(Per-capita Income)	-.358*** (.109)	2.35** (.919)	1.77 (1.08)	1.65** (.72)	.757 (.651)
Poverty (%)	-.0026 (.00233)	.00655 (.0155)	-.00951 (.0198)	.0141 (.0182)	.00883 (.0164)
Expected Empl. Growth (%)	-.00397* (.00226)	.0351 (.0257)	.0646* (.0382)	.0399 (.0297)	-.0199 (.0294)
Year (1999)	.00932* (.00551)	-.0277 (.038)	-.134* (.0805)	-.00033 (.0814)	-.0639 (.0822)
Year (2000)	.0298*** (.0108)	-.224*** (.0785)	-.342*** (.119)	-.0807 (.0996)	-.17* (.0925)
Year (2001)	.0346* (.0177)	-.151 (.13)	-.26 (.194)	-.109 (.133)	-.247* (.134)
Year (2002)	.0412** (.0205)	-.141 (.148)	-.178 (.22)	-.125 (.152)	-.272* (.141)
Year (2003)	.0591*** (.0219)	-.22 (.158)	-.234 (.212)	-.129 (.141)	-.195 (.147)
Year (2004)	.0816*** (.0244)	-.221 (.204)	-.305 (.231)	-.242 (.153)	-.235 (.149)
Year (2005)	.0987*** (.0273)	-.516** (.231)	-.516** (.25)	-.358** (.174)	-.161 (.167)
Year (2006)	.118*** (.0329)	-.776*** (.275)	-.644** (.306)	-.574*** (.211)	-.396* (.214)
Year (2007)	.138*** (.0387)	-1.03*** (.313)	-.854** (.355)	-.726*** (.247)	-.32 (.245)
Year (2008)	.15*** (.0471)	-1.38*** (.369)	-1** (.451)	-.853*** (.319)	-.542* (.28)
Year (2009)	.134*** (.0505)	-1.57*** (.396)	-.873* (.508)	-.875** (.347)	-.785** (.314)
Year (2010)	.159*** (.0493)	-1.66*** (.389)	-1.07** (.484)	-1.02*** (.328)	-.777*** (.296)
Year (2011)	.181*** (.0524)	-2.16*** (.416)	-1.27** (.512)	-1.11*** (.35)	-.692** (.324)
Constant	15*** (1.08)	-25.1* (13.1)	-22.5 (17.2)	-17.5 (13.4)	4.37 (12.6)
R-squared	0.186	0.579	0.104	0.095	0.055
Adjusted R-squared	0.179	0.575	0.096	0.086	0.046
F	4.077	62.35	4.733	3.787	3.475
Observations	2016	2016	2016	2016	2016

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 6b: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Logs)

Explanatory Variables [1]	log(FMR) (0 Bedrooms)	log(FMR) (1 Bedrooms)	log(FMR) (2 Bedrooms)	log(FMR) (3 Bedrooms)	log(FMR) (4 Bedrooms)
Prev. Year Shale Wells Drilled	-.00031 (.00035)	-.0004 (.00029)	-.00061** (.00026)	-.00074*** (.00026)	-.001*** (.00033)
Prev. Year Shale Wells Drilled	3.8e-07 (8.4e-07)	1.2e-06 (7.9e-07)	1.5e-06** (7.2e-07)	1.9e-06** (7.3e-07)	3.0e-06*** (9.7e-07)
log(Population)	.136 (.141)	.0193 (.0575)	.00862 (.0572)	-.0342 (.0553)	-.142* (.0791)
log(Per-capita Income)	.273** (.108)	.144** (.0702)	.187*** (.0624)	.0634 (.0742)	.0275 (.0956)
Poverty (%)	-.00154 (.00238)	.00214 (.00181)	-.00062 (.00172)	-.00152 (.00211)	-.00537 (.00335)
Expected Empl. Growth (%)	.00457 (.00498)	.00305 (.0028)	5.4e-05 (.00263)	-.00176 (.00301)	.00116 (.00395)
Year (1999)	.00929 (.0061)	.0149*** (.00385)	.0095*** (.00362)	.0118*** (.00418)	.013** (.00504)
Year (2000)	.00591 (.0101)	.0214*** (.00661)	.0132** (.00607)	.0222*** (.00695)	.0221** (.00888)
Year (2001)	.0303* (.018)	.0447*** (.0109)	.03*** (.0102)	.0389*** (.0119)	.0482*** (.0145)
Year (2002)	.0612*** (.0206)	.0787*** (.0124)	.0619*** (.0115)	.0717*** (.0134)	.0817*** (.0162)
Year (2003)	.0743*** (.0199)	.0958*** (.0123)	.0808*** (.0112)	.0959*** (.0132)	.106*** (.0165)
Year (2004)	.0632*** (.0219)	.09*** (.0138)	.0782*** (.0124)	.101*** (.0148)	.111*** (.0191)
Year (2005)	.193*** (.0274)	.131*** (.0166)	.107*** (.0149)	.124*** (.0172)	.109*** (.0217)
Year (2006)	.227*** (.0331)	.168*** (.0205)	.141*** (.0183)	.164*** (.0212)	.153*** (.0265)
Year (2007)	.256*** (.0383)	.203*** (.0238)	.174*** (.0211)	.204*** (.0246)	.194*** (.0309)
Year (2008)	.315*** (.0441)	.264*** (.0268)	.228*** (.0236)	.261*** (.0285)	.261*** (.0365)
Year (2009)	.365*** (.0487)	.305*** (.0289)	.262*** (.0255)	.288*** (.0315)	.3*** (.0406)
Year (2010)	.373*** (.0462)	.319*** (.0282)	.287*** (.0248)	.323*** (.0303)	.331*** (.0396)
Year (2011)	.364*** (.0501)	.316*** (.0314)	.287*** (.0278)	.332*** (.0334)	.338*** (.0435)
Constant	1.5 (2.14)	4.29*** (1.13)	4.22*** (1.08)	6.2*** (1.15)	7.95*** (1.57)
R-squared	0.890	0.892	0.887	0.863	0.784
Adjusted R-squared	0.889	0.891	0.886	0.862	0.782
F	960.4	1677.2	1793.0	1376.3	897.0
Observations	2016	2016	2016	2016	2016

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 6c: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Logs)

Explanatory Variables [1]	log(Median Housing Sale Price)	log(Median Home Resale Price)	log(Median New Construction Sale Price)
Prev. Year Shale Wells Drilled	-.00027 (.00079)	-.00042 (.00068)	-.0041*** (.00128)
Prev. Year Shale Wells Drilled Squared	2.2e-06 (2.0e-06)	2.5e-06 (1.8e-06)	2.9e-05*** (5.8e-06)
log(Population)	1.68*** (.484)	1.53*** (.38)	.475 (.47)
log(Per-capita Income)	1.52*** (.229)	1.14*** (.189)	1.24** (.592)
Poverty (%)	-.00979** (.00458)	-.00862** (.00431)	.00188 (.0125)
Expected Empl. Growth (%)	-.0148** (.00694)	-.0184*** (.00638)	-.061*** (.0219)
Year (2001)	.00342 (.0196)	.00336 (.0167)	-.164** (.0722)
Year (2002)	.0102 (.0215)	.0136 (.0183)	-.108 (.0774)
Year (2003)	.0567** (.0255)	.076*** (.0204)	-.0143 (.0733)
Year (2004)	.0737** (.0332)	.112*** (.0276)	.132* (.0776)
Year (2005)	.108*** (.0388)	.155*** (.0327)	.188** (.0943)
Year (2006)	.0671 (.0507)	.136*** (.0419)	.193 (.125)
Year (2007)	-.00289 (.0614)	.0946* (.0504)	.136 (.15)
Year (2008)	-.125 (.0762)	.00745 (.06)	-.0764 (.194)
Year (2009)	-.193** (.0784)	-.0605 (.0619)	-.302 (.223)
Year (2010)	-.172** (.0807)	-.0176 (.0655)	-.192 (.21)
Year (2011)	-.234*** (.0892)	-.0473 (.0735)	-.164 (.23)
Constant	-23.4*** (7.19)	-17.8*** (5.67)	-6.45 (9.55)
R-squared	0.563	0.650	0.425
Adjusted R-squared	0.558	0.646	0.412
F	49.92	58.76	40.73
Observations	1547	1545	781

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 7a: Two-Way Fixed Effects Regression; Shale Development Employment (Percent Change)

Explanatory Variables [1]	Percent Increase in Population	Percent Increase in Res. Bldg. Permits (1 Units)	Percent Increase in Res. Bldg. Permits (2 Units)	Percent Increase in Res. Bldg. Permits (3-4 Units)	Percent Increase in Res. Bldg. Permits (5+ Units)
Percent Increase in Shale Dev. Empl.	.021 (.042)	-3.12 (6.76)	.847 (1.55)	-.894 (2.27)	.328 (2.61)
Percent Increase in Shale Dev. Empl. Squared	1.5e-03 (3.2e-03)	.621* (.338)	.072 (.145)	.178 (.172)	5.2e-05 (.162)
Percent Increase in Population		3.91 (3.7)	-2.53 (2.19)	-2.62 (2.24)	6.24 (4.4)
Percent Increase in Per-capita Income	-.079** (.036)	-2.29 (2.54)	-.175 (.986)	-.547 (2.17)	.669 (1.35)
Poverty (%)	-.018 (.022)	-.992 (4.74)	-3.53* (1.94)	1.1 (1.78)	-2.43 (2.38)
Expected Empl. Growth (%)	.207*** (.042)	-2.27 (4.39)	-3.39 (3.44)	8.44 (8.69)	-6.96 (6.08)
Year (1998)	-.051 (.1)	18*** (4.18)	-8.78 (10.3)	-15.6 (19)	-8.92 (24.9)
Year (1999)	-.087 (.185)	3.41 (8.92)	-18.4** (8.59)	5.73 (16.3)	-4.77 (27.9)
Year (2000)	-.028 (.112)	-1.42 (6.31)	-17.4** (6.72)	6.89 (22.8)	-25.8 (28.5)
Year (2001)	.268 (.197)	1.98 (16.2)	-17.5 (13.3)	-1.29 (20.4)	-31.9 (28.9)
Year (2002)	.334 (.205)	-5.84 (23.2)	.363 (13.8)	35.3 (48.4)	-19.7 (34.3)
Year (2003)	.35** (.172)	2.01 (16.6)	10.5 (17.2)	35.6 (26.5)	-13.7 (26.7)
Year (2004)	.056 (.151)	63.6* (35.8)	11.7 (12.6)	-.86 (16.8)	-15.6 (25.8)
Year (2005)	-.156 (.218)	-13*** (4.64)	2.86 (12.2)	-7.76 (18.3)	30.8 (30.2)
Year (2006)	.134 (.152)	-5.61 (5.87)	2.69 (10.5)	-16.1 (17.7)	-33.5 (22.4)
Year (2007)	.043 (.141)	17.4 (19.2)	-11.6 (8.54)	-19.1 (17.2)	-8.85 (23.4)
Year (2008)	.339** (.153)	-15.9 (10.5)	-19.8 (12.2)	-12.7 (23.4)	-26.1 (31)
Year (2009)	.456 (.317)	-45.2 (31.7)	-30.7 (18.6)	12.1 (35)	-68.5* (38.5)
Year (2010)	.23 (.198)	13 (13)	-9.05 (11.3)	4.74 (20.5)	-30.7 (24.4)
Year (2011)	-.052 (.168)	-17.3 (14.1)	10.8 (16.3)	6.55 (16.3)	-23.2 (23.4)
Constant	.44 (.331)	23.2 (68.6)	54.3** (27.2)	-9.81 (29.6)	63.1 (40.4)
R-squared	0.081	0.024	0.017	0.009	0.010
Adjusted R-squared	0.073	0.015	0.008	-0.000	0.001
F	8.102	22.29	2.075	2.095	2.137
Observations	2175	2175	2175	2175	2175

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 7b: Two-Way Fixed Effects Regression; Shale Development Employment (Percent Change)

Explanatory Variables[1]	Percent Increase in FMR (0 Bedrooms)	Percent Increase in FMR (1 Bedrooms)	Percent Increase in FMR (2 Bedrooms)	Percent Increase in FMR (3 Bedrooms)	Percent Increase in FMR (4 Bedrooms)
Percent Increase in Shale Dev. Empl.	-.276*** (.084)	-.12 (.074)	-.084 (.079)	-.156* (.092)	-.077 (.115)
Percent Increase in Shale Dev. Empl. Squared	-.04*** (4.9e-03)	-.017*** (5.2e-03)	-.017*** (6.2e-03)	-.027*** (5.4e-03)	-.01 (8.8e-03)
Percent Increase in Population	.133 (.111)	.032 (.079)	.025 (.099)	.028 (.103)	-.095 (.137)
Percent Increase in Per-capita Income	.096* (.051)	.093** (.043)	.107** (.043)	.117*** (.044)	.083* (.046)
Poverty (%)	-.198** (.083)	-.132* (.069)	-.188*** (.068)	-.227*** (.07)	-.274*** (.083)
Expected Empl. Growth (%)	.287* (.152)	.321*** (.106)	.313*** (.104)	.353*** (.123)	.503*** (.147)
Year (1998)	.287* (.171)	.242 (.166)	.241 (.166)	.229 (.168)	.313* (.177)
Year (1999)	-.012 (.278)	-.022 (.27)	-.023 (.271)	-.013 (.277)	9.4e-03 (.283)
Year (2000)	-.689** (.302)	-.62** (.291)	-.699** (.294)	-.746** (.296)	-.755** (.308)
Year (2001)	1.08** (.5)	1.17*** (.424)	1.14*** (.431)	1.23*** (.459)	1.46*** (.498)
Year (2002)	2.43*** (.406)	2.58*** (.297)	2.63*** (.301)	2.68*** (.34)	2.98*** (.405)
Year (2003)	1.14*** (.293)	1.21*** (.226)	1.15*** (.233)	1.23*** (.251)	1.4*** (.303)
Year (2004)	-1.23*** (.134)	-1.22*** (.113)	-1.19*** (.115)	-1.18*** (.123)	-1.09*** (.136)
Year (2005)	14*** (.965)	3.69*** (.562)	2.08*** (.522)	1.12* (.6)	-1.66** (.769)
Year (2006)	3.24*** (.505)	2.86*** (.462)	2.88*** (.473)	2.97*** (.44)	3.1*** (.437)
Year (2007)	2.79*** (.16)	2.63*** (.139)	2.72*** (.141)	2.76*** (.146)	2.88*** (.159)
Year (2008)	5.7*** (.588)	5.63*** (.547)	5.72*** (.548)	5.87*** (.572)	6.29*** (.619)
Year (2009)	3.73*** (.867)	3.73*** (.645)	3.93*** (.643)	4.28*** (.728)	4.98*** (.902)
Year (2010)	2.48*** (.494)	2.27*** (.399)	2.49*** (.4)	2.8*** (.45)	3.3*** (.545)
Year (2011)	-.022 (.382)	-.263 (.338)	-.082 (.335)	.088 (.35)	.379 (.403)
Constant	3.15*** (.994)	2.36*** (.819)	2.94*** (.812)	3.28*** (.842)	3.69*** (.97)
R-squared	0.434	0.212	0.197	0.189	0.193
Adjusted R-squared	0.429	0.205	0.190	0.181	0.185
F	212.5	212.2	215.3	179.2	168.9
Observations	2160	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 7c: Two-Way Fixed Effects Regression; Shale Development Employment (Percent Change)

Explanatory Variables [1]	Percent Increase in Median Housing Sale Price	Percent Increase in Median Home Resale Price	Percent Increase in Median New Construction Sale Price
Percent Increase in Shale Dev. Empl. Share	1.19* (.715)	1.05 (.753)	-.267 (6.78)
Percent Increase in Shale Dev. Empl. Share Squared	.229*** (.066)	.213*** (.068)	.939 (16.6)
Percent Increase in Population	1.77*** (.498)	1.59*** (.528)	-.904 (1.64)
Percent Increase in Per-capita Income	.055 (.158)	-.02 (.18)	-1.15** (.576)
Poverty (%)	.087 (.218)	.039 (.227)	4.6e-03 (.841)
Expected Empl. Growth (%)	-1.64* (.975)	-1.7* (.936)	.719 (2.72)
Year (2002)	-3.57** (1.69)	-3.68** (1.68)	9.09** (4.5)
Year (2003)	1.26 (2.5)	1.75 (2.35)	6.83 (4.2)
Year (2004)	.574 (1.84)	1.14 (1.83)	11 (6.69)
Year (2005)	3.08 (2.71)	3.21 (2.58)	5.84 (6.38)
Year (2006)	-.71 (2.46)	.299 (2.36)	7.29 (7.6)
Year (2007)	-3.46 (2.51)	-1.87 (2.41)	1.66 (6.99)
Year (2008)	-10.3*** (1.38)	-7.59*** (1.32)	-4.22 (3.4)
Year (2009)	-16.8*** (2.97)	-15.1*** (3.03)	-7.89 (8.45)
Year (2010)	-6.04*** (1.31)	-5.69*** (1.32)	-2.62 (4.44)
Year (2011)	-7.33*** (2.05)	-5.64*** (2.08)	5.83 (6.82)
Constant	6.07** (2.67)	6.55** (2.75)	5.86 (8.54)
R-squared	0.139	0.113	0.074
Adjusted R-squared	0.129	0.103	0.052
F	34.79	29.10	8.662
Observations	1401	1398	674

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction
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Table 8a: Two-Way Fixed Effects Regression; Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Percent Increase in Population	Percent Increase in Res. Bldg. Permits (1 Units)	Percent Increase in Res. Bldg. Permits (2 Units)	Percent Increase in Res. Bldg. Permits (3-4 Units)	Percent Increase in Res. Bldg. Permits (5+ Units)
Shale Wells Drilled	5.2e-03*** (1.9e-03)	.147 (.118)	-.176 (.171)	-.05 (.211)	.106 (.196)
Shale Wells Drilled Squared	-6.8e-06 (4.3e-06)	-2.6e-05 (4.6e-04)	8.6e-05 (4.4e-04)	9.4e-05 (5.4e-04)	-2.3e-04 (5.1e-04)
Percent Increase in Population		3.61 (3.58)	-2.22 (2.17)	-2.59 (2.29)	6.14 (4.39)
Percent Increase in Per-capita Income	-.081** (.036)	-2.46 (2.69)	-.01 (.978)	-.533 (2.17)	.648 (1.36)
Poverty (%)	-.012 (.022)	-.742 (4.71)	-3.81* (1.96)	1.05 (1.83)	-2.33 (2.43)
Expected Empl. Growth (%)	.202*** (.038)	-3.23 (5.12)	-3.09 (3.38)	8.26 (8.75)	-7.04 (6.02)
Year (1998)	-.049 (.101)	18.4*** (4.45)	-9.09 (10.3)	-15.7 (19.1)	-8.94 (25.1)
Year (1999)	-.086 (.186)	2.93 (9.86)	-18.3** (8.57)	5.65 (16.4)	-4.75 (28)
Year (2000)	-.019 (.112)	-.872 (6.35)	-17.9** (6.79)	6.94 (23)	-25.8 (26.7)
Year (2001)	.261 (.194)	-.508 (18.8)	-16.7 (13.2)	-1.92 (20.8)	-32.1 (29)
Year (2002)	.319 (.207)	-7.55 (24.8)	1.27 (13.8)	35.2 (48.8)	-19.9 (34.5)
Year (2003)	.345** (.172)	.096 (18.9)	11.3 (17)	35.3 (26.7)	-13.7 (26.7)
Year (2004)	.052 (.151)	63.5* (35.2)	12 (12.6)	-1 (17)	-15.7 (26)
Year (2005)	-.163 (.215)	-13.9*** (4.8)	3.59 (12.2)	-7.83 (18.4)	31 (30.3)
Year (2006)	.123 (.152)	-6.35 (5.44)	3.14 (10.6)	-16.2 (17.9)	-33.9 (22.5)
Year (2007)	.032 (.142)	16.9 (19)	-11.2 (8.58)	-19.2 (17.3)	-9.06 (23.5)
Year (2008)	.307** (.148)	-19* (10.7)	-18.3 (12.1)	-13.2 (23.5)	-26.7 (31.1)
Year (2009)	.373 (.323)	-51.8 (35.7)	-26.7 (18.6)	11.7 (35.1)	-70.1* (38.2)
Year (2010)	.152 (.202)	8.07 (13.2)	-5.43 (11.5)	4.7 (20.6)	-32.1 (24.7)
Year (2011)	-.128 (.171)	-21.7* (12.5)	14.5 (17)	6.77 (16.8)	-24.5 (23.4)
Constant	.384 (.335)	22.9 (70.5)	56.1** (27.2)	-8.94 (30.2)	62.3 (41)
R-squared	0.087	0.024	0.018	0.009	0.010
Adjusted R-squared	0.079	0.015	0.009	-0.000	0.001
F	10.71	21.56	2.173	1.948	2.008
Observations	2160	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 8b: Two-Way Fixed Effects Regression; Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Percent Increase in FMR (0 Bedrooms)	Percent Increase in FMR (1 Bedrooms)	Percent Increase in FMR (2 Bedrooms)	Percent Increase in FMR (3 Bedrooms)	Percent Increase in FMR (4 Bedrooms)
Shale Wells Drilled	-.032** (.014)	-.025** (.013)	-.025* (.013)	-.025* (.014)	-.022 (.015)
Shale Wells Drilled Squared	9.4e-05** (4.1e-05)	7.1e-05* (3.7e-05)	7.2e-05* (3.9e-05)	7.0e-05* (4.1e-05)	6.0e-05 (4.3e-05)
Percent Increase in Population	.145 (.115)	.044 (.079)	.037 (.099)	.039 (.102)	-.082 (.136)
Percent Increase in Per-capita Income	.091* (.051)	.094** (.044)	.108** (.043)	.115** (.045)	.085* (.046)
Poverty (%)	-.212** (.083)	-.146** (.07)	-.201*** (.068)	-.24*** (.069)	-.288*** (.083)
Expected Empl. Growth (%)	.289* (.149)	.331*** (.105)	.328*** (.103)	.362*** (.121)	.514*** (.145)
Year (1998)	.291* (.17)	.239 (.165)	.237 (.166)	.229 (.168)	.308* (.177)
Year (1999)	-.059 (.277)	-.039 (.268)	-.034 (.269)	-.038 (.275)	7.7e-05 (.282)
Year (2000)	-.734** (.292)	-.65** (.284)	-.727** (.287)	-.779*** (.29)	-.781** (.301)
Year (2001)	1.02** (.496)	1.17*** (.42)	1.16*** (.428)	1.21*** (.456)	1.47*** (.492)
Year (2002)	2.44*** (.403)	2.61*** (.295)	2.66*** (.299)	2.71*** (.338)	3.01*** (.401)
Year (2003)	1.08*** (.293)	1.2*** (.224)	1.16*** (.232)	1.21*** (.252)	1.4*** (.299)
Year (2004)	-1.25*** (.135)	-1.22*** (.113)	-1.19*** (.116)	-1.18*** (.124)	-1.09*** (.135)
Year (2005)	13.9*** (.97)	3.67*** (.562)	2.07*** (.523)	1.1* (.601)	-1.66** (.766)
Year (2006)	3.24*** (.508)	2.88*** (.464)	2.9*** (.476)	2.97*** (.442)	3.12*** (.438)
Year (2007)	2.79*** (.157)	2.65*** (.137)	2.74*** (.139)	2.77*** (.144)	2.9*** (.158)
Year (2008)	5.77*** (.562)	5.71*** (.522)	5.82*** (.521)	5.95*** (.545)	6.38*** (.595)
Year (2009)	3.92*** (.887)	3.94*** (.666)	4.16*** (.664)	4.47*** (.747)	5.2*** (.921)
Year (2010)	2.66*** (.511)	2.46*** (.412)	2.69*** (.412)	2.97*** (.463)	3.5*** (.561)
Year (2011)	.146 (.38)	-.085 (.33)	.101 (.325)	.245 (.337)	.559 (.398)
Constant	3.32*** (.98)	2.5*** (.813)	3.05*** (.804)	3.41*** (.83)	3.82*** (.957)
R-squared	0.435	0.214	0.199	0.190	0.194
Adjusted R-squared	0.429	0.207	0.192	0.183	0.186
F	215.5	199.6	194.9	166.8	159.8
Observations	2160	2160	2160	2160	2160

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 8c: Two-Way Fixed Effects Regression; Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Percent Increase in Median Housing Sale Price	Percent Increase in Median Home Resale Price	Percent Increase in Median New Construction Sale Price
Shale Wells Drilled	-4.1e-03 (.041)	-1.5e-03 (.047)	-.04 (.083)
Shale Wells Drilled Squared	1.2e-04 (1.7e-04)	1.3e-04 (1.9e-04)	1.0e-03** (4.6e-04)
Percent Increase in Population	1.73*** (.52)	1.55*** (.553)	-1.04 (1.63)
Percent Increase in Per-capita Income	.079 (.163)	-4.2e-03 (.182)	-1.21** (.581)
Poverty (%)	.095 (.227)	.05 (.235)	.113 (.847)
Expected Empl. Growth (%)	-1.52 (.926)	-1.6* (.881)	.801 (2.54)
Year (2002)	-3.79** (1.77)	-3.87** (1.78)	9.15* (4.68)
Year (2003)	1.2 (2.49)	1.71 (2.34)	6.91 (4.18)
Year (2004)	.206 (1.8)	.841 (1.78)	11* (6.25)
Year (2005)	2.89 (2.69)	3.07 (2.57)	5.62 (6.21)
Year (2006)	-1.09 (2.4)	-7.2e-03 (2.28)	7.13 (7.16)
Year (2007)	-3.85 (2.5)	-2.18 (2.39)	1.56 (6.38)
Year (2008)	-10.5*** (1.42)	-7.71*** (1.37)	-4.3 (3.36)
Year (2009)	-16.7*** (2.76)	-15.1*** (2.79)	-8.2 (8.39)
Year (2010)	-6.3*** (1.38)	-5.98*** (1.4)	-3.29 (4.45)
Year (2011)	-7.66*** (2.19)	-5.97*** (2.21)	5.08 (6.82)
Constant	6.2** (2.8)	6.63** (2.88)	4.92 (8.67)
R-squared	0.137	0.111	0.076
Adjusted R-squared	0.127	0.101	0.054
F	27.85	25.68	53.67
Observations	1401	1398	674

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction
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Table 9a: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Percent Increase in Population	Percent Increase in Res. Bldg. Permits (1 Units)	Percent Increase in Res. Bldg. Permits (2 Units)	Percent Increase in Res. Bldg. Permits (3-4 Units)	Percent Increase in Res. Bldg. Permits (5+ Units)
Prev. Year Shale Wells Drilled	6.2e-03*** (2.2e-03)	.302 (.24)	-.147 (.234)	-.265 (.323)	.053 (.262)
Prev. Year Shale Wells Drilled Squared	-9.2e-06 (6.0e-06)	-8.8e-04 (6.5e-04)	-1.6e-04 (6.8e-04)	6.1e-04 (7.9e-04)	-3.0e-05 (7.1e-04)
Percent Increase in Population		3.91 (6.05)	-2.91 (2.87)	-.51 (3.04)	8.48 (6.69)
Percent Increase in Per-capita Income	-.061** (.025)	-2.33 (2.59)	.077 (1.01)	-.901 (2.32)	-.589 (1.19)
Poverty (%)	-.014 (.023)	-1.09 (5.22)	-4.04* (2.14)	1.87 (2.05)	-1.34 (2.57)
Expected Empl. Growth (%)	.169*** (.037)	-4.13 (5.87)	-3.25 (3.66)	7.12 (8.65)	-6.56 (6.04)
Year (1999)	-.015 (.088)	-16.1 (13.6)	-9.2 (10.1)	20.1 (16)	2.15 (21.4)
Year (2000)	.029 (.053)	-19.9** (9.62)	-9.02 (9.67)	25 (20.4)	-16.3 (20.1)
Year (2001)	.286** (.116)	-21 (24.1)	-7.86 (14.2)	10.3 (20.7)	-25.1 (19.4)
Year (2002)	.356*** (.131)	-28.4 (30.6)	10.1 (17)	46.7 (49.1)	-14.1 (28.6)
Year (2003)	.391*** (.093)	-20 (24)	20.4 (17.6)	47.7* (25.7)	-7.71 (18.4)
Year (2004)	.109 (.067)	44.5 (31.8)	21.2* (12)	13.1 (13.4)	-8.6 (20.3)
Year (2005)	-.059 (.083)	-31.8*** (6.6)	13.2 (11.5)	5.59 (13.5)	35.1 (27.7)
Year (2006)	.185** (.088)	-24.6*** (4.86)	12.6 (9.19)	-2.74 (12.6)	-27.7* (14.7)
Year (2007)	.083 (.07)	-1.47 (18.8)	-1.95 (8.92)	-5.18 (10.9)	-1.74 (14.6)
Year (2008)	.301*** (.102)	-38.7*** (13)	-9.51 (12.9)	-1.63 (23)	-18.8 (23.5)
Year (2009)	.4* (.208)	-73.3* (41)	-18.1 (20.1)	17 (36.3)	-69.2* (35)
Year (2010)	.183 (.116)	-11 (15.1)	3.17 (12.1)	15.1 (19.5)	-27.2 (25.1)
Year (2011)	-.096 (.104)	-39.6*** (12.4)	23.8 (16.6)	19.9 (17.7)	-18.5 (16.8)
Constant	.316 (.342)	46.6 (79.9)	49.7 (31.7)	-29.8 (34.6)	47.6 (34.1)
R-squared	0.097	0.024	0.019	0.010	0.012
Adjusted R-squared	0.089	0.014	0.009	0.000	0.002
F	7.739	33.96	2.494	1.902	2.336
Observations	2016	2016	2016	2016	2016

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 9b: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Percent Increase in FMR (0 Bedrooms)	Percent Increase in FMR (1 Bedrooms)	Percent Increase in FMR (2 Bedrooms)	Percent Increase in FMR (3 Bedrooms)	Percent Increase in FMR (4 Bedrooms)
Prev. Year Shale Wells Drilled	-.033** (.015)	-.026* (.014)	-.026* (.014)	-.026* (.015)	-.024 (.016)
Prev. Year Shale Wells Drilled Squared	9.8e-05** (4.3e-05)	7.2e-05* (3.9e-05)	7.5e-05* (4.0e-05)	7.4e-05* (4.3e-05)	6.5e-05 (4.4e-05)
Percent Increase in Population	.207 (.15)	.038 (.121)	.021 (.149)	.021 (.15)	-.161 (.173)
Percent Increase in Per-capita Income	.103* (.056)	.105** (.048)	.12** (.048)	.132*** (.049)	.097* (.051)
Poverty (%)	-.215** (.089)	-.153** (.075)	-.211*** (.073)	-.257*** (.073)	-.303*** (.088)
Expected Empl. Growth (%)	.288* (.156)	.341*** (.11)	.341*** (.108)	.386*** (.127)	.556*** (.153)
Year (1999)	-.323 (.313)	-.248 (.295)	-.238 (.295)	-.219 (.302)	-.257 (.314)
Year (2000)	-1.02*** (.287)	-.888*** (.277)	-.965*** (.281)	-1.01*** (.281)	-1.08*** (.287)
Year (2001)	.763 (.557)	.984** (.466)	.983** (.473)	1.08** (.504)	1.3** (.556)
Year (2002)	2.18*** (.483)	2.44*** (.362)	2.51*** (.366)	2.6*** (.406)	2.87*** (.484)
Year (2003)	.807** (.381)	1.01*** (.303)	.98*** (.313)	1.07*** (.33)	1.22*** (.386)
Year (2004)	-1.52*** (.215)	-1.43*** (.187)	-1.39*** (.189)	-1.36*** (.197)	-1.34*** (.22)
Year (2005)	13.7*** (1)	3.48*** (.591)	1.89*** (.566)	.942 (.641)	-1.9** (.793)
Year (2006)	2.95*** (.547)	2.66*** (.499)	2.69*** (.511)	2.79*** (.491)	2.87*** (.505)
Year (2007)	2.49*** (.224)	2.42*** (.2)	2.51*** (.205)	2.57*** (.212)	2.63*** (.245)
Year (2008)	5.45*** (.598)	5.49*** (.545)	5.61*** (.545)	5.78*** (.575)	6.17*** (.648)
Year (2009)	3.67*** (.999)	3.81*** (.758)	4.06*** (.753)	4.49*** (.84)	5.19*** (1.04)
Year (2010)	2.38*** (.594)	2.28*** (.487)	2.53*** (.486)	2.88*** (.535)	3.34*** (.655)
Year (2011)	-.105 (.427)	-.273 (.367)	-.073 (.363)	.119 (.381)	.349 (.468)
Constant	3.56*** (1.05)	2.74*** (.87)	3.31*** (.86)	3.69*** (.874)	4.15*** (.998)
R-squared	0.432	0.211	0.196	0.188	0.194
Adjusted R-squared	0.426	0.203	0.189	0.181	0.186
F	223.2	194.3	190.1	160.1	147.2
Observations	2016	2016	2016	2016	2016

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 9c: Two-Way Fixed Effects Regression; Prev. Year Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Percent Increase in Median Housing Sale Price	Percent Increase in Median Home Resale Price	Percent Increase in Median New Construction Sale Price
Prev. Year Shale Wells Drilled	.084* (.045)	.094* (.051)	.082 (.093)
Prev. Year Shale Wells Drilled Squared	-2.7e-04 (1.7e-04)	-3.1e-04 (1.9e-04)	5.5e-04 (5.2e-04)
Percent Increase in Population	1.72*** (.52)	1.54*** (.551)	-1.07 (1.62)
Percent Increase in Per-capita Income	.078 (.164)	-3.2e-03 (.183)	-1.2** (.582)
Poverty (%)	.126 (.221)	.082 (.229)	.151 (.846)
Expected Empl. Growth (%)	-1.52 (.943)	-1.6* (.901)	.766 (2.54)
Year (2002)	-3.78** (1.78)	-3.86** (1.78)	9.15* (4.68)
Year (2003)	1.2 (2.5)	1.71 (2.35)	6.94* (4.17)
Year (2004)	.189 (1.82)	.816 (1.81)	11* (6.25)
Year (2005)	2.85 (2.72)	3.01 (2.59)	5.65 (6.2)
Year (2006)	-1.15 (2.43)	-.078 (2.31)	7.14 (7.16)
Year (2007)	-3.92 (2.51)	-2.27 (2.4)	1.54 (6.38)
Year (2008)	-10.6*** (1.41)	-7.85*** (1.35)	-4.44 (3.35)
Year (2009)	-17*** (2.89)	-15.3*** (2.94)	-8.47 (8.4)
Year (2010)	-6.59*** (1.34)	-6.27*** (1.35)	-3.37 (4.39)
Year (2011)	-8.03*** (2.15)	-6.35*** (2.17)	4.58 (6.91)
Constant	5.88** (2.75)	6.3** (2.83)	4.52 (8.64)
R-squared	0.137	0.112	0.077
Adjusted R-squared	0.127	0.101	0.054
F	27.04	22.49	235.5
Observations	1401	1398	674

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction
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Table 10a: Difference-in-Difference Regression; Shale Development Employment (Levels)

Explanatory Variables [1]	DiD Population	Difference in Avg. Annual Res. Bldg. Permits (1 Units)	Difference in Avg. Annual Res. Bldg. Permits (2 Units)	Difference in Avg. Annual Res. Bldg. Permits (3-4 Units)	Difference in Avg. Annual Res. Bldg. Permits (5+ Units)
DiD Shale Dev. Empl.	.7152 (1.318)	.4353 (.2898)	-4.0e-04 (.006)	.0059 (.0062)	.0061* (.0036)
DiD Shale Dev. Empl. Squared	7.0e-04 (.0014)	-1.1e-04 (1.5e-04)	1.6e-06 (3.6e-06)	-1.2e-06 (2.7e-06)	-8.3e-07 (3.7e-06)
DiD Population		.047 (.033)	.0017* (.001)	-8.2e-04 (9.9e-04)	-.0016*** (5.0e-04)
DiD Per-capita Income ($)	-.3342 (.3641)	-.0865 (.061)	-.0011 (9.8e-04)	-.0017 (.0018)	-.0024** (.0011)
DiD Poverty (%)	-16.63 (186)	19.91 (38.69)	.4207 (.6526)	1.022 (.8419)	3.8e-04 (.4879)
DiD Expected Empl. Growth (%)	687.7 (603.9)	-80.57 (89.49)	-3.592** (1.748)	-2.917* (1.678)	1.807 (1.373)
log(Year 2000 Population)	2220** (857.1)	-266.8** (133.7)	-3.167 (2.559)	2.058 (2.972)	.5138 (2.138)
log(Year 2000 Per-capita Income)	6003 (5835)	-2317** (996.3)	-8.343 (19.01)	9.051 (17.19)	-29.39 (23.19)
Year 2000 Poverty (%)	1404*** (512.4)	-24.54 (42.59)	.9357 (1.337)	1.688 (1.132)	-.3185 (.8948)
Year 2000 Expected Job Growth (%)	-473 (963.4)	-112.1 (198.4)	1.872 (2.724)	-2.717 (4.979)	-3.406 (2.906)
MSA_Dummy	73.12 (916.8)	-13.34 (166)	-4.318 (3.508)	-2.654 (4.006)	.5863 (2.722)
ARC_Dummy	580.8 (1846)	205.4 (207.2)	-.5973 (5.973)	6.863 (5.087)	-2.957 (4.201)
log(Year 2000 Res. Bldg. Permits) (1 Units)		-171.5 (105.6)			
log(Year 2000 Res. Bldg. Permits) (2 Units)			-7.736*** (2.422)		
log(Year 2000 Res. Bldg. Permits) (3-4 Units)				-14** (6.513)	
log(Year 2000 Res. Bldg. Permits) (5+ Units)					-4.604* (2.734)
Constant	-9.9e+04 (6.3e+04)	2.7e+04*** (1.0e+04)	97.54 (192.8)	-136.6 (179.9)	303.6 (233.6)
R-squared	0.308	0.573	0.353	0.379	0.476
Adjusted R-squared	0.250	0.531	0.289	0.316	0.424
F	2.317	15.89	4.076	2.873	2.982
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 10b: Difference-in-Difference Regression; Shale Development Employment (Levels)

Explanatory Variables [1]	DiD FMR (0 Bedrooms)	DiD FMR (1 Bedrooms)	DiD FMR (2 Bedrooms)	DiD FMR (3 Bedrooms)	DiD FMR (4 Bedrooms)
DiD Shale Dev. Empl.	-.0057 (.0135)	.0022 (.0113)	.0064 (.0136)	.015 (.0178)	7.3e-04 (.0205)
DiD Shale Dev. Empl. Squared	-5.2e-06 (6.7e-06)	-2.6e-06 (5.9e-06)	-2.3e-06 (7.5e-06)	4.8e-07 (1.0e-05)	-7.8e-06 (1.2e-05)
DiD Population	-4.9e-04 (9.4e-04)	-7.3e-04 (9.2e-04)	-5.6e-04 (.0012)	-7.0e-04 (.0017)	-4.1e-04 (.0018)
DiD Per-capita Income ($)	4.1e-04 (.0035)	4.2e-04 (.0029)	-3.3e-04 (.0034)	-.0022 (.0046)	-.0033 (.005)
DiD Poverty (%)	-.3899 (1.826)	-.4894 (1.66)	-2.651 (1.985)	-4.633* (2.776)	-7.218** (3.362)
DiD Expected Empl. Growth (%)	-4.819 (6.573)	-4.574 (4.95)	-4.63 (6.019)	-12.43 (7.535)	-6.337 (9.402)
log(Year 2000 Population)	-6.294 (7.125)	-2.638 (6.33)	-5.385 (7.535)	-6.589 (10.04)	-8.698 (12.17)
log(Year 2000 Per-capita Income)	33.89 (49.63)	.6139 (39.53)	17.25 (44.81)	66.59 (62.28)	106.8 (80.48)
Year 2000 Poverty (%)	5.103 (3.272)	5.231* (2.991)	6.265* (3.409)	10.48** (4.924)	10.92* (5.678)
Year 2000 Expected Job Growth (%)	7.821 (12.06)	13.78 (8.577)	14.34 (9.438)	7.049 (13.25)	-1.594 (16.05)
MSA_Dummy	-25.83** (11.93)	-26.72** (10.58)	-41.36*** (12.37)	-59.37*** (15.42)	-45.22** (18.6)
ARC_Dummy	-26.57* (13.76)	-30.69** (13.99)	-36.03** (17.56)	-38.01* (22.24)	-41.22 (26.08)
log(Year 2000 FMR) (0 Bedrooms)	58.34 (44.25)				
log(Year 2000 FMR) (1 Bedrooms)		95.77** (45.46)			
log(Year 2000 FMR) (2 Bedrooms)			146.2*** (54.35)		
log(Year 2000 FMR) (3 Bedrooms)				269.2*** (68.35)	
log(Year 2000 FMR) (4 Bedrooms)					373.2*** (74.9)
Constant	-689.1 (505.1)	-602.9 (444.1)	-1063* (538.4)	-2405*** (695.9)	-3457*** (772.1)
R-squared	0.148	0.204	0.237	0.307	0.375
Adjusted R-squared	0.063	0.125	0.161	0.237	0.313
F	2.923	3.511	5.035	7.224	7.534
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 10c: Difference-in-Difference Regression; Shale Development Employment (Levels)

Explanatory Variables [1]	DiD in Housing Median Sale Price	DiD in Median Resale Price	DiD in New Construction Median Sale Price
DiD Shale Dev. Empl.	13.56* (7.27)	10.96 (6.667)	20.92 (33.21)
DiD Shale Dev. Empl. Squared	7.5e-04 (.0032)	5.8e-04 (.0031)	-.0145 (.0193)
DiD Population	1.273*** (.474)	1.072** (.4195)	3.056 (1.906)
DiD Per-capita Income ($)	3.667** (1.708)	2.991* (1.566)	2.901 (8.9)
DiD Poverty (%)	-3336*** (1126)	-3007*** (1094)	-1.2e+04* (6279)
DiD Expected Empl. Growth (%)	782.8 (3621)	2159 (3685)	-5512 (2.0e+04)
log(Year 2000 Population)	6770 (4427)	6314 (4233)	2.3e+04 (2.5e+04)
log(Year 2000 Per-capita Income)	-3.8e+04 (3.0e+04)	-2.2e+04 (2.8e+04)	5.8e+04 (1.2e+05)
Year 2000 Poverty (%)	-3716* (2079)	-3373 (2051)	-1.5e+04* (8453)
Year 2000 Expected Job Growth (%)	-1.5e+04** (6989)	-1.4e+04** (6795)	-6.3e+04 (4.0e+04)
MSA_Dummy	5464 (7024)	7318 (6759)	-1.9e+04 (3.6e+04)
ARC_Dummy	1.3e+04** (6432)	8584 (6003)	7898 (3.1e+04)
log(Year 2000 All Housing Median Sale Price)	-8375 (1.0e+04)		
log(Year 2000 Median Resale Price)		-1.4e+04 (1.1e+04)	
log(Year 2000 New Construction Median Sale Price)			3.0e+04 (3.6e+04)
Constant	4.4e+05 (2.7e+05)	3.4e+05 (2.5e+05)	-9.9e+05 (1.2e+06)
R-squared	0.501	0.421	0.441
Adjusted R-squared	0.440	0.352	0.227
F	9.477	4.622	4.245
Observations	122	122	48

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 11a: Difference-in-Difference Regression; Shale Wells Drilled (Levels)

Explanatory Variables [1]	DiD Population	Difference in Avg. Annual Res. Bldg. Permits (1 Units)	Difference in Avg. Annual Res. Bldg. Permits (2 Units)	Difference in Avg. Annual Res. Bldg. Permits (3-4 Units)	Difference in Avg. Annual Res. Bldg. Permits (5+ Units)
Shale Wells Drilled 2007-2011	-2.888 (6.986)	2.304** (1.013)	.0189 (.0273)	-.0144 (.024)	-.0102 (.0195)
Shale Wells Drilled 2007-2011 Squared	.0048 (.0078)	-.002* (.0011)	-1.5e-05 (3.2e-05)	1.4e-05 (2.8e-05)	1.3e-05 (2.2e-05)
DiD Population		.0438 (.0322)	.0017* (9.6e-04)	-8.6e-04 (9.6e-04)	-.0016*** (5.6e-04)
DiD Per-capita Income ($)	-.4122 (.2628)	-.0551 (.0552)	-.0015 (9.8e-04)	-.0012 (.0017)	-.0019 (.0012)
DiD Poverty (%)	-36.46 (176)	34.08 (44.77)	.4063 (.679)	.9849 (.8479)	-.0109 (.5115)
DiD Expected Empl. Growth (%)	644.1 (598.9)	18.16 (85.56)	-3.867* (1.979)	-1.591 (1.651)	2.761** (1.371)
log(Year 2000 Population)	2326** (1086)	-376.7** (148.4)	-3.161 (2.659)	2.14 (3.014)	.4383 (2.338)
log(Year 2000 Per-capita Income)	7100 (6639)	-2757*** (950)	-5.75 (19.3)	5.399 (16.06)	-32.23 (19.88)
Year 2000 Poverty (%)	1411*** (500.6)	-.311 (46.63)	.9326 (1.359)	1.866 (1.174)	-.1122 (.9781)
Year 2000 Expected Job Growth (%)	-666 (922.7)	.1162 (197.6)	1.885 (2.826)	-2.58 (5.172)	-3.33 (2.976)
MSA_Dummy	-147 (1007)	130.4 (172.2)	-5.321 (3.751)	-.6532 (4.185)	2.199 (3.082)
ARC_Dummy	696.3 (2036)	227.2 (198.2)	-1.518 (6.416)	8.601 (5.53)	-1.86 (4.281)
log(Year 2000 Res. Bldg. Permits) (1 Units)		-184.5 (115.6)			
log(Year 2000 Res. Bldg. Permits) (2 Units)			-7.404*** (2.419)		
log(Year 2000 Res. Bldg. Permits) (3-4 Units)				-15.76** (6.995)	
log(Year 2000 Res. Bldg. Permits) (5+ Units)					-5.97** (2.882)
Constant	-1.1e+05 (7.4e+04)	3.2e+04*** (9309)	71.38 (194)	-101.5 (168.4)	331.5* (200.1)
R-squared	0.303	0.534	0.350	0.367	0.454
Adjusted R-squared	0.245	0.488	0.285	0.304	0.399
F	2.273	10.19	3.850	2.869	2.106
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 11b: Difference-in-Difference Regression; Shale Wells Drilled (Levels)

Explanatory Variables [1]	DiD FMR (0 Bedrooms)	DiD FMR (1 Bedrooms)	DiD FMR (2 Bedrooms)	DiD FMR (3 Bedrooms)	DiD FMR (4 Bedrooms)
Shale Wells Drilled 2007-2011	-.4342*** (.1528)	-.3568** (.1485)	-.4211** (.1805)	-.5375** (.2419)	-.4657 (.2995)
Shale Wells Drilled 2007-2011 Squared	5.3e-04*** (1.7e-04)	4.0e-04** (1.7e-04)	4.9e-04** (2.1e-04)	6.4e-04** (2.7e-04)	5.2e-04 (3.4e-04)
DiD Population	-6.1e-04 (.0011)	-8.0e-04 (.0011)	-6.7e-04 (.0014)	-8.1e-04 (.0019)	-5.7e-04 (.0022)
DiD Per-capita Income ($)	.0022 (.0032)	.0026 (.0028)	.002 (.0033)	3.8e-04 (.0045)	1.5e-04 (.0051)
DiD Poverty (%)	-.756 (1.736)	-.9064 (1.578)	-3.053 (1.872)	-5.153* (2.635)	-7.604** (3.266)
DiD Expected Empl. Growth (%)	-7.139 (5.903)	-5.914 (4.636)	-6.017 (5.76)	-13.95* (7.161)	-7.594 (8.86)
log(Year 2000 Population)	-4.405 (6.211)	-.8838 (5.484)	-3.954 (6.458)	-5.047 (8.479)	-7.165 (10.85)
log(Year 2000 Per-capita Income)	34.61 (50.46)	2.385 (42.01)	20.29 (47.81)	74.26 (65.71)	102.1 (82.21)
Year 2000 Poverty (%)	4.594 (3.244)	4.726 (3.049)	5.948* (3.45)	10.25** (5.054)	10.38* (5.789)
Year 2000 Expected Job Growth (%)	1.25 (10.84)	7.085 (8.481)	7.524 (9.627)	-1.748 (13.95)	-9.047 (18.11)
MSA_Dummy	-20.51* (11.14)	-22.89** (10.16)	-35.83*** (12.1)	-52.51*** (14.96)	-37.82** (18.35)
ARC_Dummy	-15.33 (12.79)	-18.6 (13)	-22.2 (16.31)	-20.11 (20.71)	-25.36 (25.44)
log(Year 2000 FMR) (0 Bedrooms)	67.21 (40.88)				
log(Year 2000 FMR) (1 Bedrooms)		107.1** (43.12)			
log(Year 2000 FMR) (2 Bedrooms)			150.3*** (52.13)		
log(Year 2000 FMR) (3 Bedrooms)				271.2*** (66.05)	
log(Year 2000 FMR) (4 Bedrooms)					384*** (73.83)
Constant	-759.5 (494.5)	-697.3 (439.2)	-1127** (529.1)	-2505*** (688.6)	-3487*** (771.2)
R-squared	0.242	0.275	0.299	0.358	0.400
Adjusted R-squared	0.166	0.203	0.229	0.293	0.340
F	3.376	3.464	4.165	6.340	6.829
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 11c: Difference-in-Difference Regression; Shale Wells Drilled (Levels)

Explanatory Variables [1]	DiD in Housing Median Sale Price	DiD in Median Resale Price	DiD in New Construction Median Sale Price
Shale Wells Drilled 2007-2011	186.1*** (58.71)	172.7*** (58.93)	8.764 (633.1)
Shale Wells Drilled 2007-2011 Squared	-.2652*** (.0906)	-.2449*** (.0917)	1.133 (3.018)
DiD Population	1.268** (.4886)	1.071** (.4339)	3.829* (1.994)
DiD Per-capita Income ($)	3.516* (1.93)	2.775 (1.721)	6.981 (9.465)
DiD Poverty (%)	-2649** (1088)	-2401** (1062)	-8084 (7379)
DiD Expected Empl. Growth (%)	3768 (3644)	4674 (3636)	1.1e+04 (1.9e+04)
log(Year 2000 Population)	2677 (4129)	2787 (3880)	-4026 (2.2e+04)
log(Year 2000 Per-capita Income)	-4.3e+04 (3.4e+04)	-2.7e+04 (3.2e+04)	7.1e+04 (1.1e+05)
Year 2000 Poverty (%)	-2887 (2179)	-2659 (2135)	-9303 (9220)
Year 2000 Expected Job Growth (%)	-1.1e+04* (6066)	-1.0e+04* (5795)	-5.0e+04 (3.7e+04)
MSA_Dummy	6330 (6724)	7798 (6473)	8608 (3.6e+04)
ARC_Dummy	1.0e+04 (7013)	5749 (6528)	1.9e+04 (4.0e+04)
log(Year 2000 All Housing Median Sale Price)	-9251 (1.1e+04)		
log(Year 2000 Median Resale Price)		-1.5e+04 (1.2e+04)	
log(Year 2000 New Construction Median Sale Price)			5.5e+04 (4.0e+04)
Constant	5.4e+05* (3.0e+05)	4.3e+05 (2.7e+05)	-1.2e+06 (1.1e+06)
R-squared	0.500	0.428	0.364
Adjusted R-squared	0.440	0.359	0.121
F	9.485	5.507	6.358
Observations	122	122	48

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 12a: Difference-in-Difference Regression; Shale Development Employment (Logs)

Explanatory Variables [1]	DiD log(Population)	Difference in log(Avg. Annual Res. Bldg. Permits) (1 Units)	Difference in log(Avg. Annual Res. Bldg. Permits) (2 Units)	Difference in log(Avg. Annual Res. Bldg. Permits) (3-4 Units)	Difference in log(Avg. Annual Res. Bldg. Permits) (5+ Units)
DiD log(Shale Dev. Empl.)	.0204** (.00987)	-.102 (.115)	-.168 (.366)	.532 (.897)	.0016 (.608)
DiD log(Shale Dev. Empl.) Squared	-.00684 (.0128)	-.0106 (.185)	.0115 (.605)	-1.71 (1.57)	1.25 (1.34)
DiD log(Population)		2.63 (1.97)	9.07 (5.98)	-8.31 (7.77)	9.78 (8.93)
DiD log(Per-capita Income)	-.253** (.107)	-.442 (.804)	-.163 (2.85)	4.72 (4.51)	5.14 (3.39)
DiD Poverty (%)	3.4e-05 (.001)	-.00597 (.0152)	.0155 (.0669)	.067 (.0675)	.0146 (.0688)
DiD Expected Empl. Growth (%)	-.00181 (.00319)	-.116** (.0565)	-.547*** (.171)	-.441 (.268)	.117 (.181)
log(Year 2000 Population)	.00795* (.00409)	-.0767 (.115)	-.1 (.261)	.0587 (.264)	.0437 (.269)
log(Year 2000 Per-capita Income)	-.0168 (.0313)	.078 (.344)	-.241 (1.26)	.384 (2.19)	1.39 (1.33)
Year 2000 Poverty (%)	.00315** (.00124)	.0618** (.0275)	.0191 (.0783)	.101 (.0983)	-.00356 (.0726)
Year 2000 Expected Job Growth (%)	-.0167** (.00812)	.0491 (.124)	-.262 (.327)	.138 (.564)	.0208 (.361)
MSA_Dummy	-.00021 (.00487)	-.0511 (.093)	-.286 (.306)	-.372 (.359)	.0554 (.419)
ARC_Dummy	.00124 (.00501)	.11 (.089)	-.315 (.289)	.639 (.416)	.155 (.322)
log(Year 2000 Res. Bldg. Permits) (1 Units)		.106 (.0839)			
log(Year 2000 Res. Bldg. Permits) (2 Units)			-.263** (.11)		
log(Year 2000 Res. Bldg. Permits) (3-4 Units)				.108 (.139)	
log(Year 2000 Res. Bldg. Permits) (5+ Units)					-.104 (.157)
Constant	.0554 (.291)	-2.07 (3.42)	2.78 (12.4)	-7.39 (20.8)	-14.4 (12.6)
R-squared	0.381	0.244	0.273	0.205	0.068
Adjusted R-squared	0.329	0.167	0.152	0.043	-0.090
F	5.115	2.900	4.199	2.555	1.098
Observations	144	142	92	78	91

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 12b: Difference-in-Difference Regression; Shale Development Employment (Logs)

Explanatory Variables [1]	DiD log(FMR) (0 Bedrooms)	DiD log(FMR) (1 Bedrooms)	DiD log(FMR) (2 Bedrooms)	DiD log(FMR) (3 Bedrooms)	DiD log(FMR) (4 Bedrooms)
DiD log(Shale Dev. Empl.)	-.0497 (.0415)	.00718 (.0239)	.0181 (.02)	.013 (.0248)	.0102 (.0328)
DiD log(Shale Dev. Empl.) Squared	-.0139 (.0504)	-.054* (.0292)	-.00814 (.023)	-.0151 (.0305)	-.0198 (.0562)
DiD log(Population)	.918** (.437)	.263 (.302)	.397* (.238)	.573* (.293)	.855** (.423)
DiD log(Per-capita Income)	.239 (.31)	.0752 (.2)	.176 (.16)	.145 (.184)	.247 (.207)
DiD Poverty (%)	-.00137 (.00429)	-.00042 (.00311)	-.00422 (.00297)	-.00656** (.00327)	-.00928** (.00376)
DiD Expected Empl. Growth (%)	-.00289 (.0167)	-.00785 (.00923)	-.00592 (.00902)	-.0148* (.00874)	-.00499 (.0105)
log(Year 2000 Population)	-.0241 (.0184)	-.0105 (.0122)	-.0102 (.012)	-.0116 (.0127)	-.017 (.0142)
log(Year 2000 Per-capita Income)	.0544 (.122)	-.0527 (.0796)	-.0389 (.0754)	.0336 (.0796)	.0264 (.0882)
Year 2000 Poverty (%)	.00559 (.00688)	.00577 (.00471)	.00474 (.00421)	.00706 (.00487)	.00378 (.00499)
Year 2000 Expected Job Growth (%)	.0278 (.0315)	.0252 (.0179)	.0274* (.0157)	.0111 (.0178)	.012 (.0184)
MSA_Dummy	-.0384 (.0289)	-.041* (.0213)	-.0596*** (.0203)	-.0694*** (.0196)	-.0385* (.022)
ARC_Dummy	-.0372 (.031)	-.0433 (.0282)	-.0383 (.0283)	-.0259 (.0285)	-.026 (.0307)
log(Year 2000 FMR) (0 Bedrooms)	.248** (.0969)				
log(Year 2000 FMR) (1 Bedrooms)		.217** (.0919)			
log(Year 2000 FMR) (2 Bedrooms)			.261*** (.085)		
log(Year 2000 FMR) (3 Bedrooms)				.358*** (.0782)	
log(Year 2000 FMR) (4 Bedrooms)					.422*** (.0721)
Constant	-1.87 (1.21)	-.73 (.89)	-1.15 (.882)	-2.56*** (.888)	-2.82*** (.889)
R-squared	0.148	0.185	0.221	0.289	0.307
Adjusted R-squared	0.063	0.104	0.143	0.218	0.237
F	2.978	2.987	3.834	6.153	7.140
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 12c: Difference-in-Difference Regression; Shale Development Employment (Logs)

Explanatory Variables [1]	DiD in log(Housing Median Sale Price)	DiD in log(Median Resale Price)	DiD in log(New Construction Median Sale Price)
DiD log(Shale Dev. Empl.)	.0695 (.0987)	.048 (.0868)	-.451 (.325)
DiD log(Shale Dev. Empl.) Squared	-.368* (.197)	-.288 (.178)	-1.85 (1.13)
DiD log(Population)	2.97*** (.925)	3.49*** (.836)	5.43* (3.1)
DiD log(Per-capita Income)	.761 (.553)	.939* (.534)	2.21 (1.67)
DiD Poverty (%)	-.0306*** (.0116)	-.0268** (.0105)	-.00232 (.0275)
DiD Expected Empl. Growth (%)	-.0299 (.034)	.00553 (.0313)	-.00712 (.0867)
log(Year 2000 Population)	.00657 (.0437)	.00206 (.0358)	.0461 (.123)
log(Year 2000 Per-capita Income)	-.137 (.254)	-.0208 (.219)	-.121 (.653)
Year 2000 Poverty (%)	-.0135 (.0173)	-.0175 (.0151)	-.0399 (.0348)
Year 2000 Expected Job Growth (%)	-.17* (.0957)	-.124 (.0868)	.0346 (.195)
MSA_Dummy	.0463 (.0552)	.0749 (.0493)	.0938 (.177)
ARC_Dummy	.0705 (.0499)	.0323 (.0447)	.0751 (.156)
log(Year 2000 All Housing Median Sale Price)	.0882 (.0848)		
log(Year 2000 Median Resale Price)		.0174 (.0796)	
log(Year 2000 New Construction Median Sale Price)			.367* (.191)
Constant	.549 (2.44)	.3 (2.11)	-3.68 (6.33)
R-squared	0.399	0.404	0.463
Adjusted R-squared	0.327	0.333	0.258
F	3.755	3.931	2.876
Observations	122	122	48

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 13a: Difference-in-Difference Regression; Shale Wells Drilled (Logs)

Explanatory Variables [1]	DiD log(Population)	Difference in log(Avg. Annual Res. Bldg. Permits) (1 Units)	Difference in log(Avg. Annual Res. Bldg. Permits) (2 Units)	Difference in log(Avg. Annual Res. Bldg. Permits) (3-4 Units)	Difference in log(Avg. Annual Res. Bldg. Permits) (5+ Units)
Shale Wells Drilled 2007-2011	1.4e-05 (4.9e-05)	-5.9e-05 (.00065)	2.5e-05 (.00595)	-.00075 (.00499)	-.00044 (.00344)
Shale Wells Drilled 2007-2011 Squared	2.5e-08 (5.5e-08)	6.9e-07 (7.5e-07)	1.1e-07 (1.2e-05)	2.6e-06 (9.7e-06)	5.9e-07 (7.9e-06)
DiD log(Population)		1.81 (2.04)	8.79 (5.93)	-4.03 (7.14)	7.9 (7.78)
DiD log(Per-capita Income)	-.26** (.117)	-.827 (.812)	-.262 (2.81)	6.06 (4.18)	4.37 (3.38)
DiD Poverty (%)	8.3e-05 (.00105)	-.00453 (.0154)	.0122 (.0653)	.0638 (.0684)	.018 (.0695)
DiD Expected Empl. Growth (%)	.00068 (.0031)	-.126** (.0558)	-.559*** (.18)	-.398 (.256)	.0974 (.181)
log(Year 2000 Population)	.00746* (.004)	-.0652 (.114)	-.0981 (.257)	.0672 (.275)	.00863 (.283)
log(Year 2000 Per-capita Income)	-.00579 (.0284)	.0115 (.333)	-.322 (1.27)	.993 (2.28)	1.28 (1.37)
Year 2000 Poverty (%)	.004*** (.00121)	.0612** (.0267)	.0133 (.078)	.11 (.101)	-.00334 (.075)
Year 2000 Expected Job Growth (%)	-.0154* (.0087)	.0611 (.126)	-.267 (.389)	.114 (.584)	-.00409 (.366)
MSA_Dummy	.00064 (.00514)	-.0492 (.0951)	-.292 (.297)	-.406 (.361)	.0451 (.429)
ARC_Dummy	.00157 (.00513)	.0843 (.0914)	-.331 (.304)	.717* (.427)	.112 (.343)
log(Year 2000 Res. Bldg. Permits) (1 Units)		.0904 (.0896)			
log(Year 2000 Res. Bldg. Permits) (2 Units)			-.261** (.111)		
log(Year 2000 Res. Bldg. Permits) (3-4 Units)				.0776 (.14)	
log(Year 2000 Res. Bldg. Permits) (5+ Units)					-.0989 (.159)
Constant	-.0612 (.263)	-1.5 (3.34)	3.64 (12.5)	-13.6 (21.7)	-12.8 (13.1)
R-squared	0.349	0.256	0.272	0.187	0.055
Adjusted R-squared	0.295	0.181	0.150	0.022	-0.105
F	4.413	9.963	4.111	1.646	0.543
Observations	144	142	92	78	91

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 13b: Difference-in-Difference Regression; Shale Wells Drilled (Logs)

Explanatory Variables [1]	DiD log(FMR) (0 Bedrooms)	DiD log(FMR) (1 Bedrooms)	DiD log(FMR) (2 Bedrooms)	DiD log(FMR) (3 Bedrooms)	DiD log(FMR) (4 Bedrooms)
Shale Wells Drilled 2007-2011	-.00095*** (.00031)	-.00061** (.00025)	-.0006** (.00025)	-.00062** (.00028)	-.0004 (.00034)
Shale Wells Drilled 2007-2011 Squared	1.2e-06*** (3.3e-07)	6.6e-07** (2.8e-07)	6.8e-07** (2.8e-07)	7.2e-07** (3.1e-07)	3.8e-07 (3.8e-07)
DiD log(Population)	.83* (.437)	.497* (.296)	.546** (.248)	.702** (.31)	1.02** (.439)
DiD log(Per-capita Income)	.245 (.314)	.234 (.206)	.251 (.175)	.216 (.203)	.355 (.236)
DiD Poverty (%)	-.00253 (.0041)	-.00183 (.00307)	-.00526* (.00285)	-.00757** (.00322)	-.0103*** (.00381)
DiD Expected Empl. Growth (%)	-.0133 (.0149)	-.00887 (.00835)	-.00724 (.00839)	-.0166** (.00794)	-.00579 (.00928)
log(Year 2000 Population)	-.018 (.0165)	-.00373 (.0117)	-.00706 (.0112)	-.00805 (.0116)	-.0126 (.0134)
log(Year 2000 Per-capita Income)	.0305 (.117)	-.0623 (.0848)	-.0252 (.075)	.043 (.08)	.0283 (.0852)
Year 2000 Poverty (%)	.00338 (.00657)	.00325 (.00506)	.00381 (.00411)	.00607 (.0051)	.00212 (.00537)
Year 2000 Expected Job Growth (%)	.0129 (.0272)	.0194 (.0174)	.0182 (.0151)	.00257 (.0178)	.00637 (.0193)
MSA_Dummy	-.0297 (.0277)	-.0363* (.0207)	-.0551*** (.0197)	-.0641*** (.0188)	-.0363* (.0216)
ARC_Dummy	-.0178 (.0304)	-.0208 (.0271)	-.02 (.0274)	-.00791 (.0277)	-.0104 (.0305)
log(Year 2000 FMR) (0 Bedrooms)	.251*** (.0935)				
log(Year 2000 FMR) (1 Bedrooms)		.251*** (.0874)			
log(Year 2000 FMR) (2 Bedrooms)			.27*** (.0822)		
log(Year 2000 FMR) (3 Bedrooms)				.366*** (.0774)	
log(Year 2000 FMR) (4 Bedrooms)					.432*** (.0711)
Constant	-1.69 (1.17)	-.879 (.885)	-1.36 (.841)	-2.73*** (.861)	-2.93*** (.83)
R-squared	0.230	0.242	0.282	0.342	0.331
Adjusted R-squared	0.153	0.166	0.210	0.276	0.264
F	4.625	3.005	3.980	6.992	7.258
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 13c: Difference-in-Difference Regression; Shale Wells Drilled (Logs)

Explanatory Variables [1]	DiD in log(Housing Median Sale Price)	DiD in log(Median Resale Price)	DiD in log(New Construction Median Sale Price)
Shale Wells Drilled 2007-2011	.0028*** (.00094)	.00245*** (.00081)	.00474 (.00283)
Shale Wells Drilled 2007-2011 Squared	-4.1e-06*** (1.4e-06)	-3.6e-06*** (1.2e-06)	-1.6e-05 (1.3e-05)
DiD log(Population)	3.4*** (.969)	3.83*** (.854)	5.94** (2.74)
DiD log(Per-capita Income)	.908 (.681)	1.05* (.626)	2.3 (1.74)
DiD Poverty (%)	-.0246** (.00976)	-.0216** (.00912)	-.00482 (.0302)
DiD Expected Empl. Growth (%)	-.00352 (.032)	.0254 (.0292)	.0207 (.0826)
log(Year 2000 Population)	-.00451 (.036)	-.0072 (.0288)	.0172 (.11)
log(Year 2000 Per-capita Income)	-.0392 (.244)	.0498 (.215)	.139 (.589)
Year 2000 Poverty (%)	-.0105 (.0174)	-.0153 (.0158)	-.0321 (.0324)
Year 2000 Expected Job Growth (%)	-.091 (.0656)	-.0596 (.0589)	.112 (.19)
MSA_Dummy	.0217 (.0545)	.0529 (.0485)	.0912 (.164)
ARC_Dummy	.018 (.0564)	-.0131 (.0505)	-.0322 (.167)
log(Year 2000 All Housing Median Sale Price)	.0356 (.0712)		
log(Year 2000 Median Resale Price)		-.0295 (.0684)	
log(Year 2000 New Construction Median Sale Price)			.246 (.187)
Constant	.134 (2.38)	.0997 (2.09)	-4.73 (5.95)
R-squared	0.472	0.476	0.453
Adjusted R-squared	0.408	0.413	0.244
F	4.335	4.519	13.65
Observations	122	122	48

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 14a: Difference-in-Difference Regression; Shale Development Employment (Percent Change)

Explanatory Variables [1]	Difference in Percent Increase in Population	Difference in Avg. Annual Percent Increase in Res. Bldg. Permits (1 Units)	Difference in Avg. Annual Percent Increase in Res. Bldg. Permits (2 Units)	Difference in Avg. Annual Percent Increase in Res. Bldg. Permits (3-4 Units)	Difference in Avg. Annual Percent Increase in Res. Bldg. Permits (5+ Units)
Difference in Percent Increase in Shale Dev. Empl.	.497** (.221)	-.026* (.015)	-3.2e-04 (4.3e-04)	-3.0e-04 (6.3e-04)	-2.2e-04 (3.4e-04)
Difference in Percent Increase in Shale Dev. Empl. Squared	6.4e-03 (.011)	-2.3e-03** (9.3e-04)	-1.9e-05 (2.8e-05)	-4.5e-05 (3.4e-05)	-1.1e-05 (2.4e-05)
Difference in Percent Increase in Population		.049 (.031)	6.0e-04** (2.5e-04)	-4.3e-05 (1.9e-04)	4.5e-05 (2.2e-04)
Difference in Percent Increase in Per-capita Income	-.246** (.104)	-5.9e-03 (8.3e-03)	-1.9e-04 (1.6e-04)	-2.1e-06 (1.3e-04)	5.4e-05 (1.5e-04)
DiD Poverty (%)	6.5e-03 (.109)	-.012 (.011)	-2.0e-04 (3.0e-04)	8.4e-05 (2.3e-04)	3.1e-04 (2.8e-04)
DiD Expected Empl. Growth (%)	-.241 (.362)	.017 (.035)	-1.1e-03 (8.7e-04)	-2.0e-03** (8.3e-04)	4.6e-04 (7.1e-04)
log(Year 2000 Population)	.898** (.439)	.097* (.053)	1.0e-03 (9.2e-04)	4.9e-04 (7.8e-04)	2.0e-04 (8.5e-04)
log(Year 2000 Per-capita Income)	-2.53 (3.47)	-.019 (.512)	-2.1e-03 (8.9e-03)	.014* (7.5e-03)	8.7e-04 (6.7e-03)
Year 2000 Poverty (%)	.302** (.132)	.043** (.018)	1.0e-04 (5.6e-04)	5.6e-04* (3.1e-04)	-3.8e-05 (3.3e-04)
Year 2000 Expected Job Growth (%)	-1.83** (.91)	-.087 (.068)	-1.6e-03 (1.2e-03)	-1.7e-03 (1.3e-03)	-4.1e-04 (1.2e-03)
MSA_Dummy	-.09 (.53)	-.025 (.055)	-5.8e-04 (1.8e-03)	-2.1e-03 (1.8e-03)	-8.5e-04 (1.6e-03)
ARC_Dummy	.084 (.532)	.065 (.07)	1.7e-03 (2.1e-03)	5.0e-03** (1.9e-03)	1.8e-03 (2.4e-03)
log(Year 2000 Res. Bldg. Permits) (1 Units)		-.089*** (.031)			
log(Year 2000 Res. Bldg. Permits) (2 Units)			-2.9e-03*** (7.3e-04)		
log(Year 2000 Res. Bldg. Permits) (3-4 Units)				-2.1e-03** (1.0e-03)	
log(Year 2000 Res. Bldg. Permits) (5+ Units)					-4.7e-04 (7.9e-04)
Constant	12.9 (32.2)	-1.1 (4.93)	6.0e-03 (.088)	-.159** (.078)	-.011 (.068)
R-squared	0.395	0.555	0.276	0.236	0.054
Adjusted R-squared	0.345	0.511	0.204	0.159	-0.041
F	8.972	15.93	5.087	2.530	1.170
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 14b: Difference-in-Difference Regression; Shale Development Employment (Percent Change)

Explanatory Variables [1]	Difference in Percent Increase in FMR (0 Bedrooms)	Difference in Percent Increase in FMR (1 Bedrooms)	Difference in Percent Increase in FMR (2 Bedrooms)	Difference in Percent Increase in FMR (3 Bedrooms)	Difference in Percent Increase in FMR (4 Bedrooms)
Difference in Percent Increase in Shale Dev. Empl.	-1.58 (1)	.199 (.725)	.358 (.523)	.418 (.645)	.636 (.943)
Difference in Percent Increase in Shale Dev. Empl. Squared	-8.3e-03 (.062)	.03 (.04)	.041 (.031)	.051 (.035)	.041 (.05)
Difference in Percent Increase in Population	1.3** (.504)	.401 (.309)	.481** (.24)	.656** (.317)	.851* (.466)
Difference in Percent Increase in Per-capita Income	.398 (.327)	.188 (.196)	.229 (.153)	.215 (.173)	.28 (.208)
DiD Poverty (%)	-.159 (.519)	-.065 (.365)	-.451 (.337)	-.692* (.375)	-.977** (.427)
DiD Expected Empl. Growth (%)	-.137 (2.02)	-.802 (1.03)	-.646 (.998)	-1.61* (.962)	-.712 (1.17)
log(Year 2000 Population)	-2.43 (2.13)	-.551 (1.42)	-.933 (1.33)	-.985 (1.37)	-1.53 (1.55)
log(Year 2000 Per-capita Income)	6.02 (14.4)	-8.11 (9.92)	-4.41 (8.58)	3.39 (9)	1.4 (10.1)
Year 2000 Poverty (%)	.523 (.785)	.497 (.576)	.517 (.459)	.733 (.552)	.309 (.593)
Year 2000 Expected Job Growth (%)	4.03 (3.92)	3.94* (2.17)	3.67** (1.81)	2.1 (2.08)	2.03 (2.14)
MSA_Dummy	-4.2 (3.48)	-4.4* (2.51)	-6.67*** (2.41)	-7.61*** (2.27)	-3.96 (2.51)
ARC_Dummy	-3.47 (3.64)	-3.83 (3.1)	-3.48 (3.13)	-1.96 (3.11)	-1.97 (3.45)
log(Year 2000 FMR) (0 Bedrooms)	33.7*** (11.5)				
log(Year 2000 FMR) (1 Bedrooms)		26.5*** (9.9)			
log(Year 2000 FMR) (2 Bedrooms)			30*** (9.31)		
log(Year 2000 FMR) (3 Bedrooms)				40.4*** (8.57)	
log(Year 2000 FMR) (4 Bedrooms)					46.1*** (8.13)
Constant	-248* (146)	-80.8 (106)	-137 (100)	-291*** (100)	-299*** (103)
R-squared	0.167	0.176	0.222	0.293	0.301
Adjusted R-squared	0.084	0.093	0.144	0.222	0.231
F	4.941	2.426	3.366	5.693	6.591
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 14c: Difference-in-Difference Regression; Shale Development Employment (Percent Change)

Explanatory Variables[1]	Difference in Percent Increase in Housing Median Sale Price	Difference in Percent Increase in Median Resale Price	Difference in Percent Increase in New Construction Median Sale Price
Difference in Percent Increase in Shale Dev. Empl. Share	-1.13 (2.04)	-.636 (1.86)	-13.5 (22.3)
Difference in Percent Increase in Shale Dev. Empl. Share Squared	-.324** (.134)	-.251** (.122)	-6.84 (15.9)
Difference in Percent Increase in Population	3.64*** (.889)	4.12*** (.836)	9.02** (3.75)
Difference in Percent Increase in Per-capita Income	.66 (.481)	.861* (.46)	2.82 (1.78)
DiD Poverty (%)	-3.67*** (1.17)	-3.16*** (1.1)	.532 (3.6)
DiD Expected Empl. Growth (%)	-.068 (3.2)	2.68 (3.19)	.899 (9.02)
log(Year 2000 Population)	-1.57 (4.25)	-1.44 (3.61)	4.13 (11.9)
log(Year 2000 Per-capita Income)	-.044 (27.7)	8.05 (25.4)	13 (65.6)
Year 2000 Poverty (%)	-1.35 (1.91)	-2.06 (1.74)	-5.17 (3.54)
Year 2000 Expected Job Growth (%)	-17** (7.84)	-12.2 (7.38)	2.52 (21.4)
MSA_Dummy	5.28 (6.03)	9.1 (5.63)	1.43 (18.2)
ARC_Dummy	7.76 (5.75)	4.2 (5.34)	2.24 (14.9)
log(Year 2000 All Housing Median Sale Price)	9.07 (9.62)		
log(Year 2000 Median Resale Price)		-1.01 (9.22)	
log(Year 2000 New Construction Median Sale Price)			38.1* (20.4)
Constant	-58.3 (271)	-20.3 (241)	-609 (634)
R-squared	0.422	0.438	0.525
Adjusted R-squared	0.352	0.370	0.343
F	82.44	107.6	2.284
Observations	122	122	48

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 15a: Difference-in-Difference Regression; Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Difference in Percent Increase in Population	Difference in Avg. Annual Percent Increase in Res. Bldg. Permits (1 Units)	Difference in Avg. Annual Percent Increase in Res. Bldg. Permits (2 Units)	Difference in Avg. Annual Percent Increase in Res. Bldg. Permits (3-4 Units)	Difference in Avg. Annual Percent Increase in Res. Bldg. Permits (5+ Units)
Shale Wells Drilled 2007-2011	1.5e-03 (5.2e-03)	7.2e-05 (3.2e-04)	-3.8e-06 (7.7e-06)	-1.9e-05* (1.0e-05)	-5.4e-06 (8.4e-06)
Shale Wells Drilled 2007-2011 Squared	2.7e-06 (5.8e-06)	2.4e-08 (3.6e-07)	6.9e-09 (8.2e-09)	2.2e-08* (1.2e-08)	4.7e-09 (9.2e-09)
Difference in Percent Increase in Population		.047 (.031)	5.6e-04** (2.4e-04)	-3.5e-06 (1.8e-04)	3.2e-05 (2.2e-04)
Difference in Percent Increase in Per-capita Income	-.246** (.112)	-5.0e-03 (8.4e-03)	-2.0e-04 (1.6e-04)	5.3e-05 (1.3e-04)	6.2e-05 (1.4e-04)
DiD Poverty (%)	.025 (.117)	-9.5e-03 (.011)	-1.8e-04 (3.0e-04)	1.1e-04 (2.3e-04)	3.0e-04 (2.7e-04)
DiD Expected Empl. Growth (%)	.035 (.336)	.014 (.035)	-1.2e-03 (8.4e-04)	-2.0e-03** (8.3e-04)	3.5e-04 (7.0e-04)
log(Year 2000 Population)	.848* (.442)	.109* (.055)	1.1e-03 (1.0e-03)	7.9e-04 (8.2e-04)	2.9e-04 (8.4e-04)
log(Year 2000 Per-capita Income)	-1.15 (3.15)	-.101 (.52)	-3.0e-03 (9.2e-03)	.013* (7.0e-03)	2.3e-04 (6.7e-03)
Year 2000 Poverty (%)	.412*** (.126)	.04** (.017)	8.3e-05 (6.1e-04)	4.8e-04 (3.2e-04)	-8.6e-05 (3.3e-04)
Year 2000 Expected Job Growth (%)	-1.71* (.953)	-.062 (.061)	-1.6e-03 (1.2e-03)	-1.5e-03 (1.2e-03)	-4.7e-04 (1.1e-03)
MSA_Dummy	.038 (.542)	-.023 (.057)	-5.0e-04 (1.8e-03)	-1.8e-03 (1.8e-03)	-8.4e-04 (1.6e-03)
ARC_Dummy	.087 (.54)	.059 (.074)	1.7e-03 (2.2e-03)	5.6e-03*** (2.0e-03)	1.9e-03 (2.4e-03)
log(Year 2000 Res. Bldg. Permits) (1 Units)		-.093*** (.033)			
log(Year 2000 Res. Bldg. Permits) (2 Units)			-2.8e-03*** (7.3e-04)		
log(Year 2000 Res. Bldg. Permits) (3-4 Units)				-2.2e-03** (1.0e-03)	
log(Year 2000 Res. Bldg. Permits) (5+ Units)					-4.6e-04 (7.8e-04)
Constant	-1.49 (29)	-.407 (5.01)	.014 (.091)	-.154** (.073)	-5.3e-03 (.068)
R-squared	0.350	0.549	0.275	0.236	0.054
Adjusted R-squared	0.296	0.504	0.203	0.159	-0.040
F	4.253	12.89	6.657	2.238	1.055
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 15b: Difference-in-Difference Regression; Shale Wells Drilled (Percent Change)

Explanatory Variables[1]	Difference in Percent Increase in FMR (0 Bedrooms)	Difference in Percent Increase in FMR (1 Bedrooms)	Difference in Percent Increase in FMR (2 Bedrooms)	Difference in Percent Increase in FMR (3 Bedrooms)	Difference in Percent Increase in FMR (4 Bedrooms)
Shale Wells Drilled 2007-2011	-.112*** (.037)	-.067** (.028)	-.065** (.027)	-.067** (.031)	-.043 (.036)
Shale Wells Drilled 2007-2011 Squared	1.4e-04*** (3.8e-05)	7.1e-05** (3.0e-05)	7.4e-05** (3.0e-05)	7.8e-05** (3.3e-05)	4.1e-05 (4.0e-05)
Difference in Percent Increase in Population	1.01** (.486)	.499* (.293)	.541** (.244)	.696** (.318)	1.01** (.473)
Difference in Percent Increase in Per-capita Income	.282 (.327)	.225 (.197)	.233 (.165)	.199 (.191)	.335 (.227)
DiD Poverty (%)	-.321 (.506)	-.22 (.353)	-.598* (.322)	-.846** (.361)	-1.11*** (.424)
DiD Expected Empl. Growth (%)	-1.75 (1.77)	-1.19 (.936)	-1.02 (.927)	-2.01** (.871)	-.779 (1.03)
log(Year 2000 Population)	-1.93 (1.98)	-.292 (1.34)	-.752 (1.27)	-.865 (1.29)	-1.35 (1.49)
log(Year 2000 Per-capita Income)	3.37 (14.3)	-7.17 (9.79)	-2.63 (8.42)	5.44 (8.93)	3.42 (9.4)
Year 2000 Poverty (%)	.324 (.785)	.366 (.573)	.46 (.448)	.706 (.562)	.235 (.591)
Year 2000 Expected Job Growth (%)	1.7 (3.37)	2.32 (2.02)	2.12 (1.7)	.442 (2.01)	.869 (2.11)
MSA_Dummy	-3.43 (3.37)	-4.09* (2.42)	-6.27*** (2.34)	-7.17*** (2.18)	-3.8 (2.48)
ARC_Dummy	-1.61 (3.6)	-1.87 (3.04)	-1.79 (3.08)	-.324 (3.08)	-.42 (3.48)
log(Year 2000 FMR) (0 Bedrooms)	31.4*** (11.2)				
log(Year 2000 FMR) (1 Bedrooms)		28.5*** (9.5)			
log(Year 2000 FMR) (2 Bedrooms)			30.3*** (9.05)		
log(Year 2000 FMR) (3 Bedrooms)				40.5*** (8.51)	
log(Year 2000 FMR) (4 Bedrooms)					47.2*** (8.04)
Constant	-211 (143)	-102 (102)	-157 (95.6)	-311*** (97.1)	-325*** (93.7)
R-squared	0.226	0.237	0.279	0.340	0.322
Adjusted R-squared	0.149	0.161	0.206	0.274	0.254
F	4.613	2.963	3.935	6.550	6.885
Observations	144	144	144	144	144

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 15c: Difference-in-Difference Regression; Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Difference in Percent Increase in Housing Median Sale Price	Difference in Percent Increase in Median Resale Price	Difference in Percent Increase in New Construction Median Sale Price
Shale Wells Drilled 2007-2011	.255*** (.082)	.23*** (.073)	.727* (.359)
Shale Wells Drilled 2007-2011 Squared	-3.7e-04*** (1.3e-04)	-3.5e-04*** (1.1e-04)	-2.6e-03 (1.7e-03)
Difference in Percent Increase in Population	3.9*** (.967)	4.39*** (.881)	9.19** (3.61)
Difference in Percent Increase in Per-capita Income	1.05 (.645)	1.19** (.591)	3.38* (1.81)
DiD Poverty (%)	-2.75** (1.1)	-2.37** (1.05)	.32 (3.32)
DiD Expected Empl. Growth (%)	2.1 (3.41)	4.55 (3.26)	1.3 (9.14)
log(Year 2000 Population)	-.954 (3.93)	-1.15 (3.27)	3.71 (12.1)
log(Year 2000 Per-capita Income)	-2.39 (28.1)	7.01 (25.9)	9.97 (64.2)
Year 2000 Poverty (%)	-1.51 (2.06)	-2.14 (1.92)	-5.87 (3.52)
Year 2000 Expected Job Growth (%)	-7.69 (6.28)	-4.41 (5.66)	11.8 (22.1)
MSA_Dummy	3.6 (6)	7.56 (5.55)	-2.63 (16.5)
ARC_Dummy	2.59 (6.44)	-.226 (5.92)	-8.85 (15.8)
log(Year 2000 All Housing Median Sale Price)	4.48 (8.37)		
log(Year 2000 Median Resale Price)		-5 (8.1)	
log(Year 2000 New Construction Median Sale Price)			30.2 (19)
Constant	.3 (279)	23.1 (253)	-480 (640)
R-squared	0.438	0.459	0.558
Adjusted R-squared	0.370	0.394	0.388
F	4.483	4.729	232.7
Observations	122	122	48

Legend: Each column denotes a single regression; Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 16: First-Differenced Regression; Shale Development Employment (Levels)

Explanatory Variables [1]	Change in Vacancy Rate (%) 2000-2011	Change in Median Home Value ($) 2000-2011	Change in Median Rent ($) 2000-2011
Change in Shale Dev. Empl. 2006-2011	-8.6e-04** (4.0e-04)	-5.141 (7.174)	6.9e-04 (.0119)
Change in Shale Dev. Empl. 2006-2011 Squared	2.6e-07 (2.0e-07)	-2.8e-04 (.004)	-1.6e-06 (7.2e-06)
Change in Population 2000-2011	-2.4e-05*** (6.9e-06)	.3208*** (.1106)	6.1e-04*** (1.9e-04)
Change in Per-capita Income ($) 2000-2011	1.6e-04* (8.0e-05)	1.575** (.7416)	.0012 (.0014)
Change in Poverty (%) 2000-2011	.2794*** (.0837)	-2726*** (724.8)	-1.99 (1.678)
Change in Expected Empl. Growth (%) 2000-2011	.5807 (.5477)	-5268 (4891)	-9.783 (10.01)
log(Year 2000 Population)	-.066 (.226)	5395* (2728)	15.46*** (5.695)
log(Year 2000 Per-capita Income)	1.289 (2.323)	-222.2 (2.2e+04)	-33.43 (50.14)
Year 2000 Poverty (%)	.0592 (.115)	1976** (997.1)	4.28** (2.042)
Year 2000 Expected Job Growth (%)	.7717 (.8027)	-1.3e+04** (6695)	-17.25 (15.18)
log(Year 2000 Median Home Value)	.7035 (1.167)	5.3e+04*** (1.5e+04)	68.46** (31.76)
log(Year 2000 Median Rent)	-6.691*** (2.368)	6.5e+04*** (2.1e+04)	132.5*** (46.65)
Year 2000 Vacancy Rate (%)	-.031 (.0263)	680*** (126.3)	.785** (.3432)
MSA_Dummy	-.1452 (.3531)	-4988 (3435)	-6.603 (8.304)
ARC_Dummy	-1.162*** (.4383)	7660** (3832)	11.03 (9.796)
Constant	19.81 (20.73)	-1.0e+06*** (2.6e+05)	-1280** (523)
R-squared	0.340	0.686	0.543
Adjusted R-squared	0.262	0.647	0.490
F	4.870	12.40	9.101
Observations	144	138	144

Notes: Each column denotes a single regression. Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 17: First-Differenced Regression; Shale Wells Drilled (Levels)

Explanatory Variables [1]	Change in Vacancy Rate (%) 2000-2011	Change in Median Home Value ($) 2000-2011	Change in Median Rent ($) 2000-2011
Shale Wells Drilled 2007-2011	-5.5e-04 (.0026)	-8.627 (18.02)	.0768* (.0409)
Shale Wells Drilled 2007-2011 Squared	7.3e-07 (3.1e-06)	.0069 (.0199)	-9.6e-05** (4.4e-05)
Change in Population 2000-2011	-1.5e-05 (1.0e-05)	.3518** (.1348)	5.7e-04** (2.7e-04)
Change in Per-capita Income ($) 2000-2011	1.3e-04 (7.9e-05)	1.342* (.758)	8.3e-04 (.0015)
Change in Poverty (%) 2000-2011	.2897*** (.0871)	-2713*** (753.1)	-1.915 (1.719)
Change in Expected Empl. Growth (%) 2000-2011	.3875 (.5291)	-7871* (4321)	-12.05 (9.526)
log(Year 2000 Population)	.0308 (.2403)	5615* (3023)	14.43** (6.124)
log(Year 2000 Per-capita Income)	2.042 (2.39)	3989 (2.2e+04)	-31.37 (48.21)
Year 2000 Poverty (%)	.0913 (.116)	2059** (952.1)	4.207** (1.963)
Year 2000 Expected Job Growth (%)	.5476 (.8097)	-1.6e+04** (6378)	-18.92 (14.63)
log(Year 2000 Median Home Value)	.7294 (1.248)	5.3e+04*** (1.5e+04)	65.28** (31.21)
log(Year 2000 Median Rent)	-6.736*** (2.437)	6.5e+04*** (2.1e+04)	138.5*** (46.97)
Year 2000 Vacancy Rate (%)	-.0278 (.0279)	703.1*** (132.9)	.7291** (.3548)
MSA_Dummy	-.1838 (.3594)	-4871 (3426)	-7.175 (8.145)
ARC_Dummy	-1.338*** (.4341)	6465* (3712)	9.858 (9.558)
Constant	11.3 (20.9)	-1.1e+06*** (2.5e+05)	-1284*** (474.9)
R-squared	0.309	0.680	0.546
Adjusted R-squared	0.228	0.641	0.493
F	3.695	12.68	8.997
Observations	144	138	144

Notes: Each column denotes a single regression. Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 18: First-Differenced Regression; Shale Development Employment (Logs)

Explanatory Variables [1]	Change in Vacancy Rate (%) 2000-2011	Change in log(Median Home Value) 2000-2011	Change in log(Median Rent) 2000-2011
Change in log(Shale Dev. Empl. 2006-2011)	-.628 (.852)	-.106* (.0572)	-.0211 (.0159)
Change in log(Shale Dev. Empl. 2006-2011) Squared	1.07 (1.17)	.171** (.0675)	.0234 (.0208)
Change in log(Population) 2000-2011	-11*** (2.11)	.431 (.289)	.204* (.122)
Change in log(Per-capita Income) 2000-2011)	2.51 (2.91)	.349* (.178)	.0527 (.078)
Change in Poverty (%) 2000-2011	.261*** (.0843)	-.0167*** (.00505)	-.00309 (.00245)
Change in Expected Empl. Growth (%) 2000-2011	.163 (.493)	-.043 (.0367)	-.00995 (.0164)
log(Year 2000 Population)	.034 (.198)	.0453** (.0193)	.0218** (.00852)
log(Year 2000 Per-capita Income)	2.48 (1.97)	.0223 (.145)	-.0242 (.0713)
Year 2000 Poverty (%)	.127 (.103)	.0116* (.00654)	.0057* (.00289)
Year 2000 Expected Job Growth (%)	.39 (.738)	-.0815 (.0504)	-.0181 (.0249)
log(Year 2000 Median Home Value)	2.87** (1.11)	.0724 (.106)	.0719 (.044)
log(Year 2000 Median Rent)	-6.96*** (2.03)	.311** (.134)	-.113* (.0623)
Year 2000 Vacancy Rate (%)	-.00601 (.0239)	.00394*** (.00134)	.00038 (.00062)
MSA_Dummy	-.19 (.331)	-.0222 (.0219)	-.0114 (.0116)
ARC_Dummy	-1.33*** (.412)	.031 (.0267)	.0137 (.0135)
Constant	-15.9 (16.8)	-3.24** (1.4)	.16 (.674)
R-squared	0.427	0.484	0.190
Adjusted R-squared	0.360	0.421	0.095
F	7.040	9.319	2.195
Observations	144	138	144

Notes: Each column denotes a single regression. Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 19: First-Differenced Regression; Shale Wells Drilled (Logs)

Explanatory Variables [1]	Change in Vacancy Rate (%) 2000-2011	Change in log(Median Home Value) 2000-2011	Change in log(Median Rent) 2000-2011
Shale Wells Drilled 2007-2011	-.00071 (.00276)	8.9e-05 (.00013)	.00017*** (6.3e-05)
Shale Wells Drilled 2007-2011 Squared	1.2e-06 (3.2e-06)	-7.1e-08 (1.4e-07)	-2.1e-07*** (6.7e-08)
Change in log(Population) 2000-2011	-11.2*** (2)	.395 (.283)	.196* (.118)
Change in log(Per-capita Income) 2000-2011)	2.48 (2.93)	.314* (.186)	.0247 (.0793)
Change in Poverty (%) 2000-2011	.271*** (.0827)	-.0146*** (.00518)	-.00244 (.00244)
Change in Expected Empl. Growth (%) 2000-2011	.0594 (.451)	-.066** (.0321)	-.0175 (.015)
log(Year 2000 Population)	-.00136 (.207)	.0393** (.0195)	.0196** (.00836)
log(Year 2000 Per-capita Income)	2.69 (2.06)	.052 (.147)	-.0224 (.0712)
Year 2000 Poverty (%)	.115 (.108)	.00964 (.00652)	.00526* (.00283)
Year 2000 Expected Job Growth (%)	.189 (.749)	-.12*** (.0453)	-.0256 (.0233)
log(Year 2000 Median Home Value)	2.73** (1.26)	.0459 (.11)	.0603 (.0447)
log(Year 2000 Median Rent)	-6.8*** (2.05)	.349** (.139)	-.0963 (.0629)
Year 2000 Vacancy Rate (%)	-.00459 (.0241)	.00408*** (.00141)	.00027 (.00063)
MSA_Dummy	-.162 (.33)	-.0202 (.0229)	-.0128 (.0117)
ARC_Dummy	-1.37*** (.395)	.0235 (.0273)	.00919 (.0137)
Constant	-16.6 (17)	-3.32** (1.44)	.218 (.67)
R-squared	0.418	0.439	0.197
Adjusted R-squared	0.350	0.370	0.103
F	7.158	9.219	2.570
Observations	144	138	144

Notes: Each column denotes a single regression. Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 20: First-Differenced Regression; Shale Development Employment (Percent Change)

Explanatory Variables [1]	Change in Vacancy Rate (%) 2000-2011	Percent Increase in Median Home Value 2000-2011	Percent Increase in Median Rent 2000-2011
Percent Increase in Shale Dev. Empl. Share 2006-2011	-.029 (.081)	-1.66** (.691)	-.19 (.318)
Percent Increase in Shale Dev. Empl. Share 2006-2011 Squared	-.016* (9.2e-03)	.463*** (.087)	.064 (.046)
Percent Increase in Population 2000-2011	-.09*** (.017)	.303 (.358)	.193 (.154)
Percent Increase in Per-capita Income 2000-2011	.023 (.02)	.254 (.188)	.028 (.077)
Change in Poverty (%) 2000-2011	.276*** (.082)	-2.41*** (.794)	-.432 (.347)
Change in Expected Empl. Growth (%) 2000-2011	.53 (.564)	-14.8** (6.07)	-3.21 (2.95)
log(Year 2000 Population)	-.057 (.203)	7.4** (3.03)	3.05** (1.18)
log(Year 2000 Per-capita Income)	3.09 (2.06)	2.81 (20.7)	-4.37 (9.66)
Year 2000 Poverty (%)	.135 (.113)	1.67 (1.1)	.708 (.434)
Year 2000 Expected Job Growth (%)	.622 (.784)	-21.7*** (7.69)	-4.48 (3.8)
log(Year 2000 Median Home Value)	2.74** (1.25)	7.1 (17.1)	9.58 (6.21)
log(Year 2000 Median Rent)	-6.96*** (2.07)	58.1*** (20.9)	-13.8 (8.53)
Year 2000 Vacancy Rate (%)	-3.2e-03 (.024)	.701*** (.203)	.056 (.087)
MSA_Dummy	-.176 (.329)	-2.49 (3.61)	-1.55 (1.65)
ARC_Dummy	-1.37*** (.391)	2.76 (4.38)	1.59 (1.9)
Constant	-19.9 (17.4)	-507** (214)	22.7 (95.7)
R-squared	0.418	0.494	0.175
Adjusted R-squared	0.350	0.432	0.078
F	7.175	18.11	2.789
Observations	144	138	144

Notes: Each column denotes a single regression. Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Table 21: First-Differenced Regression; Shale Wells Drilled (Percent Change)

Explanatory Variables [1]	Change in Vacancy Rate (%) 2000-2011	Percent Increase in Median Home Value 2000-2011	Percent Increase in Median Rent 2000-2011
Shale Wells Drilled 2007-2011	-9.3e-04 (2.7e-03)	1.0e-02 (.019)	.025*** (8.9e-03)
Shale Wells Drilled 2007-2011 Squared	1.4e-06 (3.1e-06)	-7.3e-06 (2.1e-05)	-3.0e-05*** (9.6e-06)
Percent Increase in Population 2000-2011	-.094*** (.018)	.331 (.369)	.197 (.147)
Percent Increase in Per-capita Income 2000-2011	.022 (.021)	.277 (.198)	7.1e-03 (.077)
Change in Poverty (%) 2000-2011	.282*** (.083)	-2.29*** (.83)	-.384 (.338)
Change in Expected Empl. Growth (%) 2000-2011	.158 (.459)	-10** (4.74)	-2.84 (2.06)
log(Year 2000 Population)	-.023 (.209)	6.15** (3.07)	2.7** (1.15)
log(Year 2000 Per-capita Income)	3.06 (2.08)	4.96 (21.5)	-4.35 (9.69)
Year 2000 Poverty (%)	.114 (.109)	1.75 (1.06)	.739* (.398)
Year 2000 Expected Job Growth (%)	.331 (.758)	-18.5*** (6.62)	-4.1 (3.19)
log(Year 2000 Median Home Value)	2.59** (1.26)	10.1 (18.1)	9.16 (6.21)
log(Year 2000 Median Rent)	-7.13*** (2.07)	60.9*** (21.6)	-11.8 (8.63)
Year 2000 Vacancy Rate (%)	-3.8e-03 (.024)	.683*** (.214)	.039 (.089)
MSA_Dummy	-.145 (.333)	-3.05 (3.64)	-1.87 (1.65)
ARC_Dummy	-1.38*** (.397)	2.39 (4.51)	1.18 (1.92)
Constant	-16.8 (17.2)	-567** (220)	19.6 (93)
R-squared	0.411	0.422	0.182
Adjusted R-squared	0.342	0.351	0.086
F	6.248	8.175	2.474
Observations	144	138	144

Notes: Each column denotes a single regression. Each value listed denotes the coefficient estimate for the explanatory variable at the left for the dependent variable listed above. Robust standard errors of coefficient estimates are shown in parentheses.

* - Denotes statistical significance of 10% or better. (p-value < 0.10); ** - Denotes statistical significance of 5% or better. (p-value < 0.05); *** - Denotes statistical significance of 1% or better. (p-value < 0.01)

[1] - Shale Dev. Empl. denotes NAICS (North American Industry Classification System) industry codes which are connected with shale development employment. The specific NAICS codes we utilized to capture shale development employment effects are: 2111-Oil and Gas Extraction; 2131-Support Activities for Mining; 5413 –Architectural, Engineering, and Related Services; 2389–Other Specialty Trade Contractors; 3331–Agriculture, Construction, and Mining Machinery Manufacturing; 4862–Pipeline Transportation of Natural Gas; 2371–Utility System Construction

Appendix 3: Additional Charts and Figures

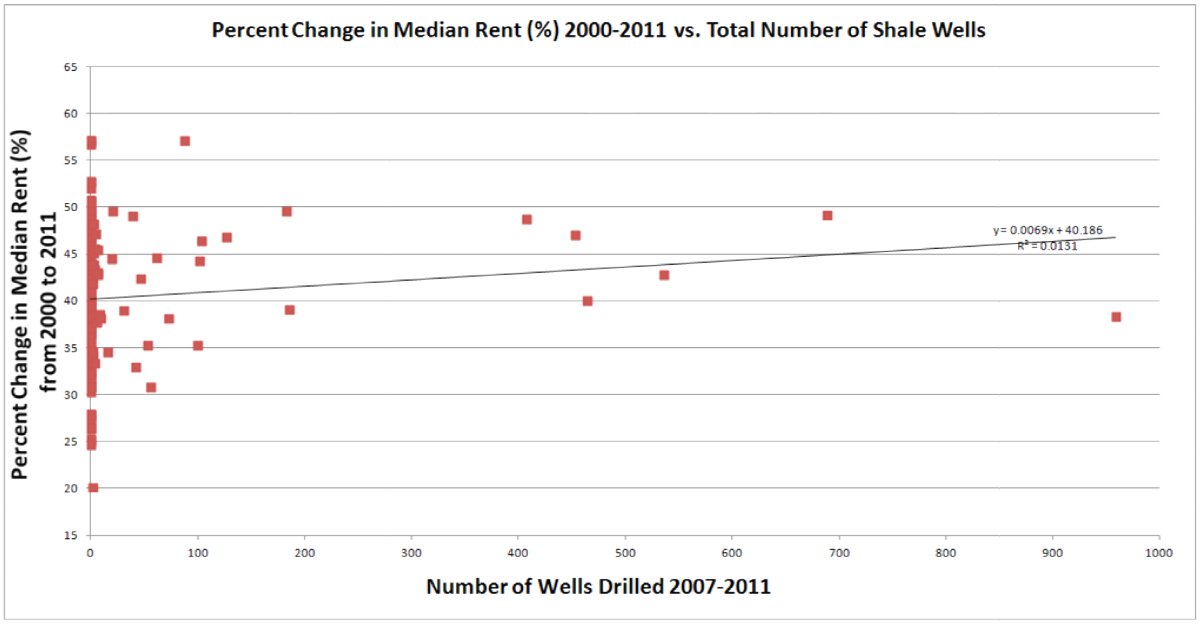


Figure 1: Relationship between the Percent Change in Median Rent and the number of shale gas wells drilled

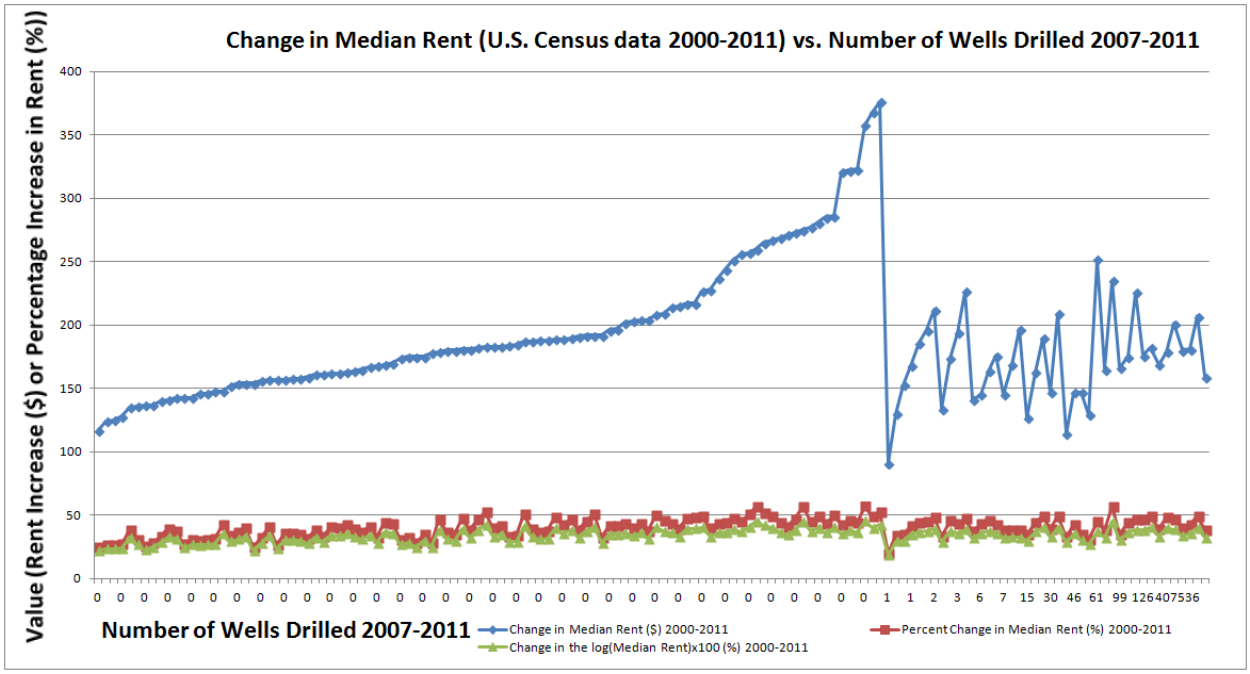


Figure 2: Illustration of the Scattered Nature of the Census Median Rent data

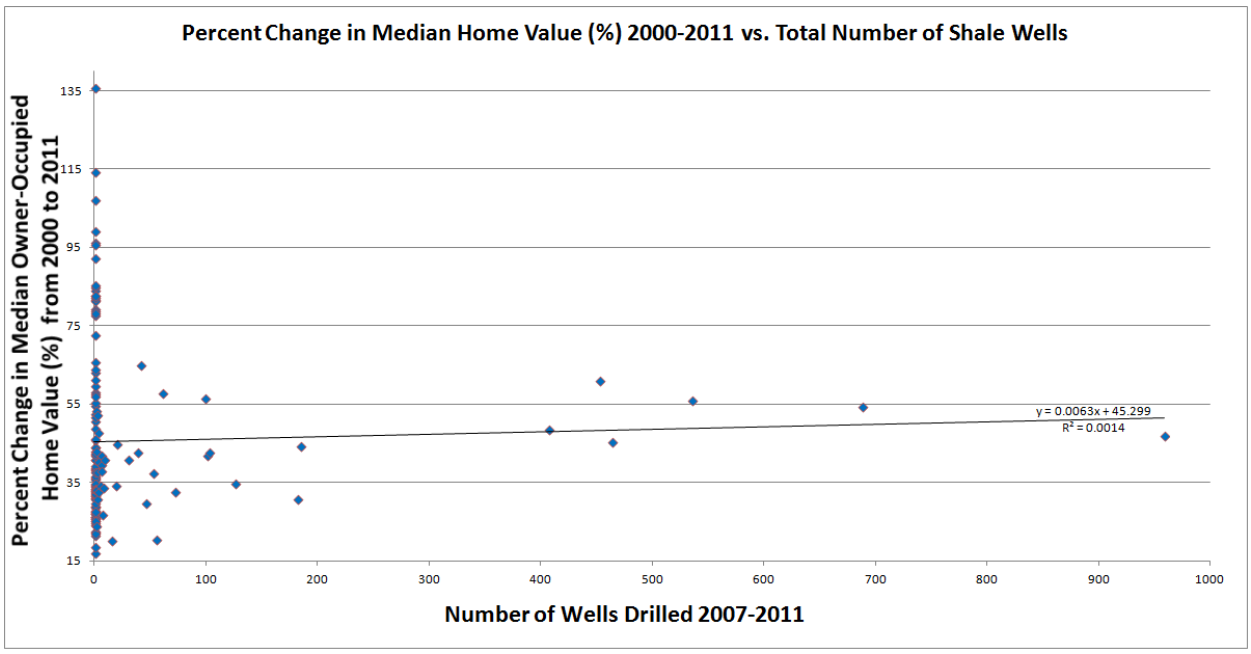


Figure 3: Relationship between Percent Change in Median Home Value and the Number of Shale Gas Wells Drilled

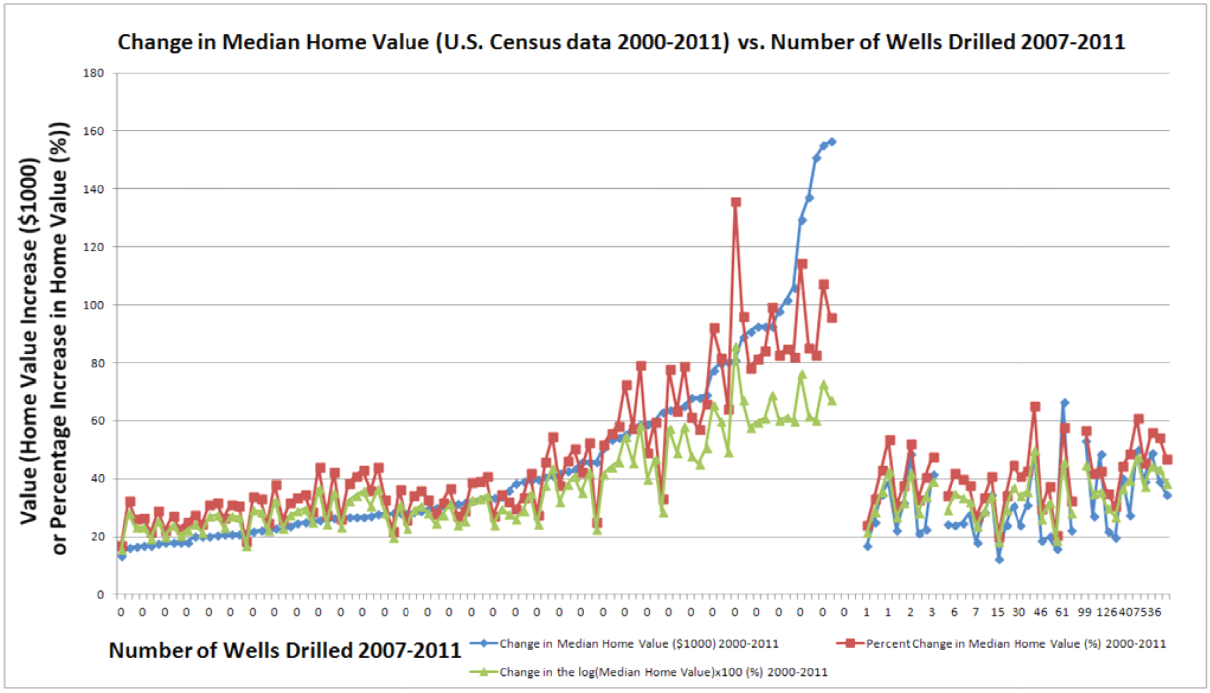


Figure 4: Illustration of the Scattered Nature of the Census Median Home Value data

Appendix 4: CoreLogic Data Limitations

In order to obtain a better picture of housing market effects from shale gas development, we purchased data from CoreLogic, Inc, an industry leader in housing market data collection and analysis. They offer data products that are unavailable from any other source. CoreLogic has created a housing price index (HPI) dataset based on actual home sales over time, which provides the most accurate quantification of whether counties undergoing substantial shale resource development had departed from previous housing market trends and how much of the difference was attributable to shale resource development. Unfortunately, despite assurances from CoreLogic, this data was unavailable for many key counties in our sample, including the heavy-shale energy producing Pennsylvania counties.

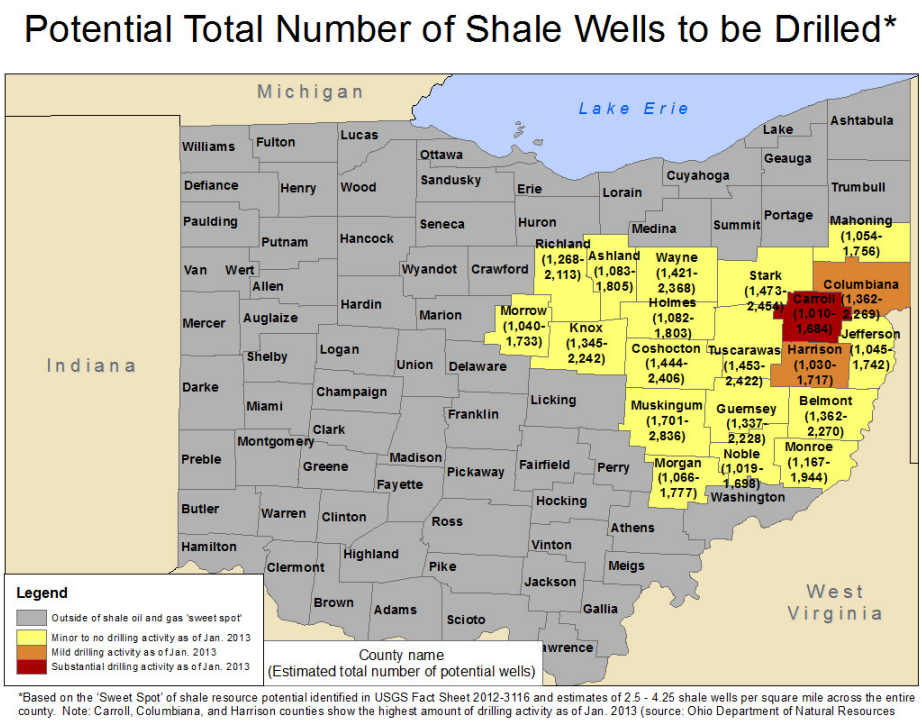
The data which we substituted for the HPI, CoreLogic's median home sale price, also proved problematic. CoreLogic's dataset was unbalanced, with median sale prices not reported for all counties in all years from 2000-2011. Similar to the HPI dataset, the median sale price dataset did not provide observations for the critical years of the shale boom for several Pennsylvania counties crucial to the analysis. Additionally, CoreLogic did not possess any other data which would have assisted in interpolating missing values in the median sale price dataset. Nonetheless, we used the median home price data they provided to conduct an unbalanced two-way fixed effects regression, which possessed some explanatory power, indicating that home median resale prices tended to be positively associated with shale development employment. We would have more confidence in these results had CoreLogic's dataset included all of the data.

We attempted to conduct a difference-in-difference regression using the CoreLogic data, but critical observations were missing from the dataset. In order to proceed with the analysis, we filled in the data gaps using our best estimates of the missing values for missing observations. Specifically, we use the average of the median housing sale price of the counties surrounding Bradford and Susquehanna to substitute for their year 2003 and 2007, years in which the data were missing. Likewise, we did not have CoreLogic median home price data for Lycoming County for 2011. Thus, for Lycoming County, we use its own median home price data for the 2003-2007 period but nearby Tioga County's price data for the 2007-2011 period in order to have corresponding data for that time period. In short, because of severe data limitations for three of the top six shale boom counties during the boom period, the results of the regressions using the CoreLogic data should be treated cautiously, especially the difference-in-difference analysis.

Appendix 5: 2016 Shale Well Drilling Scenarios

We construct low, medium, and high future drilling scenarios based on current drilling trends in Ohio and previous drilling experience in Pennsylvania from 2007-2011. Since Pennsylvania activity began in earnest in 2007, we examine what happened over the following four years to 2011. Then, since Ohio's shale activity began in earnest in 2012, we use the Pennsylvania experience to extrapolate out four years to 2016. We also estimate the scope of the total drilling potential for the counties identified by the U.S. Geological Survey as being in the 'sweet spot' of Ohio's shale oil and gas resources.

The limiting factor on the total number of shale wells that will be drilled in a given county depends on the amount of resources available and the surface area over which they occur. Assuming that sufficient resources for economically-viable extraction underlie the entire county, the upper-bound total number of wells that will be drilled is related to the area of shale that each well can tap. Each vertical well utilizing hydraulic fracturing technology can extract resources from an area up to 40 acres in size, which would require 16 wellpads per square mile (Soeder, 2013). Current horizontal drilling technology used in Pennsylvania generally allows a single horizontal well to tap around 160 acres (Soeder, 2013). We assume that a single well can on average extract the resource from 150 acres or 250 acres, depending on whether the shale resource is natural gas or oil, as suggested by USGS Fact Sheet 2012-3116 (U.S. Geological Survey, 2012). These values correspond to 2.5-4.25 wells drilled per square mile and allow us to place an upper limit on the estimated total number of shale wells drilled per county during the entire shale development time period. See Figure 1 for specific estimates.

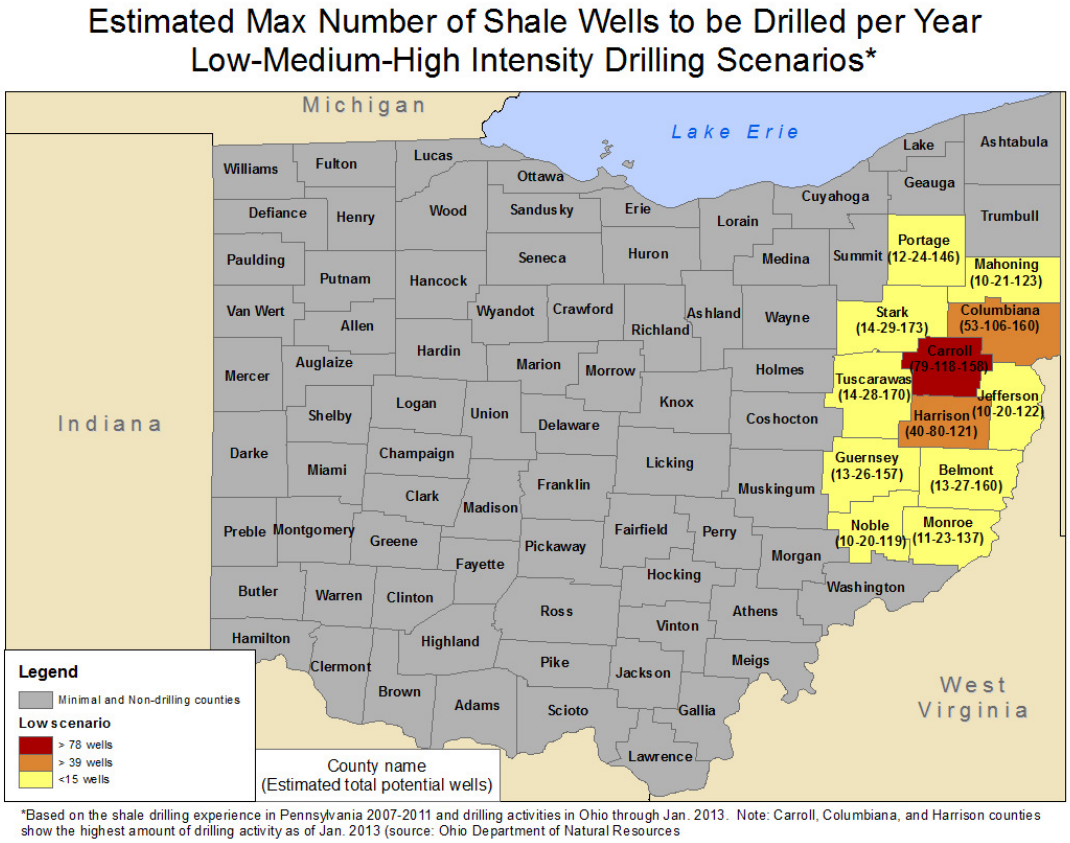


Source: U.S. Geological Survey Fact Sheet 2012-3116

Figure 1: Potential Number of Shale Wells to be Drilled in Ohio

This upper limit on the number of potential shale wells to be drilled suggests that an appropriate way to measure shale drilling intensity would be to measure how quickly shale development is approaching this ceiling. A less-populated county would likely experience greater housing market effects from shale development than a more-populated county with the same number of wells, all other things being equal. To create anticipated near-future drilling scenarios, we adopt a system based on Pennsylvania's experience which separates counties into three different drilling-intensity classes and then assigns three drilling intensity scenarios to each, displayed in Table 1. Class A corresponds to the experience of Bradford County in Pennsylvania and represents the expected focus of most of the drilling activity. We place Carroll County into this class, as it already has 35% of the approved shale drilling permits in the state (181 wells permitted as of Jan. 2013) (ODNR, 2013). Class B represents substantial drilling activity, though not as intense as Class A. The Pennsylvanian counties with the next five highest well counts fall into this class, as do Columbiana and Harrison counties in Ohio, as they each have substantially more drilling permits approved than the rest of Ohio counties (62 and 65 wells permitted, respectively, as of Jan. 2013) (ODNR, 2013). Class C counties are those which have only minimal drilling activity present. The large majority of Pennsylvania and Ohio counties experiencing some drilling activity fall into this group. Table 2 shows the class assignment for each Ohio county based on the numbers of shale well permits approved as of Jan. 2013 and the anticipated shale wells drilled per square mile per year for each of three scenarios developed using Pennsylvania's experience.

Figure 2 is a map showing the location of these counties and their anticipated drilling intensity for each scenario. Again, these estimates only extend to 2016 and do not imply that drilling activity will not eventually extend outside the counties shown on the map. In addition, by 2016, we expect a few stray wells to be drilled outside of the band shown in the map, but not enough to tangibly affect local housing markets. Finally, the actual drilling pattern will be influenced by the price of the resource and by technological changes that we cannot forecast. Yet, we note that Pennsylvania's pattern was affected by the high price of natural gas in the 2007-2008 period.



Source: Penn. Dept. of Environmental Protection & Ohio Dept. of Natural Resources

Figure 2: Estimated Yearly Number of Wells Drilled Under Low-Medium-High Drilling Intensity Scenarios

Table 1: Average Number of Shale Gas Wells Drilled per Square Mile per Year in Selected Pennsylvania Counties

County	Year					Total Wells Drilled Per Square Mile	Total Wells Drilled	Shale Development Class
	2007	2008	2009	2010	2011			
Bradford	0.00	0.02	0.14	0.33	0.35	0.84	962	A
Tioga	0.00	0.01	0.11	0.24	0.24	0.61	689	B
Washington	0.05	0.08	0.12	0.19	0.18	0.63	562	B
Lycoming	0.00	0.01	0.02	0.10	0.25	0.38	464	B
Susquehanna	0.00	0.04	0.11	0.15	0.25	0.55	454	B
Greene	0.02	0.12	0.18	0.18	0.21	0.71	409	B
Westmoreland	0.00	0.03	0.04	0.05	0.06	0.18	189	C
Fayette	0.01	0.03	0.07	0.06	0.07	0.23	185	C
Clearfield	0.00	0.01	0.02	0.03	0.05	0.11	126	C
Butler	0.02	0.01	0.01	0.04	0.04	0.13	106	C
Armstrong	0.00	0.01	0.03	0.06	0.06	0.15	104	C
Wyoming	0.00	0.00	0.01	0.06	0.18	0.25	99	C
Clinton	0.00	0.00	0.01	0.04	0.04	0.10	87	C
Potter	0.01	0.01	0.01	0.03	0.01	0.07	72	C
Centre	0.00	0.00	0.01	0.04	0.01	0.05	62	C
Elk	0.01	0.01	0.01	0.02	0.03	0.07	57	C
McKean	0.00	0.00	0.01	0.02	0.02	0.05	55	C
Sullivan	0.00	0.00	0.00	0.05	0.04	0.09	41	C
Indiana	0.00	0.01	0.01	0.01	0.03	0.05	40	C
Jefferson	0.00	0.00	0.00	0.01	0.02	0.05	30	C
Clarion	0.00	0.00	0.00	0.00	0.02	0.03	20	C
Somerset	0.00	0.00	0.01	0.00	0.01	0.02	20	C
Cameron	0.00	0.00	0.00	0.00	0.01	0.02	15	C

Table 2: Estimated Near-Future Shale Well Drilling Scenarios based on Current Ohio Trends and Pennsylvania's History of Shale Resource Development

County	Shale Wells Drilled / Shale Wells Permitted[1]	Shale Development Class[2,3,4]	County Size (Sq. Miles)	Low Intensity Drilling Scenario (Wells Drilled Per Year) [Expected Employment][5]	Medium Intensity Drilling Scenario (Wells Drilled Per Year) [Expected Employment][6]	High Intensity Drilling Scenario (Wells Drilled Per Year) [Expected Employment][7]
CARROLL	88/181	A	394.61	79 [1,149]	118 [1,295]	158 [1,142]
HARRISON	21/65	B	402.34	40 [714]	80 [1,160]	121 [1,295]
COLUMBIANA	30/62	B	531.89	53 [891]	106 [1,282]	160 [1,129]
JEFFERSON	22/35	C	408.33	10 [178]	20 [379]	122 [1,293]
MONROE	12/32	C	455.72	11 [202]	23 [423]	137 [1,262]
GUERNSEY	8/27	C	522.25	13 [236]	26 [483]	157 [1,151]
NOBLE	15/25	C	398.01	10 [172]	20 [370]	119 [1,295]
BELMONT	12/21	C	532.13	13 [241]	27 [492]	160 [1,128]
MAHONING	5/16	C	411.62	10 [179]	21 [382]	123 [1,292]
PORTAGE	6/14	C	487.38	12 [218]	24 [452]	146 [1,219]
STARK	7/13	C	575.27	14 [263]	29 [529]	173 [1,008]
TUSCARAWAS	3/12	C	567.64	14 [259]	28 [523]	170 [1,032]
COSHOCTON	1/5	C	563.91	14 [257]	28 [520]	169 [1,043]
HOLMES	0/3	C	422.53	11 [185]	21 [393]	127 [1,288]
MUSKINGUM	1/3	C	664.58	17 [307]	33 [604]	199 [658]
KNOX	1/2	C	525.49	13 [238]	26 [486]	158 [1,144]
TRUMBULL	0/2	C	618.3	15 [284]	31 [566]	185 [857]
ASHLAND	1/1	C	422.95	11 [185]	21 [393]	127 [1,288]
GEAUGA	0/1	C	400.16	10 [173]	20 [372]	120 [1,295]
MEDINA	1/1	C	421.36	11 [184]	21 [392]	126 [1,289]
WAYNE	1/1	C	554.93	14 [252]	28 [512]	166 [1,069]
TOTAL	235/522	-	-	-	-	-

[1] - As of Jan. 2013. Source: Ohio Department of Natural Resources, 2013

[2] - Class A corresponds to 0.20, 0.30, and 0.40 shale wells drilled on average per square mile per year for the Low, Medium, and High Intensity Drilling Scenarios

[3] - Class B corresponds to 0.10, 0.20, and 0.30 shale wells drilled on average per square mile per year for the Low, Medium, and High Intensity Drilling Scenarios

[4] - Class C corresponds to 0.025, 0.05, and 0.30 shale wells drilled on average per square mile per year for the Low, Medium, and High Intensity Drilling Scenarios

[5] - 'Low Intensity Drilling' corresponds to drilling levels at the beginning of shale resource development or current drilling trends; The number in brackets provides the estimated increase in shale development jobs if this drilling scenario persists for five years. See footnote in Appendix 5 for discussion of the prediction procedure.

[6] - 'Medium Intensity Drilling' corresponds to sustained levels of drilling once local drilling operations have moved out of the introductory phase; The number in brackets provides the estimated increase in shale development jobs if this drilling scenario persists for five years. See footnote in Appendix 5 for discussion of the prediction procedure.

[7] - 'High Intensity Drilling' corresponds to potential drilling levels seen during the peak of a resource boom; The number in brackets provides the estimated increase in shale development jobs if this drilling scenario persists for five years. See footnote in Appendix 5 for discussion of the prediction procedure.

Tables 3, 4 and 5 illustrate the anticipated effects of shale gas and oil drilling in Ohio under each drilling scenario with regard to some key housing market measures of availability and affordability. To achieve this, we conduct a simple regression of the increase in shale development related jobs from 2006-2011 on the total number of shale wells drilled from 2007-2011 on the sample of Ohio, Pennsylvania, West Virginia and New York counties we use in our analysis. These results suggest that each new shale well drilled is associated with approximately 4.5 new shale development jobs in the county at the end of the five year period, reaching a peak of 1,340 jobs added if 590 wells are drilled, which relates to the quadratic nature of our model.[19] The anticipated number of wells drilled per year under each drilling scenario is summed over the five year period for each of the Ohio counties currently experiencing shale development. These drilling values are used with the regression equation to obtain a prediction of the shale development job growth over this time period. Using this result with the total number of employed persons in 2011 for each county, we construct a predicted measure of increased employment share that is associated with shale development at the end of the five years for each county. We use the anticipated number of wells drilled for each scenario and the associated increase in the share of shale development employment with the regression estimates from the earlier housing availability and affordability analysis to predict the impacts on each of the key housing market variables for each drilling scenario. Recall, our regression analysis tended to predicted very little drilling influence on housing markets. Generally, the results we report are on the high range of our estimated impacts for housing markets, which still suggest a relatively modest impact. The respective low, medium, and high-drilling scenario housing market results are provided in Tables 3, 4, and 5.

The predicted effects of future shale development in Ohio on local housing markets is closely tied with how many shale wells will be drilled and the growth of shale development employment relative to total county employment. The increase in direct shale development jobs is typically less than 1,000 jobs per county, though Carroll County is an exception. This correlates well with observations of Pennsylvania. At the upper end, Bradford County in Pennsylvania added about 1,300 shale development-related jobs during their 5-year boom period. However, the size of the total workforce in each county and its growth rate determines how large is the increased *share* of shale development employment relative to the total workforce. Yet, due to the small population and workforces in Harrison and Carroll counties, and the ability of shale development workers to commute from nearby cities, some of the estimates in Tables 3-5 should be viewed cautiously because they may not exactly follow the Pennsylvanian experience. For example, in the medium- and high- intensity drilling scenarios the Median Resale Price of homes in Harrison County is actually predicted to decrease – which is due to the fact that Harrison County has such a small *total* workforce that the county becomes an outlier in our quadratic equation compared to the rest of the sample when we consider the shale development employment share. We do not necessarily expect that 10% and 20% of the residential workforce in

[19] The regression equation we use to link wells drilled to predicted employment is:
$Increase\ in\ Shale\ Development\ Jobs\ over\ Five\ Years = \alpha + \beta_1 * Total\ Wells\ Drilled + \beta_2 * Total\ Wells\ Drilled^2 + \varepsilon$
where α is the regression constant, β_1 and β_2 are the regression coefficients and ε is the error term. The results provided substantial confidence for our estimates. β_1 and β_1 matched intuition in terms of sign and size ($\beta_1 = 4.542$ and $\beta_2 = -0.00385$), with t-statistics respectively equaling 4.64 and –2.99. Both coefficients are significant to the 1% level. The regression constant, $\alpha = -44.2$, was not statistically significant. The R-squared for this simple regression was nearly 0.24 and robust standard errors are used in calculating the t-statistics.

Carroll and Harrison counties to be associated with shale development in 2016 in the medium intensity scenario. Similarly, the analysis using Pennsylvania's experience indicates that Fair Market Rent only rose in those counties where very large amounts of shale wells had been drilled (925 wells have to be drilled in the 5 year period before the prediction equation starts to show a marginal positive effect). We do not necessarily believe that Carroll, Columbiana and Harrison counties will experience a 13-14% drop in FMR as the medium intensity drilling scenario would seem to suggest. This particular result is affected by the specific conditions present in Pennsylvania during our analysis and the data limitations we face.

In conclusion, we place our best confidence in the results which indicate that in general, drilling activity will lead to moderate population increases, modest increases in median home resale prices and in the number of newly constructed homes. Furthermore, it is important to bear in mind that due to the closer proximity of the shale resources to commutable Ohio cities compared to those in Pennsylvania, the full effect of shale wells drilled in a given county is less likely to remain solely in that county.

Table 3: Selected Effects Predicted by the Regression Analyses for Ohio Shale Drilling Counties for the Low-Intensity Drilling Scenario							
County	Anticipated Total Wells Drilled over 5 years (Low Scenario)[1]	Predicted Increase in Shale Development Jobs over 5 Years (Low Scenario)[2]	Predicted 5-Year Growth in Shale Development Share of Total Workforce (Low Scenario)[3]	Predicted 5-Year Population Growth (Low Scenario)[4]	Predicted 5-Year Perc. Change in FMR (1-bedroom) (Low Scenario)[5]	Predicted 5-Year Total Single-Unit Residential Construction Permits Approved (Low Scenario)[6]	Predicted 5-Year Perc. Change in Median Resale Price (Low Scenario)[7]
BELMONT	67	241	0.77%	0.38%	-3.8%	144	0.30%
CARROLL	395	1149	9.18%	4.56%	-13.8%	598	1.40%
COLUMBIANA	266	891	2.03%	1.01%	-11.6%	471	0.73%
GUERNSEY	65	236	1.16%	0.58%	-3.7%	142	0.45%
HARRISON	201	714	13.32%	6.62%	-9.6%	383	0.45%
JEFFERSON	51	178	0.60%	0.30%	-2.9%	112	0.24%
MAHONING	51	179	0.14%	0.07%	-3.0%	113	0.06%
MONROE	57	202	2.81%	1.40%	-3.3%	125	0.94%
NOBLE	50	172	3.62%	1.80%	-2.9%	110	1.13%
PORTAGE	61	218	0.29%	0.15%	-3.5%	133	0.12%
STARK	72	262	0.13%	0.07%	-4.0%	155	0.05%
TUSCARAWAS	71	259	0.58%	0.29%	-4.0%	153	0.23%

[1] - Anticipated Total Wells Drilled was calculated by assuming that the indicated drilling scenario occurred each year over the five year span from 2012-2016.

[2] - The predicted increase in shale development jobs was caluclated using the regression mentioned in the footnote in Appendix 5 and the anticipated total wells drilled over the five year period.

[3] - The increase in energy employment share is caluclated via the equation: $$Incr.in\ Shale\ Dev.\ Emp.Share(2012-2016)=\frac{Pred.\ Incr.in\ Shale\ Dev.\ Emp.(2012-2016)}{2011\ Total\ Emp.\ \ +Pred.\ Incr.in\ Shale\ Dev.\ Emp.(2012-2016)}$$

[4] - Population Growth was predicted using the statistically significant coefficient esimates from the DiD analysis in Table 14a (1st column) in Appendix 2.

[5] - Perc. Change in FMR (1-bedroom) was predicted using the statistically significant coefficient esimates from the DiD analysis in Table 13b (2nd column) in Appendix 2.

[6] - Res. Building Permits were predicted using the statistically significant coefficient esimates from the DiD analysis in Table 11a (2nd column) in Appendix 2.

[7] - Perc. Change in Median Resale Price was predicted using the statistically significant coefficient esimates from the Two-way Fixed Effects analysis in Table 4c (2nd column) in Appendix 2.

Table 4: Selected Effects Predicted by the Regression Analyses for Ohio Shale Drilling Counties for the Medium-Intensity Drilling Scenario							
County	Anticipated Total Wells Drilled over 5 years (Medium Scenario)[1]	Predicted Increase in Shale Development Jobs over 5 Years (Medium Scenario)[2]	Predicted 5-Year Growth in Shale Development Share of Total Workforce (Medium Scenario)[3]	Predicted 5-Year Population Growth (Medium Scenario)[4]	Predicted 5-Year Perc. Change in FMR (1-bedroom) (Medium Scenario)[5]	Predicted 5-Year Total Single-Unit Residential Construction Permits Approved (Medium Scenario)[6]	Predicted 5-Year Perc. Change in Median Resale Price (Medium Scenario)[7]
BELMONT	133	492	1.56%	0.78%	-6.9%	271	0.58%
CARROLL	592	1295	10.23%	5.08%	-13.0%	663	1.25%
COLUMBIANA	532	1282	2.90%	1.44%	-13.8%	660	0.97%
GUERNSEY	131	483	2.35%	1.17%	-6.8%	267	0.82%
HARRISON	402	1160	19.98%	9.93%	-13.9%	603	-3.17%
JEFFERSON	102	379	1.26%	0.63%	-5.5%	214	0.48%
MAHONING	103	382	0.29%	0.15%	-5.6%	216	0.12%
MONROE	114	423	5.71%	2.84%	-6.1%	237	1.44%
NOBLE	100	370	7.46%	3.71%	-5.4%	209	1.51%
PORTAGE	122	452	0.60%	0.30%	-6.5%	251	0.24%
STARK	144	529	0.26%	0.13%	-7.4%	290	0.11%
TUSCARAWAS	142	523	1.17%	0.58%	-7.3%	287	0.45%

[1] - Anticipated Total Wells Drilled was calculated by assuming that the indicated drilling scenario occurred each year over the five year span from 2012-2016.

[2] - The predicted increase in shale development jobs was caluclated using the regression mentioned in the footnote in Appendix 5 and the anticipated total wells drilled over the five year period.

[3] - The increase in energy employment share is caluclated via the equation: $$Incr.in\ Shale\ Dev.\ Emp.Share(2012-2016) = \frac{Pred.\ Incr.in\ Shale\ Dev.\ Emp.(2012-2016)}{2011\ Total\ Emp.\ + Pred.\ Incr.in\ Shale\ Dev.\ Emp.(2012-2016)}$$

[4] - Population Growth was predicted using the statistically significant coefficient esimates from the DiD analysis in Table 14a (1st column) in Appendix 2.

[5] - Perc. Change in FMR (1-bedroom) was predicted using the statistically significant coefficient esimates from the DiD analysis in Table 13b (2nd column) in Appendix 2.

[6] - Res. Building Permits were predicted using the statistically significant coefficient esimates from the DiD analysis in Table 11a (2nd column) in Appendix 2.

[7] - Perc. Change in Median Resale Price was predicted using the statistically significant coefficient esimates from the Two-way Fixed Effects analysis in Table 4c (2nd column) in Appendix 2.

Table 5: Selected Effects Predicted by the Regression Analyses for Ohio Shale Drilling Counties for the High-Intensity Drilling Scenario							
County	Anticipated Total Wells Drilled over 5 years (High Scenario)[1]	Predicted Increase in Shale Development Jobs over 5 Years (High Scenario)[2]	Predicted 5-Year Growth in Shale Development Share of Total Workforce (High Scenario)[3]	Predicted 5-Year Population Growth (High Scenario)[4]	Predicted 5-Year Perc. Change in FMR (1-bedroom) (High Scenario)[5]	Predicted 5-Year Total Single-Unit Residential Construction Permits Approved (High Scenario)[6]	Predicted 5-Year Perc. Change in Median Resale Price (High Scenario)[7]
BELMONT	798	1128	3.51%	1.75%	-6.6%	565	1.11%
CARROLL	789	1142	9.13%	4.54%	-7.0%	573	1.41%
COLUMBIANA	798	1129	2.56%	1.27%	-6.7%	565	0.88%
GUERNSEY	783	1151	5.43%	2.70%	-7.3%	578	1.42%
HARRISON	604	1295	21.80%	10.83%	-12.8%	662	-4.59%
JEFFERSON	612	1293	4.18%	2.08%	-12.6%	661	1.24%
MAHONING	617	1292	0.98%	0.49%	-12.5%	660	0.38%
MONROE	684	1262	15.28%	7.59%	-10.9%	640	-0.35%
NOBLE	597	1295	22.03%	10.95%	-12.9%	663	-4.79%
PORTAGE	731	1219	1.61%	0.80%	-9.3%	615	0.60%
STARK	863	1008	0.50%	0.25%	-3.5%	499	0.20%
TUSCARAWAS	851	1032	2.29%	1.14%	-4.1%	512	0.80%

[1] - Anticipated Total Wells Drilled was calculated by assuming that the indicated drilling scenario occurred each year over the five year span from 2012-2016.

[2] - The predicted increase in shale development jobs was caluclated using the regression mentioned in the footnote in Appendix 5 and the anticipated total wells drilled over the five year period.

[3] - The increase in energy employment share is caluclated via the equation:

$$Incr.in\ Shale\ Dev.\ Emp.Share(2012-2016) = \frac{Pred.\ Incr.in\ Shale\ Dev.\ Emp.\ (2012-2016)}{2011\ Total\ Emp.\ + Pred.\ Incr.in\ Shale\ Dev.Emp.\ (2012-2016)}$$

[4] - Population Growth was predicted using the statistically significant coefficient esimates from the DiD analysis in Table 14a (1st column) in Appendix 2.

[5] - Perc. Change in FMR (1-bedroom) was predicted using the statistically significant coefficient esimates from the DiD analysis in Table 13b (2nd column) in Appendix 2.

[6] - Res. Building Permits were predicted using the statistically significant coefficient esimates from the DiD analysis in Table 11a (2nd column) in Appendix 2.

[7] - Perc. Change in Median Resale Price was predicted using the statistically significant coefficient esimates from the Two-way Fixed Effects analysis in Table 4c (2nd column) in Appendix 2.