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Authors	Mount, Daniel J;Kelsey, Timothy W;Brasier, Kathryn J
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Hotels and Oil/Gas Development

Booms, Busts, and the Future of Hotels in Oil/Gas Development Areas

Daniel J. Mount, Timothy W. Kelsey, and Kathryn J. Brasier
Pennsylvania State University, University Park, PA

ABSTRACT

The development of new production methodologies for oil and gas wells has revolutionized energy production in the United States, shifting the country from a net importer to a net exporter of oil and natural gas (United States Energy Information Administration, 2015). The combination of horizontal drilling and hydraulic fracturing has allowed development of previously known but inaccessible energy reserves, spurring intensive energy development in varied locations across the country. With this new development has come a rapid expansion in housing needs for workers. Historically, developments such as this are prone to boom/bust cycles. This paper studies the effect of the housing needs in various drilling locations through a study of hotel performance over a 12-year period. This study finds that drilling activity has significantly increased hotel revenues in the drilling areas, but because of falling prices and oversupply, individual hotels are struggling to maintain break-even occupancies. Based on forecasts for oil and gas prices, with additional new supply, this bust cycle will continue through 2018.

Keywords: *oil/gas drilling, fracking, hotel revenues, hotel performance*

Introduction

The development and use of horizontal drilling methods and hydraulic fracking have opened up new oil and gas deposits (“plays”) for exploration. The new drilling activity is primarily in six different plays. These include the Dallas–Fort Worth area (Barnett Shale), rural Louisiana (Haynesville Shale), parts of Pennsylvania and West Virginia (Marcellus Shale), Arkansas (Fayetteville Shale), southern Texas (Eagle Ford Shale), and North Dakota (Bakken Shale).

The large scale and pace of this activity has generated widespread interest about its impacts on the host communities, including on residents (Brasier et al., 2011; Jacquet, 2009), housing (Williamson & Kolb, 2011), the environment (Kargbo, Wilhelm, & Campbell, 2010; Rozell & Reaven, 2012; Roy, Adams, & Robinson, 2013), and workers and the economy (Brown, 2014; Weber, 2012; Wrenn, Kelsey, & Jaenicke, 2015). Adding urgency to this interest are past experiences of communities who

underwent similar energy development, well documented in the boom/bust academic literature, only to find that reliance on such extractive industries leaves them vulnerable to wide economic swings and overly dependent on a narrow range of industries (Freudenburg, 1992). Such experiences with the cyclical nature of this industry raise important questions about whether the local economic gains from recent shale energy development will similarly be transitory, create path dependencies toward greater long-run economic vulnerability, and be detrimental to the host communities in the long run.

This study examines early evidence from the hotel industry in seven study areas (the Marcellus play is separated into two different types of gas products to create the seven study areas from the six plays) about the boom/bust cycle and thus potential long-run impacts of shale energy development. The study also defines the plays as either urban or rural. The urban plays are near large urban areas, and demand will be influenced by other factors common to urban areas. The rural plays have economies that are primarily

dependent on shale energy development and will most likely show larger swings in demand over the drilling time frame. The hotel industry provides a useful bellwether for the impacts on local economic activity because it is one of the most positively affected sectors by the onset of energy development due to the rapid influx of transient workers (see, e.g., Mount, Kelsey, & Brasier, 2014). In addition, shale energy development has occurred over a long enough time span that some host communities have experienced both the initial “boom” of activity and the decline in activity due to falling energy prices and geographic shifts in energy company attention. This work examines topline performance of the hotels in the plays, focusing on occupancy, average daily rate (ADR), and revenue per available room (RevPAR). Examining the hotel industry in shale play communities thus provides a useful perspective on initial implications of shale energy development as well as a view on the immediate negative effects of downturns in the industry.

Background

The nature of shale energy development means much of the workforce is not composed of local residents (Brundage et al., 2011; Jacquet, 2009). Many of the jobs are highly specialized and require technical training, such as seismic testing, drilling, and well completion (often referred to as “fracking”; Brundage et al., 2011). Areas without a history of oil and gas development typically do not have sufficient numbers of residents with these skills and credentials. In addition, such specialized workers typically are only needed on a well site for a few days or weeks, so they move frequently among work locations. The result is that shale energy development relies on a highly transient workforce, which can create significant housing difficulties in host communities (Williamson & Kolb, 2011; Weber, Geigle, & Barkdull, 2014), at least in the early years of development before housing markets can adjust (Farren, Weinstein, Partridge, & Betz, 2013).

Hotels are typically used to house these temporary workers, especially in rural areas with a limited availability of rental units. Hotels also provide important local revenue opportunities associated with shale development. Several prior studies examined impacts on the hotel industry in the Marcellus

shale region of Pennsylvania early in that play’s development and found major increases in hotel revenue. O’Neill (2012) found that RevPAR increased in this region by 8.8% from 2009 to 2010 and 10% from 2010 to 2011, while lodging demand increased by 12.5% in 2010 and 7.4% in 2011, higher than the national averages (which were 7.2% and 4.7%, respectively). PKF Hospitality Research (2012) looked at the Bradford, Lycoming, Susquehanna, and Tioga Counties in northeast Pennsylvania, which included four of Pennsylvania’s top five drilling counties during this time frame, and found that RevPAR increases in these top counties were even higher than O’Neill’s analysis, growing at an annual rate of 14.8% between 2007 and 2011. Using industry data, Mount et al. (2014) estimated that Marcellus shale activity in Pennsylvania from 2006 to 2011 generated nearly \$1 billion of additional hotel revenue through 2012, an increase of 32.6% in their study areas. In addition, demand was up by 26%. They found that the industry responded by adding 66 new hotels (15 other hotels closed during this time period) for a net gain of 4,131 rooms.

These prior studies were conducted early in the development of Marcellus shale, during the years that drilling activity was increasing from year to year. Drilling activity peaked in Pennsylvania in 2011 and subsequently has fallen dramatically in some counties due to changing market conditions and industry interest. For example, activity in Bradford County, Pennsylvania’s top Marcellus drilling county, fell by 76% between 2011 and 2014 (from 390 wells in 2011 to only 93 in 2014). Drilling in neighboring Tioga County, Pennsylvania’s second-highest drilling county through 2011, fell 89%, from 273 wells in 2011 to 30 wells in 2014. Areas of Pennsylvania with “wet gas,” in contrast to these “dry gas” areas, have seen an increase in drilling. Dry gas essentially is mostly methane, considered “pipeline ready” direct from the well. Wet gas comes from the well with liquid components like propane, ethane, and butane, which are separated and sold, making wet gas more profitable to produce than dry gas when natural gas prices are low. During this same time period of drilling activity decline in Bradford County and other dry gas areas, activity increased 48% in wet gas Washington County and more than doubled in wet gas Greene County (from 120 wells drilled in 2011 to 255 wells

drilled in 2014; Pennsylvania Department of Environmental Protection, 2006–2014).

Several factors contributed to the slowdown and shift in drilling activity, including falling natural gas prices and a resulting shift in emphasis in the type of natural gas of interest to the industry. Natural gas prices at the wellhead in the United States fell from a peak of \$10.79 per mcf (thousand cubic feet) in July 2008 to a low of \$1.89 per mcf in April 2012 (United States Energy Information Administration, 2015) and have remained relatively low since then. Oil prices stayed high during much of this decline in natural gas prices, creating strong incentives for producers to shift away from natural gas production and into oil production. The U.S. Energy Information Administration reported that around 2009, the number of drilling rigs focused on oil increased sharply, while the number targeting natural gas fell from its historical distribution of about 80% to 90% of all active drilling rigs (2011). Oil and natural gas rigs were about equal in number by 2011, very different than the prior distribution (United States Energy Information Administration, 2011). The result was an increase in drilling activity in shale plays containing oil, such as the Bakken (jumping from about 50 active rigs in 2009 to almost 250 rigs in 2012) and Eagle Ford (increasing from about 80 rigs in 2009 to almost 600 rigs in 2012), and major declines in drilling activity in natural gas plays (United States Energy Information Administration, 2015). More recently, falling oil prices have created similar drilling activity declines in the shale oil plays. In the Bakken, for example, the number of active drilling rigs fell by almost half between 2014 and 2015, while the decline in the Eagle Ford play was about 40% during this same time period (United States Energy Information Administration, 2015).

These changes in drilling activity have created minibooms and busts across shale plays, with subsequent effects on the host communities (Jacquet & Kay 2014). Studying the hotel industry during these swings in the activity helps understand the impacts of this dynamic industry on local communities. It further provides insight into the effects of these swings on the hotel industry itself. This research will compare hotel demand, supply, and total revenue data to key performance indicators (occupancy percentage, ADR, and RevPAR) for seven shale regions.

The Oil and Gas Shale Plays

There are two primarily oil-producing plays, the Bakken play in North Dakota and the Eagle Ford play in Texas, and five primarily natural gas-producing plays. Three of these five gas plays are rural plays (which we characterize as “rural gas” plays) and include the Fayetteville play in Arkansas; the Haynesville play, which includes areas of Texas and Louisiana; and the northeast / north central portions of the Marcellus play in Pennsylvania. Each of these areas had a population density of fewer than 104 people per square mile (United States Census Bureau, 2014). We include two “urban gas” plays, the Barnett play in Texas, which includes the Dallas–Fort Worth metropolitan area, and portions of the Marcellus play in Pennsylvania, which includes the suburban Pittsburgh area. These two areas have population densities of more than 225 people per square mile (United States Census Bureau, 2014). The counties in each play were determined by selecting counties with at least one well during the 2005–2015 time period or, in the case of the Marcellus region, wells that were adjacent to very rural counties with limited hotel options for industry workers. Hotel performance reports were obtained from Smith Travel Research for the specified counties. We describe each play in turn.

Rural Oil Plays

Eagle Ford. The Eagle Ford Shale play covers 23 counties in southern Texas, extending from the Mexican border north of Laredo through the area halfway between Austin and Houston. The shale formation takes its name from the town of Eagle Ford, Texas, approximately 6 miles west of Dallas, where the shale outcrops at the surface as clay soil (Railroad Commission of Texas, 2013). The play is roughly 50 miles wide and 400 miles long. The region is largely rural, with no major metropolitan center within the active play.

The region produces oil, natural gas, and petroleum liquids (oil, condensate, and natural gas liquids). The first well in the Eagle Ford formation was drilled in 2008, with oil and gas production increasing dramatically in the subsequent 4 years; oil production grew from 358 barrels/day in 2008

to 338,911 barrels/day in 2012, and gas production grew from 8 mcf/day in 2008 to 964 mcf/day in 2012. The number of wells increased concomitantly, with 40 producing oil wells in 2009 to 1,262 in 2012 and 67 producing gas wells in 2008 to 855 in 2011 (Railroad Commission of Texas, 2013).

Bakken. The Bakken play is located in western North Dakota and eastern Montana in the United States and southern Saskatchewan and Manitoba in Canada. The region produces mostly oil and has seen rapid expansion since 2007. Although some natural gas is found, the infrastructure to capture the gas and get it to market is very limited.

The Bakken is the most rural of the shale plays examined here. The total population in the nine North Dakota counties comprising the main activity areas is less than 85,000 people in an area of about 16,000 square miles, resulting in a population density of 5.2 people per square mile (United States Census Bureau, 2014).

Urban Gas Plays

Barnett. The Barnett play is located in the Dallas-Fort Worth region of Texas and is where the hydraulic fracturing and horizontal drilling techniques were first successfully combined to make gas production economically viable from shale. The primary product from this region is natural gas. The region includes both rural and highly urban landscapes, though its population density of 456.6 people per square mile is the highest of the study regions. The total population in the 15 counties of the play was 5,660,806 (United States Census Bureau, 2014).

Marcellus (Southwest). As discussed, for the purposes here, the Marcellus region is broken into two separate regions. The southwestern region includes seven counties in Pennsylvania, six of which are in the Pittsburgh metropolitan area, and six counties in West Virginia. This region's primary product is natural gas. Pennsylvania's Washington County is the location of the first Marcellus shale well, which went into production in 2005. Since then, the number of wells in the state of Pennsylvania had grown to nearly 9,000 by the end of 2014. This 13-county region has both rural and urban areas,

with an overall population of 1,170,175 from 2009 to 2013 and an overall population density of 226.1 people per square mile (United States Census Bureau, 2014).

Rural Gas Plays

Fayetteville. The Fayetteville play is located in a 15-county region in north-central Arkansas. The region produces natural gas. The region experienced rapid growth in the number of wells beginning in 2007, with a total of more than 5,700 wells drilled by the end of 2014 (Arkansas Oil and Gas Commission, 2015).

The Fayetteville region is relatively rural, with a population density of 47.3 people per square mile. The population grew from 430,229 in 2000 to an estimated 478,284 from 2009 to 2013, a growth of 11.2% (United States Census Bureau, 2014).

Haynesville. The Haynesville shale play is located in the region of northwestern Louisiana, eastern Texas, and far southwest Arkansas. The formation takes its name from the nearby town of Haynesville, Louisiana, where geologists first identified the formation decades ago (Louisiana Department of Natural Resources, n.d.). The region produces mostly dry natural gas. Exploration began in 2006, with a rapid increase in the number of wells in 2008.

The region is less rural than some of the others, with a population density of 91.3 people per square mile. The region is about 11,000 square miles with just over a million residents (1,004,108; United States Census Bureau, 2014).

Marcellus (Northeast / North Central). The northern region of the Marcellus is much more rural than the southwest and includes nine counties in Pennsylvania and three in neighboring counties in New York. Although there is no active drilling in New York, these three counties are included because of the location of hotels/motels to support workers in the northern-tier counties. Only one of the nine Pennsylvania counties, Lycoming, is part of a metropolitan area. The region had a population of 973,314 in 2013, a loss of 0.6% from 2000. The population density of the region was 103.6 people per square mile in 2013 (United States Census Bureau, 2014).

Methodology

The study compares actual performance data of hotels in these seven drilling plays to national hotel trends. The study covers the 2005–2016 period, as this date range captures the beginning of the revenue impact in most of the drilling regions. The decision to use national trends rather than state trends was made based on the fact that during the study period, state trends in the study regions generally outperformed national trends because the drilling regions alone impacted state hotel performance measures.

The baseline data for the comparison are demand, supply, and total revenue for U.S. hotels, as collected and shared by Smith Travel Research. The key performance indicators of occupancy percentage, ADR, and RevPAR are calculated from the data. The percentage changes in these data are then applied to the shale plays to establish the “nondrilling scenario” (e.g., what would have happened in the region if hotel demand had followed national trends). We use 2005 as the base year for the study, so percentage changes shown in the table below begin in 2006.

The national hotel industry annual percentage changes are applied to each play’s base-year data to provide annual numbers going forward from the base year for the nondrilling scenario. These numbers are then compared to the actual data for each play. When working with large industry segments, Smith Travel Research models the data for non-participating hotels so that the numbers presented in their data represent 100% of the hotels in areas studied.

Results

A discussion of the results needs to take place on two levels. The first is the “macro” discussion relative to total revenue for the hotel industry by play. The second is the “micro” discussion relative to individual hotels in the plays.

The Hotel Industry

Using national trends as a baseline, Table 1 shows the estimated total revenue differences between the actual revenues realized and the nondrilling scenario, where the revenues were increased by U.S. industry averages for each year. The table shows the

three types of products—rural oil, urban oil, and rural gas—and then further divides those into the individual plays. The largest impact on hotels is seen in the regions with oil development. We estimate that hotel revenues in rural oil plays were \$1.6 billion higher across all these years due to drilling-related activity, 64% higher than it would have been without drilling. Urban gas areas experienced higher revenues as well, but not as high as the oil regions; increased revenues in urban gas areas were about \$2.0 billion more than would be expected without the drilling, an 8% upturn. In contrast, hotel revenues in rural gas regions were only \$91 million more than would have occurred without drilling, a 1.4% increase. It is important to note that the rural oil and urban gas revenues continue to increase compared to the nondrilling scenario, albeit at a slower pace. The rural gas areas experienced a peak in development and total revenue in 2011 but have experienced declines since then (from a positive \$330 million increment that has now decreased to the \$91 million). If the 2016 decreases continue at the same pace, the rural gas areas will no longer have a positive additional revenue number. It is counter-intuitive to suggest that the hotels in these areas would have been better off with no drilling, and it is apparent that total demand is dropping because of other reasons as well.

There were differences among the plays within each category. In the rural oil plays, revenues were 188% higher in the Bakken compared to a nondrilling scenario, yet due to the relatively small number of hotels and market, this was a net increase of about \$600 million, less than the estimated \$1.1 billion increase in the slightly more populated Eagle Ford play (which had a 52% increase).

In urban gas areas, the Barnett play showed a total revenue increase of 5% above a nondrilling scenario, while the Marcellus urban gas area showed a 37% increase. Both areas experienced a revenue growth above a nondrilling scenario of around \$700 million. The Barnett play, which includes the Dallas–Fort Worth metroplex, has a much higher hotel room supply and more demand generators. The Barnett hotel industry has to spread that increase over far more hotels.

In the rural gas plays, the Marcellus play experienced a net increase in revenues of \$260 million (14%). Fayetteville experienced a slight revenue gain

Table 1. Estimated Cumulative Impact of Shale Energy Development on Hotel Revenues, 2005–2016

	Rural Oil	Urban Gas		Rural Gas			
Estimated Total Revenue	\$1.6 billion	\$2.0 billion		\$91 million			
Increase during study period (% change)	64.2%	8.0%		1.4%			
Peak Year	2014			2016			
	Eagle Ford	Bakken	Barnett	Marcellus (PA/WV)	Fayetteville	Haynesville	Marcellus (PA/NY)
Estimated Total Revenue	\$1.1 b.	\$0.6 b.	\$1.1 b.	\$0.9 b.	\$5.6 m.	\$175.3 m.	\$260.4 m.
Increase during study period (% change)	51.9%	187.8%	5.0%	36.7%	0.6%	-4.8%	13.7%
Peak Revenue Year	2014	2014	2016	2014	2015	2010	2012

of \$5 million, less than 1% compared to nondrilling-scenario revenues. Haynesville enjoyed peak years from 2009 to 2011, when the total hotel revenues were more than \$100 million over the nondrilling scenario, but falling demand and oversupply have created a glut of hotels, with consequent reduction in revenues.

Combining all the plays together, the total incremental hotel revenues attributed to drilling activities is nearly \$3.7 billion between 2005 and 2016. It appears that the incremental revenues may continue to increase but at a slowing pace. This additional revenue has led to the development of 500 new hotels, approximately 15,000 new jobs, and tax revenues for the taxing authorities in each area. In all plays except the Barnett play, the key performance indicators have reached peak years and are now decreasing.

The Individual Hotels

When looking at the performance of hotels at the unit level, the results clearly illustrate the boom/bust cycle. Table 2 presents the U.S. percentage changes in hotel demand, supply, total revenue, occupancy

percentage, ADR, and RevPAR compared to the same actual measures for each region. The analysis differentiates the performance indicators by type of resources (oil vs. gas) and the population density of the play (urban vs. rural) to elucidate the influences of these two critical features of the industry and the resident communities on the hotel activity. The first column shows the cumulative changes from 2005 to 2016 in the United States for the measures. For example, hotel demand in the grew a total of 20.5% from 2005 to 2016. During the same time period, hotel demand in rural oil play counties grew a total of 73.4%, and urban gas plays similarly outperformed national trends. Demand in rural gas play counties, in contrast, grew by 3.6%, lagging behind the national trend.

The U.S. hotel industry has enjoyed stable growth in demand (20.5%), especially over the last 7 years, when year-over-year demand growth has been 1.7% or greater. When this is combined with slow supply growth, the industry fundamentals are positive for the industry.

However, that is not the case with the drilling areas due to their higher levels of supply growth. Hotel demand in all of the urban gas and oil play areas

Table 2. Hotel Demand, Supply and Revenue Growth in Study Plays Compared to U.S. Trends

2005–2016 Growth	U.S. Trends (%)	Rural Oil		Urban Gas			Rural Gas	
2005–2016 Growth by Play	U.S. Trends (%)	Eagle Ford	Bakken	Barnett	Marcellus (PA/WV)	Fayetteville	Haynesville	Marcellus (PA/NY)
Demand	20.5%	73.4%		31.8%		3.7%	-2.2%	16.1%
Supply	13.8%	108.6%		18.5%		18.3%	27.6%	27.2%
Revenue	59.9%	145.4%		78.4%		82.2%	37.3%	48.9%

Table 3. Performance Indicators Percent Changes Compared to National Trends

2005–2016 Performance	U.S. Trends (%)		Rural Oil		Urban Gas		Rural Gas	
2005–2016 Performance								
Peak Year	2016	2014	2011	2016	2014	2008	2005	2011
Occupancy Rate	7.5	-16.9		11.2		-17.8		
ADR	38.1	41.6		35.4		25.3		
RevPAR	46.8	17.6		50.5		3.0		
Peak Year Occupancy %	65.5%	63.6%	84.9%	70.2	70.9	57.5	67.4	69.3
2016 Actual Occupancy %	65.5%	51.0%	42.4%	70.2	52.0	49.0	51.7	51.3

exceeded the U.S. trend, yet supply growth exceeded demand growth in all plays except the Barnett play, which resulted in supply exceeding demand and thus declining occupancy rates (see Table 3). Even the 151% increase in demand in the Bakken play was overshadowed by the 216% increase in supply.

Through 2016, the Bakken play still showed a revenue increase of nearly four times that of 2005 (\$20 million total revenue in 2005 compared to \$78 million total revenue in 2016), yet this is less than half of the total revenue in the peak year of 2014, just 2 years prior (\$159 million). The rural gas areas enjoyed the early growth from drilling, with demand outpacing both U.S. demand trends and local supply from 2008 to 2010. In every year since then, hotel demand in the rural gas plays has not kept pace with U.S. demand or local supply. The urban gas play has two different scenarios: The Barnett play (with the Dallas–Fort Worth metro area) has been able to outpace U.S. demand over the study period. The Marcellus urban gas area (including the suburban Pittsburgh metro area) has exceeded U.S. demand but has a supply increase that exceeds its demand increase. Pittsburgh has been one of the hottest markets for hotel development, and there are now fears that the market is oversupplied.

The demand increases in the drilling areas, as suggested earlier, initially are good for the local economies. If hotel supply increases as a result, supply can exceed the demand during a drilling bust, making for deteriorating fundamentals at the individual hotel level. Hanson (2006) suggested a rule-of-thumb break-even occupancy in the hotel industry of 53%. As of February of 2016, Hanson feels that there is no reason that rule-of-thumb break-even occupancy

would have changed (B. Hanson, personal communication, February 2016). As can be seen in Table 4, all of the plays, except the Barnett play, now have occupancy levels below the suggested break-even point. In 2016, all of the plays, except the Barnett play, had declining demand coupled with continued supply increases. All of the plays, except the Barnett play, had their lowest occupancy levels in the last 15 years.

The dynamic that is most affecting individual hotel performance is supply. With the promising outlook provided by prognosticators early in the drilling phase, hotel developers and owners went to work. In most cases, the new supply numbers have been striking. To add some context to the new supply numbers shown in Table 2, the hotel supply in the Bakken play tripled from 2009 to 2016 (725,563 rooms to 2,253,565). Demand has now dropped back to 2012 levels, yet at that time, the area had only half of the hotel rooms they have now. The Fayetteville play hotel demand peaked, modestly, by 12% over the 2007–2008 period, lifting occupancy levels from 57% to 64%. Supply growth of 16.8% from 2008 to 2011, coupled with flat to slightly declining demand, lowered the 2011 occupancy to 54%. The rural Marcellus region experienced its greatest demand increases in the 2010–2011 period, but supply growth expanded for 2 years beyond that when actual demand was declining.

Discussion

Except for the Barnett play, due to the Dallas–Fort Worth metro demand generators, all of the hotel numbers in the drilling region are relatively similar.

The early entries into the hotel market may have had a couple of good years during the boom years of drilling; the late entries may have never reached the 53% break-even occupancy. In all of these plays, demand is decreasing and the areas are faced with an oversupply of hotels.

As hotel projects are sometimes planned years in advance, a look at impending supply is critical in determining what the future may hold for these struggling areas. There are two primary sources for hotel industry forecasting. For the U.S. hotel industry in 2017, CBRE forecasts demand growth of 2.2% and supply growth of 1.9%, resulting in an occupancy increase of 0.3%. Smith Travel Research forecasts similar numbers, with demand growth at 2.0% and supply growth of 2.0%, resulting in no change in the occupancy percentage (Ricca, 2017).

Using data provided by Smith Travel Research, future supply can be estimated for each of the plays (see Table 4). On the supply side, all the plays' supply increases for 2017 are close to the U.S. trends (for the U.S. trend number, the average of the two forecasts is used). Supply beyond 2017 shows more variance. Smith Travel Research reports their future supply numbers in different categories—namely, under construction and planning (planning may consist simply of planning or final planning when the project is further in the pipeline). The 2017 supply forecasts are fairly accurate, as those hotels are most likely in the construction phase. The numbers beyond 2017 are far less certain, as projects may be deferred or abandoned.

Considering the declining demand in the plays discussed previously, any supply growth will likely reduce occupancy at the hotel unit level in 2017. The other important variable to consider is demand. While the U.S. forecast is for an increase in demand of 1.5% or 1.6% for 2017, the demand in the drilling

areas, especially the oil and rural gas and oil plays, is largely dependent on the oil and gas prices.

Rural Oil. The primary driver of market demand in the oil and rural gas plays is the price of oil and gas. The price of oil has been volatile over the years (Macrotrends, 2017). In June 2008, the price of oil was \$155.36 per barrel but then plummeted to \$47.99 by January 2009. In October 2009, it topped \$80.00 per barrel and stayed over that benchmark until October 2014. Annual double-digit increases in demand for both the Bakken and Eagle Ford plays were seen from 2010 to 2014. Both plays had their highest monthly demand in October 2014 (Eagle Ford had 404,701 rooms and Bakken had 146,613 rooms). By November 2015, the price of oil had dropped to \$67.79 per barrel, and both the Bakken and Eagle Ford oil plays experienced immediate drops in demand in November 2014. The price as of February 2017 was about \$54.00 per barrel. As long as the price of oil stayed over \$80.00 per barrel, the Bakken and Eagle Ford plays continued to experience demand growth.

The long-term forecast for oil (Longforecast, 2017a) is that the price will experience growth through 2019, with the price of oil reaching \$86.50 per barrel with a slight drop-off in 2020 to \$78.27. Specifically, the 2017 and 2018 forecasts have a top price of \$65.83 per barrel. Oil production is expected to decrease slightly in 2017 (*Economic Times*, 2017), from 8.9 to 8.8 million barrels, and there is concern that crude oil inventories remain an issue, as oil storage has increased. Past performance suggests that if the price of oil stays under or at the \$60.00 per barrel price, as is forecast for 2017, this will not be enough to drive drilling demand back to the plays. As there have been double-digit decreases in demand for the last 2 years for the Bakken play, and a forecasted slight supply growth next year, it will be difficult for the hotels in 2017 to even maintain the low 42.4% occupancy achieved in 2016. The forecasted oil prices from 2018 through 2020, barring unexpected supply news, should help these hotels regain lost occupancy. The Eagle Ford play has experienced similar decline demand, with decreases of about 6% in each of the last 2 years. Even if the play has "hit bottom" on demand, and that is difficult to determine, the play would still need a 3.9% increase in demand to offset the new supply at the unit level.

Table 4. Supply Growth Percentage by Play

	2017 Supply Growth	Future Supply Growth (Beyond 2017)
U.S. Forecasts	1.9	2.1
Eagle Ford	3.9	7.7
Bakken	1.5	3.0
Barnett	1.7	5.3
Marcellus (Urban)	3.2	3.0
Fayetteville	1.4	7.1
Haynesville	1.6	3.8
Marcellus (Rural)	1.5	5.0

Rural Gas. The price of gas has also been volatile over the years (Longforecast, 2017b). Although the price of gas had exceeded \$4 MMBtu (thousand British thermal units) before 2002 (peaking at more than \$14 in December 2000), the price rose again above \$4 in March 2002. Except for a 3-month period in 2009, the price stayed above \$4 until September 2011. Since then, the price of gas has only risen above \$4 for a 1-year period, primarily covering the 2014 calendar year. The demand patterns of the rural gas plays reflect those price fluctuations. Both the Marcellus and Haynesville rural gas plays had annual demand increases that exceeded the U.S. trend through 2010, with the Marcellus expansion lasting through 2011. With the falling price of gas in 2011, both plays then experienced decreasing demand through 2013. Both plays had increasing demand in 2014 as the natural gas price increased through that year, and both have suffered demand decreases through 2016. The Fayetteville play, on the other hand, saw rising demand through 2009 but has not had a year since then when play demand exceeded U.S. demand percentage changes. Interestingly, total play demand has never varied by more than 2% for the demand achieved in 2009. This would suggest that the Fayetteville play has a stabilized demand.

The long-term forecast for gas prices (Longforecast, 2017b) is that they will show a steady 18.7% increase through 2017 to \$3.36 MMBtu by February 2018 but will then fall back to current price levels of \$2.80 MMBtu by June 2018. The Marcellus and Haynesville plays, which have seen hotel occupancies decrease to 51%, will probably see further decline through 2017, as forecasted gas prices will not drive a rally that will result in demand increases that are greater than the projected supply increases in each of the plays. Unless 2018 gas prices are forecast to increase or the planned supply increases are not realized, hotel occupancies will stay suppressed through 2018. The Fayetteville play, where the hotel demand and occupancy seems to have stabilized, will continue on the same suppressed path, as the projected supply growth matches the projected U.S. demand growth, and gas prices will not drive that demand at a local level.

Urban Gas. The urban gas plays have two things in common. First, they are influenced by urban populations (the Barnett play includes the Dallas–Fort

Worth urban area, and the Marcellus play includes much of suburban Pittsburgh but not Pittsburgh itself). Second, these plays have a greater proportion of liquefied natural gas (LNG; wet gas) production. Much of the international LNG trade is based on prices tied to crude oil (Free Republic, 2008), so LNG prices have similar patterns to oil prices. LNG prices began to show year-over-year monthly price decreases beginning in August 2014 (United States Energy Information Administration, 2017), which continued through October 2016. Demand in the Marcellus urban gas play exceeded U.S. trends for every year in this study until 2015. Through 2015 and 2016, as LNG prices continued to decline, this play experienced a significant decrease in demand of more than 20%. The Barnett play is a different operating environment that includes the Dallas–Fort Worth urban area. The demand created by drilling has much less impact on the play's hotel performance numbers. The Barnett play is where fracking was first successfully employed; the region experienced significant demand growth of more than 7% each year in 2004 and 2005. Since then, the demand growth has exceeded U.S. demand growth in every year except 2009, when it was just 1% lower than U.S. demand growth. This was the recession era, and it seems likely that economic downturn influenced the area more than continued demand growth in the drilling sector. The Barnett play continues to outperform the U.S. demand trends through 2016; coupled with slow supply growth, this leads to continually improving operating performance indicators at the unit level.

The forecast for LNG prices in the short term is for slow, steady growth (Knoema, 2017), similar to the short-term forecasts for oil prices. As the Marcellus urban play is experiencing significant demand decline, this slow, short-term price increase may not offset the continuing demand decline. Coupled with a projected 3.0% increase in supply, this play's hotels will most likely continue to suffer declining occupancy and revenues in 2017. If the planned new supply beyond 2017 is deferred and the LNG prices have a continued slow growth, the hotels should be able to stabilize performance in 2018. The Barnett play should continue to experience growth that reflects U.S. forecasts. Slow, steady LNG price increases will not hurt the hotel performance in the Barnett play; the projected supply of 1.7% should balance out the slowing demand so that hotel

performance indicators should be very similar in 2017 to what they were in 2016.

Conclusion

Hotel demand and supply data from U.S. oil and gas shale plays show a clear pattern of boom and bust related to drilling activity. Our analysis shows that the hotel sector in shale plays initially experiences significant increases in demand, with revenues \$1.6 billion and 64% above what it has been without drilling and major hotel construction and a consequent increase in hotel supply in these communities. When drilling activity declined due to falling energy prices, this supply boom left the hotel sector in these communities worse off than it would have been without the boom, with occupancy rates below 52%. Energy price forecasts in the short term indicate that prices, and thus drilling and hotel demand, likely will not increase significantly. Any future supply that is still in the planning stages must be carefully considered before proceeding to the construction phase.

Implications

The findings suggest that the boom/bust cycle in shale energy development can leave the hotel sector worse off in the long run. This is consistent with previous boom/bust cycles. This research, and the examination of other historical boom/bust cycles, suggests that developing hotels early in the cycle brings impressive early revenues, but it is difficult to understand where you are in a boom/bust cycle. Hotels that missed the early development phase opened amid declining demand scenarios or were simply abandoned. While the initial thoughts were that this would be an extended boon to the hotel industry in those areas with new drilling, this boom/bust cycle, similar to so many others, suggests that investors/developers must be cautious with any commodity- or energy-driven demand. Simple oversupply or other shifting market conditions can change the operating environment in a very short time.

Limitations

The purpose of this study was to examine the impact of new oil/gas drilling technologies on hotel

revenues in the newly active drilling plays. While the study has provided insight into the boom/bust cycle of revenues, the study does not examine bottom-line profits or other measures of financial returns or market value. The issue of the impact of time and the underlying performance of the U.S. economy is considered in using the U.S. hotel industry as a baseline when comparing the performance of hotels and drilling plays to U.S. hotel industry performance. Other factors that may affect the performance of individual hotels within a play, such as brand affiliation and hotel size, are not considered. These would be valuable insights in future research.

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Appendix

Table A1. Counties Included in Each Oil or Gas Shale Play

Rural Oil Play		Urban Gas			Rural Gas	
Eagle Ford (Texas) 338 hotels	Bakken (North Dakota) 79 hotels	Barnett (Texas) 479 hotels	Marcellus (portion) 198 hotels	Fayetteville (Arkansas) 113 hotels	Haynesville 262 hotels	Marcellus (portion) 175 hotels
Atascosa	Billings	Cooke	Pennsylvania	Cleburne	Texas	Pennsylvania
Bastrop	Burke	Dallas	Armstrong	Conway	Angelina	Bradford
Bee	Divide	Denton	Beaver	Faulkner	Gregg	Clinton
Brazos	Dunn	Ellis	Butler	Franklin	Harrison	Lackawanna
Burleson	McLean	Erath	Fayette	Independence	Marion	Lycoming
DeWitt	McKenzie	Hill	Greene	Jackson	Nacogdoches	Sullivan
Dimmitt	Mountrail	Hood	Washington	Johnson	Panola	Susquehanna
Fayette	Stark	Jack	Westmoreland	Lee	Rusk	Tioga
Frio	Williams	Johnson	West Virginia	Phillips	Sabine	Wyoming
Gonzales		Montague	Brooke	Pope	San Augustine	New York
Grimes		Palo	Hancock	Prairie	Shelby	Broome
Karnes		Pinto	Marshall	Stone	Louisiana	Chemung
LaSalle		Parker	Monongalia	Van Buren	Bienville	Tioga
Lavaca		Somervell	Ohio	White	Bossier	
Lee		Tarrant	Wetzel	Woodruff	Cado	
Leon		Wise			DeSoto	
Live Oak					Natchitoches	
Madison					Red River	
Maverick					Sabine	
McMullen					Webster	
Milam						
Robertson						
Walker						
Webb						
Wilson						
Zavala						

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