Data InSight

GUIDING BUSINESS ANALYTICS IN COMMERCIAL REAL ESTATE

NAI Partners

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Shifts in Houston's Manufacturing Industry with Declines in the Oil Industry

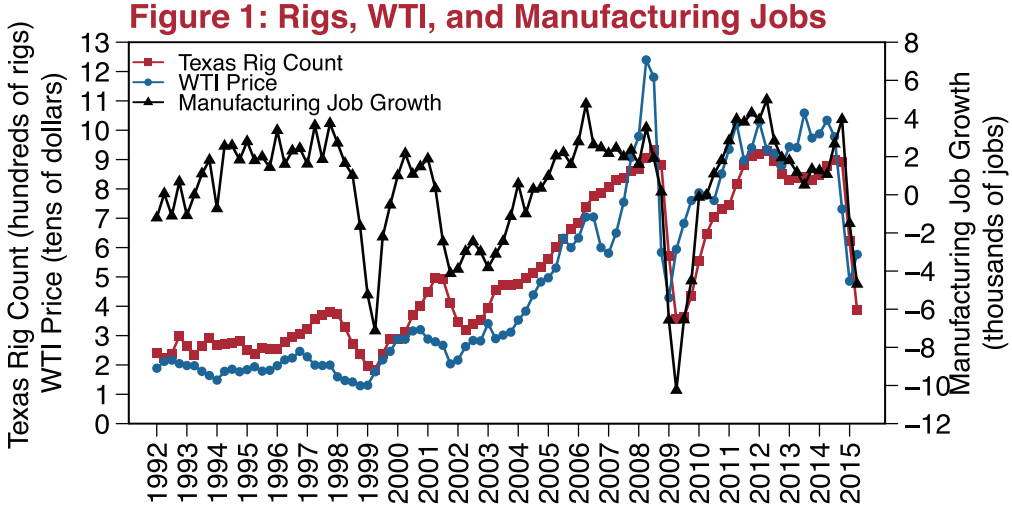
Executive Summary

Currents levels of supply and demand provide a strong outlook for Houston's industrial real estate. Yet, due to close ties with upstream oil, Houston's manufacturing sector is more susceptible to economic changes arising from the downturn in oil, particularly machinery and fabricated metals. Here, we explore how the decline in Texas rig counts is shaping Houston's manufacturing industry, including job growth and commercial real estate (CRE).

Houston's manufacturing jobs are down an annualized -8% from December 2014 through May 2015. This change in manufacturing job growth is predicted by Texas rig counts. With Texas rig counts down 60% to 363 at the end of June 2015, statistical analyses predict a loss of -8,665 jobs, which is very close to the actual loss of -9,000. Importantly, 66.9% of variation in manufacturing job growth is explained by Texas rig counts alone, suggesting that two-thirds of Houston's manufacturing job growth is tied to rig activity. On average, a gain (or loss) of one rig equates with a corresponding change of 36.2 manufacturing jobs. Economic forecasts show that Houston's manufacturing employment will likely continue to decline to a loss of about 20,000 jobs. Manufacturing jobs should then rebound to positive job growth in 2016 and/or 2017, depending on a quick or slow recovery from the oil pullback.

Manufacturing job growth is not predictive of the supply or demand of manufacturing CRE. However, vacancy rates of Houston's manufacturing CRE is predicted by Texas rig count. A strong negative relationship occurs between vacancy and Texas rig counts, that is manufacturing vacancy decreases as Texas rig counts increase. On average, one new active rig in Texas leads to a decrease in vacancy by 0.0058%; a sizable increase of 200 active rigs for example reduces vacancy by 1.16%. With Texas rig counts down to 363 in June 2015, manufacturing vacancy is predicted to increase to 5.5%, with an 80% predicted range of 3.6 - 7.4%. As of Q2 2015, manufacturing vacancy is 1.9%, suggesting that with some delay between rigs going offline and subsequent job losses, increased vacancy is likely to occur in Houston's manufacturing CRE. It is important to note, however, that these vacancy rates are still very low, supporting a strong industrial CRE outlook.

Figure 1: Rigs, WTI, and Manufacturing Jobs



Data InSight is a monthly business-to-community (B2C) whitepaper series that uses data analytics to look at current and historical trends in commercial real estate (CRE). Indeed, like many other industries, CRE is undergoing a revolution in the volume, velocity, and variety of data being generated. At NAI Partners, we are embracing this data revolution through data science --- the process of using the scientific method and statistics to extract knowledge from data. Complementing its full CRE platform and more than 500 years of combined broker and professional experience, NAI Partners offers a data analytics consulting service to guide its clients in their business intelligence and decision making in CRE.

Motivation

The underlying issues of the oil pullback remain consequential for Houston's economy. With rig counts down 60%, capital spending of oil companies cut upwards of 35%, and job layoffs being realized, Houston's economy is feeling the effects of the oil downturn. Houston's employment in May 2015 picked up to an annualized 1.8% growth, compared to a 3.1% loss in April, but employment year to date is flat. Job forecasts are down to 15,000[1] and 20,000 - 30,000[2] for 2015, compared with 100,000 per year from 2012 to 2014. Nevertheless, Houston will likely avoid a recession for two prominent reasons[1]. First, there is a strong national economy which carries over to Houston and Texas economies. Second, with low natural gas prices, there is a huge explosion of $138 billion in petrochemical projects throughout the U.S.A., 21% of which is concentrated in Houston's greater metropolitan area (largely on the east side).

While the fundamentals of supply and demand suggest a strong outlook for industrial real estate, there are certain sectors and product types that are more susceptible to the economic influences of the oil downturn. Job losses are more prominent in those sectors most strongly exposed to the oil industry, which may then ripple through industrial real estate. For example, the manufacturing industry — including machinery and fabricated metals — is closely tied to upstream oil.

In this issue of Data InSight, we examine how the economic impacts of the most recent oil bust is impacting Houston's manufacturing economy. Specifically, we use Texas rig counts as a predictive variable to measure changes in Houston's job growth in the manufacturing sector. We then forecast manufacturing job growth in Houston under quick and slow scenarios of economic recovery from the oil downturn[1]. We conclude by asking whether Texas rig counts or manufacturing job growth are indicative of the performance of manufacturing CRE.

Manufacturing Employment and the Oil Industry

Growth in the oil industry following the Great Recession led manufacturing jobs in Houston to increase by 11%, from 234,000 jobs in December 2011 to a high of 261,200 jobs in December 2014. As of May 2015, the greater metropolitan area of Houston has about 252,200 manufacturing jobs, representing about 8.5% of total Houston employment. Figure 1 shows manufacturing job growth, Texas rig counts, and WTI prices on a quarterly basis from 1992 through Q2 2015. Not surprisingly, a strong positive correlation occurs between Texas rig counts and WTI prices (Spearman's correlation = 0.90, $p < 0.00001$). (See Methods below for details on interpreting correlation coefficients.)

Houston's manufacturing sector has lost about 9,000 jobs since December 2014, an 8% decline in manufacturing employment. Manufacturing job growth in Houston is correlated with the oil industry, as indicated by WTI prices and Texas rig counts (Figure 1). Indeed, increases and decreases in manufacturing employment do correspond with Texas rig counts. These correlations are particularly evident in the oil downturns of 1999, 2009, and 2015 (Figure 1).

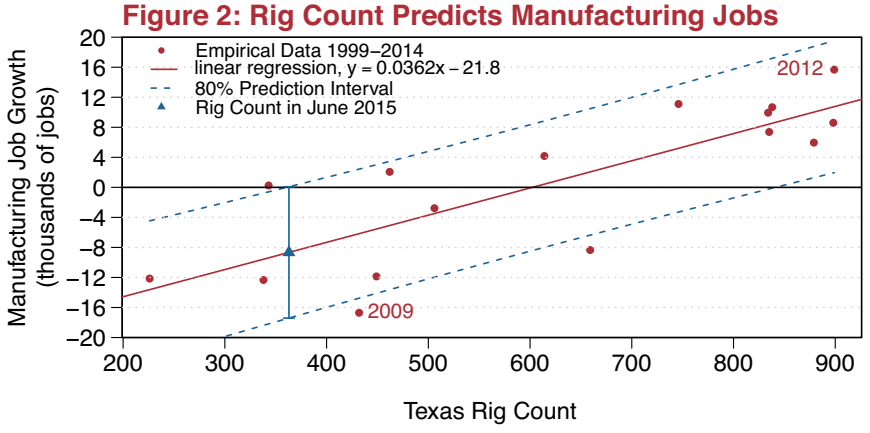
Given the strong ties between Houston's manufacturing sector (e.g., machinery, fabricated metals) and the oil industry, can Texas rig counts predict changes in manufacturing job growth? Figure 2 shows the statistical relationship between manufacturing job growth and Texas rig counts. The explanatory variable is rig count (*x*-axis) and the response variable is manufacturing jobs (*y*-axis), which is scaled in thousands of jobs. The solid red circles are the empirical data points for 1999 - 2014. Two data points are labeled by their year, namely 2009 and 2012, representing years of decline and growth in manufacturing.

Statistical analysis shows a strong positive relationship between manufacturing job growth and Texas rig counts. The number of active rigs in Texas is predictive of Houston's manufacturing job growth. The red line in Figure 2 is the linear regression model of the relationship between manufacturing job growth and rig count, of the form $y=mx+b$ (see Methodology below). Specifically, $y=0.0362x-21.8$, where y is the manufacturing job growth, x is rig count, m is the slope of the line, and b is the y-intercept. The slope of the line, m = 0.0362 (rise over run, if you recall from high school algebra), describes how y changes as x increases, that is an increase by 1 unit of the x variable increases the y variable by how much. Because we have scaled the y-axis by thousands, the slope of 0.0362 means one new active rig supports an increase of 36.2 manufacturing jobs, or a rig loss reduces 36.2 manufacturing jobs.

The dashed blue lines are 80% prediction intervals (upper and lower bounds) for manufacturing job growth. That is, 8 out of 10 times (0.80 probability) manufacturing job growth is predicted to be in this range for the given number of active rigs in Texas (red line). With Texas rig counts down to 363 in June 2015, a loss of -8,665 jobs is predicted (blue triangle, Fig 2), with an 80% prediction interval for job growth of -17,409 to +787. Through May 2015, Houston has seen a loss of -9,000 manufacturing jobs, pretty close to the predicted value of -8,665 for the current rig count.

The coefficient of determination (r^2) tells us how well the actual data fit the statistical model. In this case, r^2 = 0.669, that is 66.9% or two-thirds of variation in manufacturing jobs in Houston is explained by Texas rig counts. This is a large value, given the many different factors that can simultaneously shape

Figure 2: Rig Count Predicts Manufacturing Jobs



manufacturing employment, rig counts, and the oil industry. This two-thirds value does not support the notion that Houston is more diversified than in past decades.

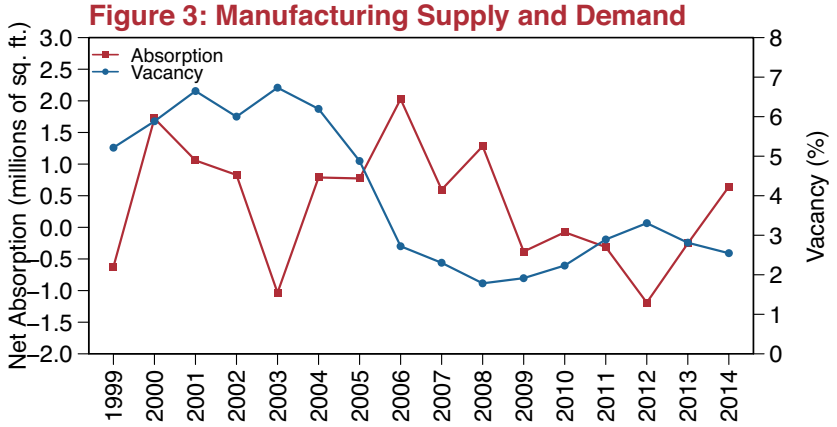
Dr. Bill Gilmer of the University of Houston's Institute for Regional Forecasting has forecasted total nonfarm employment for Houston in 2015, 2016, and 2017 based on two scenarios of recovery from the oil pullback, namely a quick or a slow recovery[1]. Here, we extend these scenarios and forecasts to job growth in just the manufacturing sector. Under both scenarios, manufacturing employment will continue to decline to about 242,000 jobs by the end of 2015. Under the scenario of a quick recovery, manufacturing employment will rebound in 2016 to 258,100 jobs, but under a slow economic recovery manufacturing employment will decline to 239,000 by the second quarter of 2016 and then pick up to 246,900 jobs by the end of 2016. In 2017, job growth will increase to 270,300 jobs under a quick recovery and 264,600 jobs under a slow recovery.

Manufacturing and Commercial Real Estate

Industrial commercial real estate (CRE) in the greater metropolitan area of Houston has 547.1 million square feet of rentable building area (RBA), representing 18,000 buildings. Of all industrial CRE, manufacturing accounts for 14.6%, that is 79.8 million square feet among 1,382 buildings. Figure 3 shows the supply (vacancy) and demand (net absorption) of manufacturing CRE in Houston.

Given close ties between the manufacturing and oil industries in Houston (Figures 1 and 2), supply and demand of manufacturing CRE may well vary with Texas rig counts and/or manufacturing job growth. Houston's job growth has proven to be a good predictor of the performance of overall industrial and office CRE (*Data InSight* Vol 1, Issues 2,3,4). Yet, our analyses here indicate that manufacturing job growth is not a good predictor of the supply or demand of manufacturing CRE. Specifically, neither net absorption nor vacancy of manufacturing CRE varied predictably with manufacturing job growth. This is likely because manufacturing jobs are low in number and do not scale with the large volumes of manufacturing space occupied by such employees.

Figure 3: Manufacturing Supply and Demand

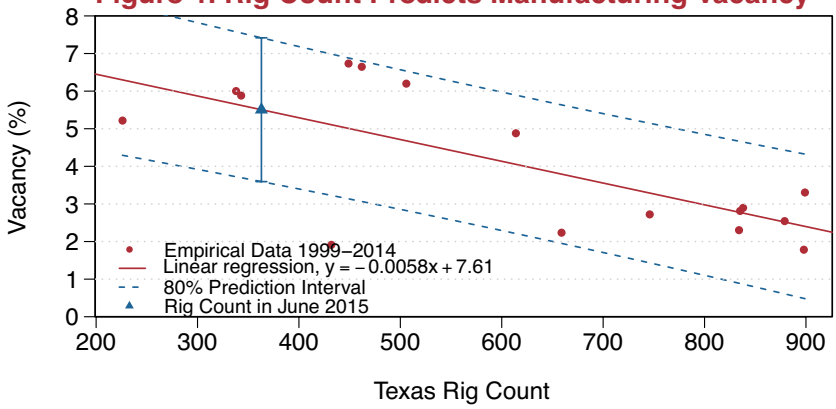


On the other hand, Texas rig count is a good predictor of the supply (% vacancy), but not demand (net absorption), of manufacturing CRE in Houston. Figure 4 shows the statistical relationship between vacancy and Texas rig counts. The explanatory variable is rig count (*x*-axis) and the response variable is percent vacancy (*y*-axis). The solid red circles are the empirical data points for 1999 - 2014. The coefficient of determination (r^2) tells us how well the actual data fit the statistical model. Here, $r^2 = 0.519$, that is 51.9% of variation in manufacturing vacancy in Houston is explained by Texas rig counts. This is a fairly large value, given that many factors can simultaneously shape vacancy, rig counts, and the oil industry. With Texas rig counts explaining 66.9% of variation in manufacturing job growth and 51.9% of variation in vacancy of manufacturing CRE, Houston's manufacturing sector does not appear to be as diversified as we may think it is.

The number of active rigs in Texas is predictive of vacancy in Houston's manufacturing CRE. There is a strong negative relationship between vacancy and Texas rig counts, that is vacancy in manufacturing CRE decreases as Texas rig counts increase. The red line in Figure 4 is the linear regression model ($y=mx+b$) of the relationship between vacancy and rig count (see Methodology). Specifically, $y=-0.0058x+7.61$, where y is percent vacancy, x is Texas rig count, m is the slope of the line, and b is the y-intercept. The slope of the line, $m = 0.0058$, describes how we expect y to change as x increases. In this case, a slope of 0.0058 indicates that one new active rig leads to a decrease in vacancy by 0.0058%. That is, an increase of 100 active rigs reduces vacancy by 0.58%, 200 rigs reduces vacancy by 1.16%, and so forth.

The dashed blue lines are 80% prediction intervals (upper and lower bounds) for vacancy. That is, 8 out of 10 times (0.80 probability) vacancy is predicted to be in this range for the given number of active rigs in Texas (red line). With Texas rig counts down to 363 in June 2015, manufacturing vacancy is predicted (blue triangle, Fig 4) to be 5.5%, with an 80% prediction interval of 3.6% to 7.4%. As of Q2 2015, vacancy is 1.9%, suggesting that with some time lag between rigs going offline and then subsequent job losses, increased vacancy is likely to occur in manufacturing CRE. This predicted

Figure 4: Rig Count Predicts Manufacturing Vacancy



increase in manufacturing vacancy rates is still at a low level, say compared to 14% office vacancy rates, *Data InSight* Vol 1, Issue 4). The outlook for manufacturing and overall industrial CRE remains strong, despite these consequences of oil on Houston's manufacturing industry.

Methodology

Data sources include Baker Hughes, Texas Workforce Commission, Federal Reserve Bank of Dallas, and Federal Reserve Economic Data (FRED). Commercial real estate data were obtained from CoStar following the close of Q2 2015. The statistical analyses and data visualizations were performed using the R software and programming language:

> R Core Team (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
>
> URL http://www.R-project.org/.

Correlations Coefficients

Correlation does not equate with causation. Correlation coefficients can range from +1.0 to -1.0. A value of 0 indicates no correlation. A positive value indicates that as one variable increases so does the other variable, while a negative value indicates that as one variable increases, the other variable decreases. Values between 0 and 0.3 (0 and -0.3) are considered weak positive (negative) correlations. Values between 0.3 and 0.7 (-0.3 and -0.7) are considered moderate positive (negative) correlations. Values between 0.7 and 1.0 (-0.7 and -1.0) are considered strong positive (negative) correlations.

Texas Rig Counts and Manufacturing Employment

We used linear regression to examine the predictive relationship between annual changes in manufacturing employment (i.e., job growth) and Texas rig count from 1999 - 2014. We tested the assumptions of linear regression that could render a biased statistical model. None of the following assumptions were violated: statistical outliers, overly influential points in job growth, normality, unequal variance, heteroscadascity, and serially correlated residuals (nonwhite noise error). There was a statistically significant, positive effect of Texas rig count on manufacturing job growth ($F_{1,14}$=28.2, p=0.0001, r^2=0.669). Note, Figure 1 depicts rig counts and manufacturing job growth on a quarterly basis, but statistical analyses were performed on annual values of each variable (Figure 2).

Manufacturing Real Estate versus Texas Rig Counts and Manufacturing Employment

We performed linear regression analyses of how the supply and demand of manufacturing commercial real estate may vary with one or both of Texas rig counts and/or manufacturing jobs in Houston. Specifically, we tested net absorption, leasing activity, and vacancy rates with each of Texas rig counts and manufacturing job growth in Houston. We tested the assumptions of linear regression that could render a biased statistical model. The only statistically significant result was for vacancy to decrease with increasing rig counts in Texas ($F_{1,14}$=15.08, p=0.0012, r^2=0.519). For the linear regression, none of the following assumptions were violated: statistical outliers, overly influential data points in rig count, normality, unequal variance, heteroscadascity, and serially correlated residuals (nonwhite noise error).

Footnotes

1. R.W. Gilmer. "Houston Outlook Grows Darker as the Oil Downturn Becomes Deeper and longer", June 23, 2015, http://www.bauer.uh.edu/centers/irf/houston-updates.php
2. Jankowski, P. and J. Philip. Houston: Economy at a Glance. Greater Houston Partnership. Vol 27, Number 7, July 2015.

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Dr. J. Nathaniel Holland is a research scientist with 20 years of experience in using the scientific method to extract information from complex multi-dimensional data. He joined NAI Partners in 2014 as Chief Research and Data Scientist. At NAI Partners, Nat leverages his sharp intellectual curiosity with his skills in statistical modeling to guide data-driven business decisions in commercial real estate. Like many data scientists in the private sector, Nat joined NAI Partners following a career in academia. Prior to taking up data analytics at NAI Partners, he held professorial and research positions at Rice University, University of Houston, and the University of Arizona between the years of 2001 and 2014. Nat is the author of more than 50 scientific publications, and he has been an invited expert speaker for more than 60 presentations. Trained as a quantitative ecologist, he holds a Ph.D. from the University of Miami, a M.S. from the University of Georgia, and a B.S. from Ferrum College.

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