

Reduced Job Growth and Large Deliveries Shape Forecasts for Absorption and Vacancy in the Houston Office Market for 2015 - 2017

Executive Summary

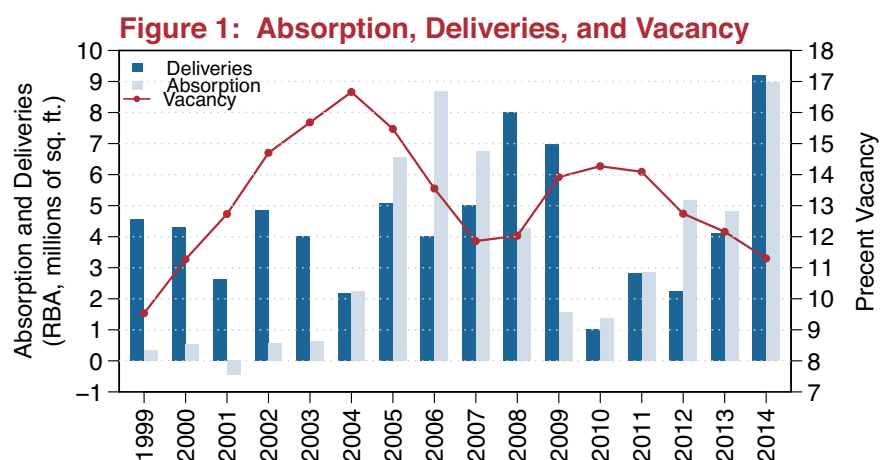
How will Houston's office market perform given the economic pullback with oil prices and the large delivery of many new buildings? Reduced demand (lower net absorption with slowing economy) combined with increased supply (greater vacancy rates with new deliveries) could soften the Houston office market (Figure 1). Yet, absent of proper data analyses, false conclusions can be drawn from such speculation. Here, we use predictive analytics to assess (1) how net absorption of office space will change with the revised job forecast for Houston and (2) how office vacancy in 2015, 2016, and 2017 will shift with deliveries, preleasing, and net absorption.

Houston's job growth was recently downgraded for 2015, rebounding in 2016 or 2017 depending on a quick or slow recovery from the oil downturn. With 13,000 new jobs in 2015, net absorption is predicted to be 2.0 million sq. ft., with an 80% prediction interval of -1.1 to 5.1 (Table 1). We are unlikely to see the negative end of this interval, as Q1 2015 has already posted 1.5 million sq. ft. of net absorption. A slow economic recovery suggests similar net absorption in 2016 as in 2015, but rebounding to 6.1 million in 2017. A

fast recovery suggests reasonably strong absorption of 4.0 and 5.2 million in 2016 and 2017.

New deliveries can lead to increases or decreases in vacancy rates, depending on net absorption (Figure 1). The large pending deliveries (~20 million sq. ft.) for coming quarters and years could greatly increase vacancy above its current 12%. Our data analyses indicate that vacancy in 2015, 2016, and 2017 will depend more on preleasing than on net absorption from a quick or slow recovery from the oil downturn (Table 2). A scenario of 0% preleasing leads vacancy rates to bounce above 14.5% toward 16% in 2015 and

2016, before returning back to 14% in 2017. However, it is more reasonable to anticipate buildings to deliver with some intermediate level of preleasing, say 33% or 66%. For 33% preleasing, vacancy rates will only increase to 12.9 - 13.6% in 2015 and 2016, but then decrease back to 11% in 2017. For 66% preleasing, vacancy rates will decrease to 10.5 - 11.4% in 2015 and 2016, and then to 9% or less in 2017. These analyses indicate that while the Houston office market may experience some short-term softening, forecasts of net absorption and vacancy show stability in the supply and demand of the office market.



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 performance of any free market hinges on the supply and demand of the commodity of interest. How will Houston's office market perform in coming quarters and years, given speculation that it is simultaneously facing a decrease in demand and an increase in supply? In commercial real estate, supply is measured by vacancy and demand by net absorption. Vacancy measures empty space in the office market. Net absorption measures the change in occupied space from one time period to another. Positive net absorption occurs when there is an increase in occupied space; negative net absorption occurs when there is a decrease in occupied space. Both vacancy and net absorption are in units of square feet (sq. ft.) of rentable building area (RBA). The simultaneous decrease in demand and increase in supply of office space is based on the economic downturn in the oil industry and the concurrent increase in the delivery of many new office buildings.

First, we can evaluate a potential decrease in office demand arising from the economic downturn in Houston's oil industry through job growth. Job growth is a good economic predictor for the demand of office space, explaining about 51% of variation in net absorption (see below). With the pullback in the oil industry, prior job forecasts for Texas and Houston are being downgraded, suggesting lower office absorption. Dr. Keith Phillips of the Federal Reserve Bank of Dallas has reduced his state forecast by 0.5% to 0.5-1.5% job growth, which is 59,000 - 176,000 new jobs in 2015. Congruently, Dr. Bill Gilmer of the Institute for Regional forecasting at the University of Houston has downgraded his Houston forecast to about 0.5% job growth in 2015, which is about 13,000 new jobs (prior forecasts were 43,000 - 63,000). Dr. Gilmer projects that if Houston's economic recovery from the oil pullback is quick, then job growth will rebound in 2016 and 2017 to 61,300 and 87,900 new jobs, respectively. If the recovery is slow, then job growth will remain low in 2016, rebounding in 2017 to 109,700 new jobs.

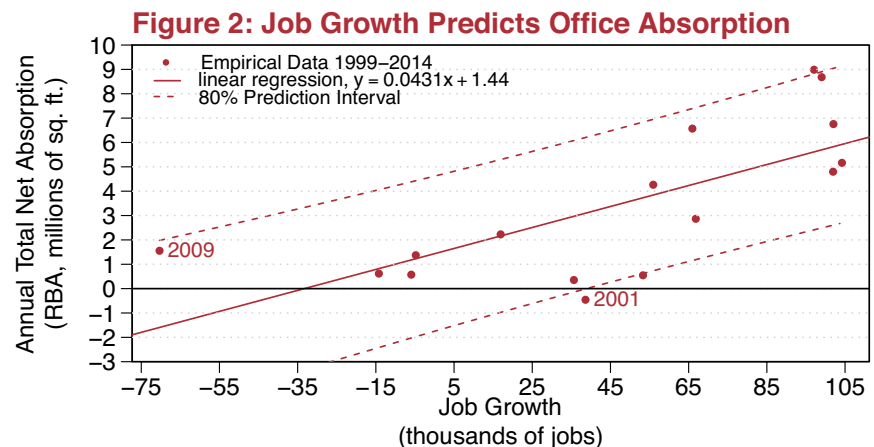
Second, we can study changes in office supply, as measured by percent vacancy, by analyzing new deliveries, preleasing of those deliveries, and net absorption. New deliveries can contribute to both increases and decreases in vacancy, depending on net absorption. Houston's supply of office space has seen great expansion through

the construction and delivery of new Class A and B office buildings (Figure 1). From 1999 - 2004, Houston saw more than 22 million sq. ft. of new deliveries, but positive net absorption remained less than 4 million sq. ft., leading vacancy to increase to 16%. In contrast, 2005 - 2007 saw 14 million sq. ft. of new deliveries, but 22 million sq. ft. of positive net absorption greatly exceeded the new supply, leading vacancy to decline to 12%. In the years 2011-2014 following the Great Recession, Houston's economy was expanding and positive net absorption of 22 million sq. ft. exceeded the 18 million sq. ft. of new deliveries, leading vacancy to decline further toward 11%.

Current forecasts for new deliveries of Class A and B office buildings are 12 million sq. ft. in 2015, 7 million sq. ft. in 2016, and less than 1 million sq. ft. in 2017. With such increases in the supply of new office buildings, how will the dynamics of vacancy and net absorption unfold? An increase in office supply through new deliveries, combined with a reduction in demand and absorption of office space due to low job growth, may destabilize Houston's strong office market. Yet, absent of proper data

issue, as economic data are often inherently messy. Moreover, the underlying factors that produce economic phenomena in one business cycle can shift, resulting in a different pattern in another business cycle. Nevertheless, at NAI Partners we are pushing forward with using data analytics to understand predictive relationships between economics and commercial real estate.

Given the newly revised job forecast for Houston, we return to our prior predictions (Data InSight Vol. 1, Issue 2) of how net absorption will shift with job growth. We forecast net absorption in 2015, 2016 and 2017 based on job growth for a quick versus slow economic recovery from the oil downturn. Despite the shifting forecast, job growth remains a reasonably strong predictor of office absorption (Figure 2). The explanatory variable of job growth on the x-axis is scaled in thousands of jobs per year. The response variable of total net absorption on the y-axis is scaled in millions of square feet per year. The solid red circles are the empirical data points for 1999 - 2014, two of which are labeled by their years of 2002 and 2009, corresponding with the dot-com/Enron crises and the Great Recession.



analyses, false conclusions can be drawn from such speculation. Here, we use predictive analytics to forecast how net absorption will change with the revised job growth for Houston, and how vacancy in 2015, 2016, and 2017 will shift with deliveries, preleasing, and net absorption.

Job Growth Predicts Absorption

In his book *The Signal and the Noise*, Nate Silver popularized the scientific principle of how important but difficult it is to detect patterns in data given all the noise in them. The field of economics underscores this

The solid red line in Figure 1 is the linear regression model of the statistical relationship between job growth and net absorption, of the form $y=mx+b$ (see Methodology below). Specifically, $y=0.0431x+1.44$, where y is net absorption, x is job growth, m is the slope of the line, and b is the y -intercept. The coefficient of determination (r^2) indicates how well the data fit this linear statistical model. In this case, $r^2 = 0.51$, that is **51% of variation in absorption is explained by job growth**. This is a fairly large percentage given the many factors simultaneously occurring in economics and commercial real estate which

could obscure any such relationship. Yet, at the same time, that leaves 49% of variation in net absorption unexplained by job growth.

The slope of the line, $m = 0.0431$, 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. Accounting for the y -axis scaled in millions and the x -axis in thousands, the slope of 0.0431 means that on average **43.1 sq. ft. of net absorption occur for every one new job**. The 95% confidence interval for this slope is 18.9 to 67.2 sq. ft. of net absorption per job. The dashed red lines are the 80% prediction intervals (upper and lower bounds) for net absorption. That is, there is an 80% probability that absorption will be in this range for a given level of job growth.

The y -intercept, $b = 1.44$, describes how much absorption occurs when job growth is zero. **Even with low to near zero job growth, Houston still tends to experience net absorption of about 1.44 million sq. ft.** The 95% confidence interval for y -intercept is -0.209 to 3.077 million sq. ft. This aspect of net absorption becomes more important for estimates of job growth that approach values of zero.

Office Absorption Under the Revised Job Forecast

With only 13,000 new jobs in 2015, net absorption is predicted to be about 2.0 million sq. ft., with an 80% prediction interval of -1.1 to 5.1 (Table 1). Note, Q1 2015 already posted 1.5 million sq. ft., matching the baseline 1.44 million sq. ft. in the absence of any new jobs. For this reason, **even though job growth will decline in 2015 compared to 2014, we are unlikely to see negative net absorption of the prediction interval unless remaining quarters of 2015 post repeated substantial negative absorption.**

As predicted by job growth, net absorption in 2016 and 2017 depends on a quick or slow recovery from the oil pullback. A slow recovery in job growth suggests that the low predicted levels of absorption in 2015 will persist into 2016, at 2.1 million sq. ft. with an 80% prediction interval of -1.0 to 5.2 (Table 1). Then, in 2017, net absorption is predicted to rebound toward 6.1 million sq. ft., with an 80% prediction interval of 2.9 to 9.4 (Table 1). On the other hand, a quick recovery in job growth suggests modestly strong years of net absorption in both 2016 and 2017, at 4.0 and 5.2 million sq. ft. The total amount of absorption in 2016 and 2017 is about the

Table 1. Forecast for net absorption based on revised estimates of job growth for a quick and a slow economic recovery from the oil downturn in Houston. Job growth comes from Dr. Bill Gilmer, Director of the Institute for Regional Forecasting, University of Houston.

Year	Economic Recovery	Job Growth	Net Absorption	
			Predicted (mil sq. ft.)	80% Prediction Interval (mil sq. ft.)
2015	Quick	12,900	1.989	-1.158 to 5.135
	Slow	13,400	2.010	-1.135 to 5.156
2016	Quick	61,300	4.073	0.959 to 7.186
	Slow	15,600	2.105	-1.035 to 5.245
2017	Quick	87,900	5.218	2.049 to 8.386
	Slow	109,700	6.156	2.906 to 9.407

same whether the recovery is quick or slow, the difference is in whether the absorption occurs in one year (slow, 2017) or two years (quick, 2016 and 2017).

New Deliveries and Vacancy Rates

Percent vacancy is measured by the amount of vacant space divided by the total RBA of the office market. Vacant space is the sum of vacant space at the prior point in time, current deliveries, and current net absorption. New deliveries of Class A and B buildings are forecasted to be 12 million sq. ft. in 2015, 7 million sq. ft. in 2016, and < 1 million sq. ft. in 2017. Such large deliveries could increase vacancy, depending on preleasing of those new buildings and net absorption of the market as a whole. **Here, we forecast how percent vacancy varies with new deliveries, net absorption and preleasing.**

Vacancy for Class A and B buildings in Q1 2015 was about 12%. Year-end vacancy in 2015, 2016, and 2017 appear to depend more on the percent of new deliveries that are preleased, than on net absorption arising from quick versus slow economic recovery from the oil downturn. Specifically, Table 2 shows percent vacancies that are cross tabulated for two scenarios of net absorption, namely job growth under quick and slow economic recovery from oil downturn, and then four scenarios of the percent of new deliveries that are preleased (0%, 33%, 66%, 90%).

With 0% preleasing, future vacancy rates are going to bounce above 14.5% toward 16% before returning to 14% in 2017. Yet, in today's market, obtaining financial support for the construction of new buildings can be difficult without some level of tenant occupancy in the new office space. Hence, it is unlikely that buildings will deliver with

0% preleasing. On the other hand, with 90% preleasing, future vacancy rates are not going to bounce upwards, but rather decrease to 10% and down toward 7% in 2017 given job growth and a recovering economy. Like 0% preleasing, it is also unlikely that new buildings will deliver with a high 90% occupancy.

It is most reasonable to anticipate buildings to deliver with some intermediate level of preleasing, say 33% or 66% preleased. For 33% preleasing, vacancy rates will increase to 12.9 - 13.6% in 2015 and 2016, but then decrease back to 11% in 2017. On the other hand, for 66% preleasing, vacancy rates will decrease to 10.5 - 11.4% in 2015 and 2016, and then to 9% or less in 2017. **Thus, if we assume a moderate level of preleasing (33% or 66%), then vacancy rates do not increase excessively due to the large deliveries anticipated in coming years.**

Caveats and Uncertainty in the Predictive Analytics

Uncertainty in the predictive analytics center around predicting net absorption from job growth and then forecasting vacancy rates given variation in preleasing. First, for job growth, we have assumed 80% prediction intervals in Table 1. This is a probability of 0.80, which means that, while we are 80% certain, 2 out of 10 cases may fall outside this prediction interval given the noise associated with the data. If this were NBA free throws, we would likely bet on the shooter at 80% to win the game, but in two instances we would lose our bet.

Second, in predictive analytics, it is important to note whether the new values of the predictor variable (job growth) is within the range of the original data on which the projections are based. Extrapolation far

Table 2. Forecasts of vacancy rates (percent of RBA) for the Houston office market in 2015, 2016, and 2017. Predictive analytics include new deliveries, predictions for net absorption given job growth under quick and slow economic recovery from the oil downturn (Table 1), and four scenarios of different percentages of new buildings that are preleased.

Year	Deliveries (mil sq. ft.)	Economic Recovery	Percent of Deliveries Preleased			
			0%	33%	66%	90%
2015	12,374,217	Quick	14.5	12.9	11.4	10.2
		Slow	14.4	12.9	11.4	10.2
2016	7,623,808	Quick	15.3	12.9	10.5	8.7
		Slow	16.0	13.6	11.2	9.5
2017	700,000	Quick	13.7	11.2	8.7	6.8
		Slow	14.0	11.5	9.0	7.2

outside the original data range can lead to unreliable predictions. In our case, job growth of original data ranges from -70,000 to +105,000. Most forecasted job numbers in Table 1 are well within this data range, which increases the likelihood of a reliable prediction. However, some caution is warranted for net absorption predictions based on the 109,000 job forecast of 2017, as it is an extrapolation outside of the original data range.

In forecasting vacancy rates, we made several important assumptions, including that net absorption is determined by job growth and preleasing shapes absorption of new deliveries. It is important to note that while job growth explains 51% of net absorption in the office market, this still leaves 49% of absorption unexplained. Factors contributing to this 49% of unexplained variation could be influential, altering the direction and/or magnitude of the predictive analytics of net absorption based on job growth.

Most critical to the forecasted vacancy rates is from where the occupancy is coming for the preleasing. Is the occupancy new business to Houston, expansion business within Houston, or simply a lateral move from one space to another. When a business moves to occupy office space of a new building, it often leaves behind other space that is then unoccupied and needs to be backfilled within the same market which can increase vacancy. Under growing economies, such as 2004 - 2007 and 2011 - 2014 in Houston, net absorption often equals or exceeds new deliveries, indicating that large backfilled holes from preleasing are not left vacant. As a result, vacancy does not increase. Yet, under stable or declining economies, vacancy can increase as net absorption with be low or even negative. Under such scenarios, preleasing is less likely to support construction needs to

obtain financing, though consideration needs to be given to the time lag between the construction start and its delivery. The relationships among preleasing, backfilling vacated space, net absorption, and vacancy are complex, requiring further analysis.

Methodology

Commercial real estate data on office space were obtained from CoStar following Q1 2015. Data for Class A and B buildings were combined for office space. Job and employment data were obtained from the Federal Reserve Bank of Dallas. Job growth for Houston are based on forecasts of Dr. Bill Gilmer, Director of the Institute for Regional Forecasting (IRF) of the University of Houston. Many thanks to Drs. Gilmer and Perdue of the IRF for valuable discussions of these topics and analyses herein. The statistical analyses and data visualization 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/>.

We used linear regression to examine the predictive effects of annual changes in employment (i.e., job growth) on annual total net absorption (direct plus sublease) from 1999 - 2014. Assumptions of linear regression that could render a biased statistical model were tested. None of the assumptions were violated, including statistical outliers in absorption, overly influential points in job growth, statistical outliers in employment, normality in absorption, unequal variance, heteroscedascity, and serially correlated residuals (nonwhite noise error). There was a statistically significant, positive relationship between job growth and total net absorption for office space ($F_{1,14}=14.6$, $p=0.0018$, $r^2=0.51$).

Percent vacancy is equal to the vacant sq. ft. divided by total RBA. In turn, vacant sq. ft. is the sum of vacant sq. ft. at one prior point in time plus current deliveries plus current total net absorption. Deliveries were estimated based on NAI Partners and CoStar data. Net absorption was estimated based on the linear regression with job growth for quick and slow recovery of Dr. Gilmer. RBA is equal to RBA at the prior point in time plus current deliveries minus any demolitions. The current analyses and forecasts for vacancy do not include any estimates of reductions in RBA due to demolition. Table 2 only presents the actual predicted value of percent vacancy, but 80% prediction intervals are available upon request.

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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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