CBRE Hotels *Hotel Horizons*® Forecasting Approach to U.S. Hotel Markets

How We Forecast

CBRE Hotels' Americas Research prepares hotel market forecasts based on accepted econometric procedures and sound judgment. The product name for the CBRE Hotels' forecasts is *Hotel Horizons®.* The two-stage process for producing the forecasts firstly involves econometric estimation of future hotel market activity and financial performance based on historical relationships between economic and hotel market variables, and secondly, a judgmental review of modeled outputs by experienced hotel market analysts. Our hotel industry expertise dates back to the 1930s. CBRE Hotels and others believe that errors in forecasting are minimized by relying on both data analytics and judgment.[1]

Econometric Models

Econometric forecasting represents one of the most sophisticated approaches to gaining insight into future economic activity. Unlike some forecasting methods used in business practice, the models that underlie econometric forecasts contain variables based in economic theory. The forecasts come from historical relationships, similar to statistical correlations, among hotel market measures and economic variables. The measures for the variables come from actual market transactions involving individuals and firms interacting in the economy.

Positive Features of Econometric Models:

- The variables included in the models follow from economic theory.
- The relationships between variables are estimated with advanced statistical methods.
- The forecasts developed with econometric models are objectively determined, unlike forecasts based only on judgmental approaches.

Gaining insight into the futures of complicated economic environments requires the introduction of multi-level forecasting models. Several equations often need to be identified and estimated to model complex economic conditions such as the national economy. Multi-equation models have considerable appeal for economic forecasting because they explicitly recognize the interdependence of relationships commonly encountered in markets. Perhaps the best example of this type of model is one that involves both the demand side and the supply side of markets, in which prices of goods are set by the interaction of buyers and sellers. Thus, price appears as a variable in both the demand and supply equations.

[1] See, for example, Nate Silver, *The Signal and the Noise* (2012).

The Equations

The *Hotel Horizons*® econometric forecasting models fall into the category of multi-equation, demand and supply models. These models have the structure defined below, but vary in their construction for particular market applications (*e.g.,* different cities and hotel market segments). The three estimated equations are:

1. Demand (D) – The number of rooms occupied

$$D_t = f(D_{t-1}, RADR_{t-n}, \Delta RPI_{t-n} \text{ or } \Delta EMP_{t-n}, EMP_{t-n} \text{ or } RPI_{t-n}, Q_t) \quad (1)$$

2. Change in Supply (ΔS) – Change in the number of available rooms

$$\Delta St = f(S_{t-n}, RADR_{t-n}, OCC_{t-n}) \quad (2)$$

3. Real ADR (RADR) – The real average daily rate

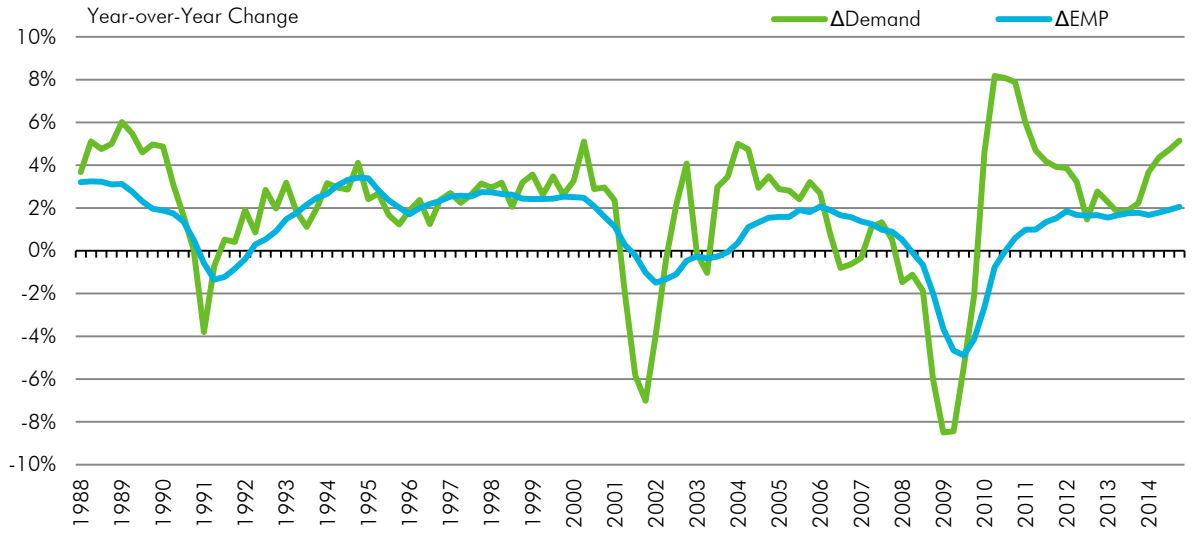
$$RADRt = f(RADR_{t-n}, OCC_{t-n}, Q_t) \quad (3)$$

Given:
RADR: Real Average Daily Rate
OCC: Occupancy (Demand/Supply)
Q: Quarterly indicator
RPI: Real Personal Income
EMP: Employment level
t = Time subscript
n = Time lag end period
Δ = Year-over-year change in a variable

The Demand Equation

Demand for hotel rooms, identified in Equation (1), is primarily driven by the general level of economic activity in the nation or city, as measured by RPI and EMP. Equation (1), therefore, recognizes the fundamental relationship between room purchasing behavior and either growth or decline in the relevant economy. The RPI and EMP are highly correlated with, and subsume, most other measures of economic activity. The addition of other economic measures, then, provides only small gains in the statistical precision of the model, and may create econometric problems (*i.e.*, co-linearity). Figure 1 shows the historical relationship between the change in U.S. EMP and lodging demand.

Figure 1: Change in Lodging Demand and Employment



Sources: STR, Inc.; BEA.

Both economic theory and historical data relationships strongly support the inclusion of RADR in the demand equation because lower RADRs motivate increases in travel and leisure spending, while higher RADRs motivate decreases. Finally, the data show that room demand does not completely adjust to changes in the economy during a single quarter. Some effects from changes in the economy during the current period will reverberate over subsequent quarters, suggesting that a given quarter's current levels of room demand correlate with prior-quarter demand levels.

Consequently, lodging demand is modeled as a function of past demand levels in order to capture the effects of non-instantaneous adjustments and contemporaneous or lagged personal income or employment levels. Lagged RADR levels capture the price effects.

Finally, the demand equation includes quarterly dummy indicators (Q) to capture the considerable fluctuations of lodging demand during different seasons. Such terms are necessary since the equations are estimated with non-seasonally-adjusted quarterly data.

The Supply Equation

In historical lodging data, a strong relationship exists between growth in the supply of new hotel rooms and prior-period lodging market conditions. As with lodging demand, historical movements in seasonally-adjusted supply growth suggest that the lodging supply's adjustments in response to economic shocks do not occur instantaneously, but over several quarters. As a result of this slow adjustment process, current growth in supply is correlated with the previous quarter's movements in supply. In Equation (2), new hotel room growth in modeled as a function of past levels of new room growth, past RADR, and past occupancy levels.

For all markets, we use published and locally-derived information about hotel project completion schedules to manually overwrite model estimates of room completions for the first six quarters of the forecast period. Hotel pipeline information is sourced from the STR, Inc. & Dodge Data and Analytics pipeline reports, as well as from on-the-ground knowledge from our many consultants and analysts in each market.

The ADR Equation

Historical RADR movements also suggest non-instantaneous adjustments and a strong correlation with room scarcity in the market. Equation (3), which estimates RADR, therefore defines RADR as a function of past real room rates and contemporaneous occupancy levels. The RADR equation also includes quarterly dummy indicators to control for seasonal variation in rates.

Estimation Procedures

The model's three main equations [Equations (1), (2), and (3)] are estimated separately for:

- All hotels in the U.S., as well as for the six chain scales (Luxury, Upper Upscale, Upscale, Upper Midscale, Midscale, and Economy) and the six location categories (Urban, Suburban, Resort, Interstate, Airport, Small/Town Metro).
- Upper-Priced and Lower-Priced hotels across each of 59 of the largest cities in the nation.

These equations are estimated with ordinary least squares in a non-simultaneous fashion using data from STR, Inc. and Moody's Analytics that extends back to the late 1980s. The data from STR, Inc. includes supply, demand, and revenue data for 59 city markets as well as for the entire U.S. At the city level, classification of hotels into the two segments is done by STR on the basis of chain affiliation. If a chain or independent hotel is categorized as Luxury, Upper Upscale, or Upscale based on previous-year ADR, it is considered "upper-priced." Alternatively, if the hotel is Upper Midscale, Midscale or Economy, it is classified as "lower-priced."

The STR data has a monthly frequency. For the purposes of econometric analysis and publishing, the monthly data are converted to quarterly and annual frequencies. The average daily number of rooms occupied for all hotels in a market during a particular period represents the market demand for that period; correspondingly, the average daily number of rooms available for all hotels in a market during a particular period represents the market supply for that period. Historical occupancy levels are generated as the ratio of occupied rooms to available rooms, while historical nominal ADR series are created as the ratio of total room revenue to occupied rooms.

The parameters (*i.e.,* coefficients on each variable) then are used to forecast demand, supply change, and RADR by multiplying the parameters by CBRE Econometric Advisors and Moody's Analytics forecasts of the economic variables and relevant previously estimated values (lagged variables). Three additional calculations are made with these results, as follows:

1. Supply change is added to the previous-period number of available rooms to produce an available rooms level in future periods.
2. Number of rooms sold is divided by number of available rooms to obtain occupancy percent in each future period.
3. Expected inflation is added to real ADR to convert to nominal ADR.

Regression equation estimations using time-series data, such as the work done to produce Hotel Horizons® forecasts, may encounter an econometric problem known as autocorrelation. For each of the equations estimated by CBRE Hotels, we run tests to detect the presence of autocorrelation. If the problem is found, corrective measures are introduced.

Judgmental Intervention

A committee of hotel experts from CBRE Hotels performs a thorough review of each model prediction. These assessments are made by locally-based hotel experts working in the various offices around the U.S. The quarterly forecasts for the current and forecast period years are subject to review. The committee modifies the model's market prediction when there is compelling evidence that factors have come into play that the model could not possibly foresee. A Super Bowl-type event, as an extreme example, would cause the committee's forecast to differ noticeably from the model's prediction—not only

in the city in which the event will occur, but also competing cities within the region. In most instances, however, the committee either defers to the model prediction or makes modest adjustments.

Jamie Lane
Senior Economist
CBRE Hotels' Americas Research
(404) 809–3950
jamie.lane@cbre.com

Last updated: April 28, 2015