Looking Under the Hood:  
The Catalysts of Hotel Credit Spreads  

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Executive Summary

In a prior report, "A New Canary for Hotel Mortgage Market Distress," we introduced the loan spread as a new metric for forecasting a change in relative delinquency levels for hotels. In this report, we take a look under the hood to see what are the catalysts that drive the hotel credit spread e.g., make our canary sing or croak. For lenders, the higher the perceived risk, the higher the required return (interest rate). If all property types have similar risk, then the interest rate among property types should also be similar. However, the interest rate for hotels exceeds other property types especially office buildings. This implies that hotel loans are riskier than loans for office buildings. In this report, we examine the catalysts or drivers of hotel credit spreads. The credit spread is the difference between the interest rate on hotel loans and the interest rate on office loans. This credit spread is also known as the relative risk premium or risk premium differential. Using a Vector Autoregression (VAR) statistical framework, which allows for the mutual impact of interdependent economic time series, we find that there are several catalysts of hotel credit spreads (relative risk premium). Our study spans a variety of economic conditions including expansions and contractions which is important because it allows us to subsume a variety of economic events. Hotel credit spreads widen in the face of the following events: a worsening in the general economy, a decline in anticipated corporate profitability, a decrease in capital availability, a decrease in hotel revenues, and an increase in relative risk. These variables thus capture risk and return information embedded in the risk premium differential (spread). The relative risk premium reflects risk and is systematically priced.

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For lenders, the higher the perceived risk, the higher the required return (interest rate). If all property types have similar risk, then the interest rate among property types should also be similar. However, the interest rate for hotels exceeds other property types especially office buildings. This implies that hotel loans are riskier than loans for office buildings. In this report, we examine the catalysts or drivers of hotel credit spreads. The credit spread is the difference between the interest rate on hotel loans and the interest rate on office loans. This credit spread is also known as the relative risk premium or risk premium differential. Using a Vector Autoregression (VAR) statistical framework, which allows for the mutual impact of inter-dependent economic time series, we find that there are several catalysts of hotel credit spreads (relative risk premium). Our study spans a variety of economic conditions including expansions and contractions which is important because it allows us to subsume a variety of economic events.1 Hotel credit spreads widen in the face of the following events: a worsening in the general economy, a decline in anticipated corporate profitability, a decrease in capital availability, a decrease in hotel revenues, and an increase in relative risk. These variables thus capture risk and return information embedded in the risk premium differential (spread). The relative risk premium reflects risk and is systematically priced.

Introduction

Why study the catalysts of the interest rate spread? It is important to understand the behavior of the interest rate or credit spread, because it contains important economic information for forecasting loan delinquencies as demonstrated in CHR Report "A New Canary for Hotel Mortgage Market Distress."2 A change in the hotel loan credit spread forecasts a change in delinquency levels. Hotels pay higher interest rates on loans compared to the rates on other property types such as office buildings. The argument that lenders advance for charging a higher interest rate for hotel loans is that underwriting hotel property is riskier relative to loans on other property types. The shaded yellow band in Exhibit 1 and the heavy solid line in Exhibit 2 show the show the substantial variation in the incremental risk premium for hotels over and above office properties over time.

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1 If two time series make relatively slow movements through time (a common feature for economic data), then a long time series (spanning many years) is needed before the true joint tendencies of the two variables can be measured reliably. Obtaining many observations by sampling frequently (say, through weekly or even daily observations) does not appreciably increase the power to measure the joint relationship between the two time series if the data span a total of only a few years. Robert J. Shiller and Pierre Perron, "Testing the Random Walk Hypothesis: Power vs. Frequency of Observation," Economic Letters, Vol. 18, (1985), pp. 381-386. Also, Robert J. Shiller, Market Volatility (Cambridge, MA: The MIT Press, 1989).

Motivation: Why Analyze the Relative (Differential) Risk Premium?

**Components of Interest Rates.** An interest rate on a risky loan contains several components. The first component is the nominal risk-free interest rate which consists of the real rate of interest and the expected inflation premium. The second component is a market risk premium for risky assets that reflects uncertainty. Lenders require additional interest to compensate for increased risk. A third component is the term structure of interest rates. The longer the term of the loan, the higher the rate is in general. The final component is the idiosyncratic risk premium which is specific to a particular investment, in the current study, hotel properties. Exhibit 1 shows the incremental interest rate components for hotels. The area in blue represents the nominal interest rate on 10-year constant maturity Treasury bond which includes the real rate of interest and the inflation premium. The area in red denotes the risk premium for office properties. The interest rate on office properties is higher than yields on Treasuries of comparable maturities because of implicit default risk among other factors. The spread over Treasuries also reflects the systematic factors that drive all real estate property types including the general real estate market factor (risk premium), compensation for the general illiquidity of the commercial real estate market, transaction costs, tax treatment, and other imperfections in the commercial real estate market. In sum, the area in red represents the risk adjustment that is systematic in nature in addition to the idiosyncratic risk associated with offices. The final component in yellow represents the difference between hotel and office interest rates. We will hereafter refer to this idiosyncratic risk premium for hotels as the risk premium differential i.e., risk of hotels relative to office properties.

**The Symbiotic Relationship between Office and Hotel Property Types.** A question which arises is why the focus on the risk premium for hotels relative to office properties? What is so special about office properties? Why not use some other property type such as retail which uses percentage leases which gives landlords a call option on the economy in good times and a base rent in bad times. For one, several professional hotel advisory services such as Cushman & Wakefield as well as HVS have found that a historical relationship exists between occupied office space and room night demand. Consequently, occupied office space is a useful indicator of anticipated room-night demand. This relationship exists since corporate travelers are one of the three major sources of hotel demand.

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4 Longer-maturity credit instruments such as 10-year treasuries are better at reflecting anticipated future economic conditions one to two years ahead (Simon Gilchrist, Vladimir Yankov, and Egon Zakrajšek, "Credit Market Shocks and Economic Fluctuations: Evidence from Corporate bond and Stock Markets," *Journal of Monetary Economics*, Vol. 56, No. 4 (May 2009), pp. 471-493).

5 A percentage lease is a lease whose rental is based on a percentage of the monthly or annual gross sales made on the premises. Common types of percentage leases include a fixed minimum rent plus a percentage of the gross, a fixed minimum rent against a percentage of the gross, whichever is greater; and a fixed minimum rent plus a percentage of the gross, with a ceiling to the percentage rental among others.

6 For example, Cushman and Wakefield found that for Washington, D.C. approximately 263 room nights are generated per year on average for every 1,000 square feet of occupied office space per year (Cushman and Wakefield, "More Than a Guessing Game: Number Crunching and Market Comparisons Shed Light on Hotel Demand," http://valuation.cushwake.com/Valuation/documents/publications/BB_Hotel_Demand_CM_V_Aug08_EN.pdf).

Lease characteristics represent another reason for choosing the office property type as a benchmark for comparing hotels with respect to interest rate deals. Office properties have longer leases while a short-term 24-hour lease is typical for hotels. Greater uncertainty of future cash flows is associated with short-term leases. This in turn requires a greater premium (higher borrowing cost) to compensate for this risk. The short term lease contract makes hotels more prone to shocks arising from capital market factors (e.g., stock returns) and the general economy.

With respect to hotel revenues, hotels generate revenues from several related sources. Revenue comes from rooms, food and beverage sales, and other secondary sources (such as rental of meeting space, business center services, spa services, and recreational amenities such as golf, tennis, and beach operations). To assess the relative importance of, and the degree of variation in, various revenue sources we obtained data from *PKF Hospitality Research* for our study period. This data is available on an annual frequency. On average, for our time period, room revenues account for 67.06% of sales (varying between a minimum of 64.60% and a maximum of 69.20%, a variation of less than ±2.5%), food and beverage sales account for an additional 25.63% of sales (24.20% minimum and 26.70% maximum, a variation of less than ±1.5%), and other sources of revenue account for the remaining 7.33% of sales (5.90% minimum and 8.80% maximum, a variation of less than ±1.5%). The revenue breakdown for hotels is shown in Exhibit A1 in Appendix A. Although the overall level of hotel revenues remains variable, the composition of revenues is relatively stationary over time with revenue arising from rooms, food and beverage, and other sources each maintaining a constant proportion to total revenues over the study period.8

By looking at the differential in interest rates between hotel and office property types, we already control for factors that systematically impact all property types to a similar extent such as the general real estate market (e.g., overall real estate risk premium), the capital market (e.g., credit spread of corporate bonds), and general economic conditions regardless of whether they are observable or not. Consequently, we are better able to study traits that elicit differential risk premium between property types. Working with measures in terms of differentials, not the absolute levels, is an important and novel feature of our study.

Data

The average spread for a property type over Treasury at the time of loan origination (SATO) for mortgage loans for hotels and office property types, is obtained from Lehman Brothers for the period starting July 1998 through January 2008. We update the SATO data using Cushman Wakefield Sonnenblick-Goldman survey of indicated spreads9 for conventional commercial mortgage loans over a 10-year Treasury bond beginning in February 2008 and ending in March 2011.10 All data are monthly. This gives us a relatively long time series that encompasses both the

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8 Another aspect that may be important in the hotel sector is property management. With respect to our variable of interest -- the credit spread -- it may be reasonable to expect that property management is an important determinant of the cost of debt in a *cross-section* of hotel properties. However, since we focus on the time series variation in the spread, the cross-sectional variation in management quality is averaged out in our *aggregated* time series data.

9 According to Christopher T. Moyer at Cushman & Wakefield, the rate ranges are based on general rate indications from lenders for those asset classes, recent quotes, and closed transactions.

10 The Cushman data is used since the Lehman data was discontinued with the collapse of Lehman Brothers. To account for the fact that our data uses series from both Lehman and Cushman Wakefield Sonnenblick-Goldman, in addition to the results reported in the report, we also estimate all VARs in models that include a shift variable to account for change in the data. The results (not reported for brevity) remain the same.
times of economic growth and the times of economic distress (recessions). We therefore are able to study the behavior of the spread under a variety of economic conditions.\footnote{The Lehman data is normalized for loan size and loan to value to capture the true difference in SATO by property type while the Cushman data is normalized for loan size but not LTV. Prior studies have also used SATO data that hasn’t been normalized. For example, the ACLI data on loan commitments made by life insurers that Nothaft and Freund use in their study are also not standardized for changes in terms and maturities (Frank Nothaft and James Freund, “The Evolution of Securitization in Multifamily Mortgage Markets and Its Effect on Lending Rates,” \textit{Journal of Real Estate Research}, Vol. 25, No. 2 (2003), pp. 91-112.). We do not use the ACLI data in the current study since it is quarterly while the Cushman and Wakefield data are monthly. In addition to this, hotel loans are not necessarily made in each quarter by insurance companies. However, we do use the ACLI data to assess our combined data series (which we first convert to a quarterly series). Our overall data series for both office buildings and hotels is highly correlated with the data series from one source (ACLI). We provide additional details in Appendix A. To account for possible LTV differences for the Cushman and Wakefield data we also estimate all VARs with a control for LTV differences added to the models. The results (not reported for brevity) remain the same.}

Wall Street analysts use SATO as a measure of default risk e.g., default models use loan specific SATO as one of the key performance drivers. The intuition for using SATO as a default metric is that the yield spreads (interest rate – risk free rate) for various property types include two options, default risk (put option) and prepayment risk (call option). Prepayment risk for commercial mortgages is often minimized through “lock out” provisions or “yield maintenance” requirements which reduce the value of the call option while the value of the put option (default) remains unchanged. We subtract the SATO corresponding to office from the SATO for hotels to obtain the differential risk premium at time $t$,

\[
\text{Differential Risk Premium}_t = \text{RISKDIFF}_t = \text{SATO}_{\text{Hotel},t} - \text{SATO}_{\text{Office},t}
\]

The differential risk premium (incremental risk premium for hotels over and above office properties, see the shaded yellow band in Exhibit 1) is our variable of interest. A positive risk premium differential suggests higher risk including greater default (delinquency) risk since the hotel loan is made at a wider spread relative to an office loan.

The macro-economic variables we examine include the percent change or growth rate in expected corporate earnings per share on the S&P500 (PCTEPS) and the rate of unemployment (UNEMPL).\footnote{Prior research indicates a connection between real estate returns and the macro-economy (Nafeesa Yunus, "Modeling Relationships among Securitized Property Markets, Stock Markets, and Macroeconomic Variables," \textit{Journal of Real Estate Research}, Vol. 34, No. 2 (2012), pp. 127--156). We focus on the role of macroeconomic conditions in setting relative cost of capital. In equilibrium there is a direct link between cost of capital and returns. We use unemployment, but we also estimated all the models using the growth rate in total employment (EMPL) instead of unemployment and the results (not reported for brevity) hold.}

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\footnote{Analysts typically form their expectations of earnings per share after conference calls with a firm’s management and the announcement by management of forward looking earnings guidance.}

\footnote{Wheaton and Rossoff use GDP as their primary demand instrument (William Wheaton and Lawrence Rossoff, “The Cyclic Behavior of the U.S. Lodging Industry,” \textit{Real Estate Economics}, Vol. 26, No. 1 (1998), pp. 67--82). We do not use GDP our study since it is not forward looking. Besides this, GDP is published quarterly and revised monthly.}

The growth rate in expected earnings per share represents Wall Street's consensus on the expected movements in the economy. It also reflects management’s short term expectations.\footnote{Analysts typically form their expectations of earnings per share after conference calls with a firm’s management and the announcement by management of forward looking earnings guidance.} Since most overnight stays are business related and corporations plan their travel in advance, expected earnings are used as an anticipated demand instrument.\footnote{Wheaton and Rossoff use GDP as their primary demand instrument (William Wheaton and Lawrence Rossoff, “The Cyclic Behavior of the U.S. Lodging Industry,” \textit{Real Estate Economics}, Vol. 26, No. 1 (1998), pp. 67--82). We do not use GDP our study since it is not forward looking. Besides this, GDP is published quarterly and revised monthly.} Expected earnings also reflects the growth in future disposable income; the leisure demand market segment depends heavily on disposable income. Finally, news about future corporate earnings also reflects corporate
borrowers’ shocks to their ability to pay debt in the future. Our rationale for including expectation variables is that if markets are efficient e.g., reflect all available information then credit spreads should reflect expectations in addition to realizations.

We use the difference in the standard deviation of total returns on Hotel REITs and Office REITs (DIFFSTDEV) as our proxy for the additional anticipated riskiness in performance of hotel REITs over and above office REITs. Other authors have used the implied volatilities of near-the-money options on the OEX(S&P100) index to proxy for changes in a firm’s future volatility in their study of credit spreads. Previous corporate bond studies have often used stock returns to proxy for changes in a firm’s health. Similarly, we use volatility of REIT returns as a metric of the uncertainty about future returns on a property type. Titman and Torous indirectly show that greater variability of property values increases the likelihood of default in circumstances where the unpaid loan amount exceeds property value. REIT returns are used given the greater frequency (monthly) of values relative to underlying property values which are typically reported on a quarterly basis. In addition to this, REIT returns contain market expectations (are forward looking) for a given property type in contrast to underlying property values. The volatility of hotel REITs should exceed office REIT volatility given the higher frequency of rent resetting of the former due to shorter lease term, ceteris paribus. Hotel property values should thus adjust more quickly relative to office values which are subject to existing contract rents on longer term leases. In sum, we study a system with several variables capturing the state of the economy and the demand for hotel services. The variables include expected earnings per share, and unemployment, which are metrics that influence either discretionary income or the perception of financial security. Appendix A gives a description and source(s) the variables used in this study.

Methodology

We employ a vector autoregression (VAR) model to analyze the information content of the incremental credit spread for hotels, as well as the information contained in the variables measuring activity in the economy as a whole, the capital markets and the real estate markets. A VAR is a useful and flexible way of analyzing economic relations in time series data. This methodology allows us to examine simultaneous behavior of the variables and takes into account the mutual impact of the variables on each other. Stated differently, the variables are considered in a system, much like a system of several (say, three) equations in several (say, three) unknowns. The variables are mutually inter-dependent and impact one another in an analogous fashion to a chemistry experiment designed to come up with a drug cocktail where each new drug introduced interacts with all of the other drugs in the formula. Each drug chosen may have the same or different ingredients to another drug used. A VAR model is more suitable for capturing dynamic relations between inter-dependent economic variables than a single equation linear regression. A VAR model is a set of equations (drugs), one equation for each variable (each equation represents one drug. Each drug consists of several

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16 The authors use non-callable, non-puttable debt of industrial firms in contrast to our study wherein mortgages contain both a call and a put option (Pierre Collin-Dufresne, Robert Goldstein and Spencer Martin, “Determinants of Credit Spread Changes,” Journal of Finance, Vol. 56, No. 6 (2001), pp. 2177-2208.). Further, it has been found that systematic volatility is not priced in the cross-section of equity REIT returns, but idiosyncratic volatility is priced, and this finding warrants our investigation of the role of standard deviation (R. Jared DeLisle, S. McKay Price, and C.F. Sirmans, "Pricing of Volatility in REITs," Journal of Real Estate Research, Vol. 35, No. 2 (2013), pp. 223–248).


18 See Appendix A for a precise explanation of each of the model variables and data sources.
ingredients). For example, to examine joint evolution of three economic variables $x, y, z$, the following VAR system can be estimated,

$$
x_t = \alpha_1 + \beta_{1,1} \cdot x_{t-1} + \beta_{1,2} \cdot x_{t-2} + \beta_{1,3} \cdot y_{t-1} + \beta_{1,4} \cdot y_{t-2} + \beta_{1,5} \cdot z_{t-1} + \beta_{1,6} \cdot z_{t-2} + u_t
$$

$$
y_t = \alpha_2 + \beta_{2,1} \cdot y_{t-1} + \beta_{2,2} \cdot y_{t-2} + \beta_{2,3} \cdot x_{t-1} + \beta_{2,4} \cdot x_{t-2} + \beta_{2,5} \cdot z_{t-1} + \beta_{2,6} \cdot z_{t-2} + v_t
$$

$$
z_t = \alpha_3 + \beta_{3,1} \cdot z_{t-1} + \beta_{3,2} \cdot z_{t-2} + \beta_{3,3} \cdot x_{t-1} + \beta_{3,4} \cdot x_{t-2} + \beta_{3,5} \cdot y_{t-1} + \beta_{3,6} \cdot y_{t-2} + w_t
$$

There are three regression equations, one for each variable. Subscript $t$ is for the value of the variable at time $t$. In each regression equation, past (lagged) values of the dependent variable are included. For example, in the first equation above, the past values of $x$ variable are included: with one lag, $x_{t-1}$, and with two lags, $x_{t-2}$. The system above is said to be estimated with two lags. Each regression equation also includes the past (lagged) values of the other two variables in the system. In this example, each variable depends on its own past, and on the past values of the other two variables. The equations are estimated statistically in a manner similar to the ordinary regression, and estimates of the coefficients $a_i$ and $b_{i,j}$ are obtained.

The technique is useful in examining complex relationships among variables when the variables are serially correlated (current values depend on past values), which is a common feature of economic data. Typically, VARs have little serial correlation in the residuals. This is helpful for separating out the effects of economically unrelated influences in the VAR. We use the VAR model to reveal the evolution of the credit spread and the other economic variables as well as the dynamic interactions between the variables.

The VARs are analyzed by examining impulse response functions (IRFs). An impulse response function is a graph that shows how a given variable in the VAR system responds over time to a change (a shock) in every other variable in the system. For example, to analyze the effect of variable $z$ on variable $x$, an IRF is created with time on the x-axis, and the response (change) in variable $x$ on the y-axis. To compute the response, a shock (positive change) to variable $z$ is traced through the system of equations. Because the effects are considered in a system, a shock in $z$ affects variable $x$ directly ($x_t$ depends on $z_{t-1}$ and $z_{t-2}$), but also indirectly, through the variable $y$ ($x_t$ depends on $y_{t-1}$ and $y_{t-2}$, and the values of $y$ depend on $z$). An impulse-response function, therefore, captures the dynamic inter-dependence in the variables, and is able to characterize the dynamic structure of the model. The impulse response functions do this by showing how shocks to any one variable have a ripple effect on every other variable, and eventually feed back to the original variable itself. We describe and explain the impulse response functions in more detail when we present our results. Additional details on VAR are in Appendix B.

Results

In efficient capital markets, prices reflect market expectations of risk and return. Relative cost of capital may reflect past changes in relative risk. At the same time, markets anticipate future developments and adjust the required rate of return on capital when expected conditions (such as relative risk) change. In this environment, the risk premium differential may contain information that leads to forecasts of changes in relative risk. We use multivariate analysis to explore the relationship between risk premium differential, relative risk, and economic and capital market conditions. Our VAR system includes five variables: (1) risk premium differential (RISKDIFF); (2) a measure of corporate profitability—a percent change in the forward earnings per share (PCTEPS); (3) risk differential measured as the difference in standard deviations (DIFFSTDEV); (4)
unemployment rate (UNEMPL); and (5) CMBS issuance as a proxy for capital supply conditions. Two lags of each variable are included in the system.

The impulse response functions (IRFs) for our VAR system are shown in Exhibit 3. All graphs in Exhibit 3 show the response of the relative risk premium e.g., a widening or narrowing of the interest rate on hotel loans relative to the interest rate on office loans to changes in the other variables in the system. In each case the response is traced forward for 12 months (x-axis). Each graph contains: (1) the zero effect level (horizontal black line); (2) the change in the risk premium differential (the response is shown on the y-axis), to a unit change in corresponding independent variable. The response function is the blue curve. (3) The 95% confidence interval, shown by the red dashed lines. When the effect (blue curve) is separated from the zero level (the black horizontal line) by the standard error bound, we conclude that the effect is significant. For example, figure 3.2 in Exhibit 3 shows the response in risk premium differential (hotel credit spread) to a change in forward EPS (our measure of expected corporate profits). The effect lies below zero and beginning from month 7 the effect is separated from the zero level by the standard error bound. This shows that an improvement in expected corporate profits (a shock to Forward EPS) results in a tightening between the interest rate on hotels and the interest rates on office buildings (a lower risk premia differential; lower interest rate spread). Proceeding from left to right within each row and from the first to the third row, the following results obtain:

- Graph 3.1: The interest rate spread (relative risk premium) is not only predictable but this predictability continues to persist for some time.
- Graph 3.2: If higher earnings are anticipated, the interest rate spread narrows
- Graph 3.3: The interest rate spread increases with relative risk (hotels become riskier than offices).
- Graph 3.4: The interest rate spread increases given an increase in unemployment
- Graph 3.5: Increase of capital availability (an increase in CMBS issuance and the resulting inflow of funds) results in lower relative risk premium (tightening of the interest rate spread).

In the next VAR system we add two variables that measure the demand for hotel services - total hotel revenues (HOTREVYR) and total hotel demand (HOTDMNDYR). We also exclude two existing variables - risk differential (DIFFSTDEV) and unemployment rate (UNEMPL) from the system since DIFFSTDEV and UNEMPL could contain the same information as HOTREVYR and HOTDMNDYR. We will explore this relationship more fully in a subsequent VAR impulse response function analysis. Two lags of each variable are included in the system.

Exhibit 4 shows the plots of the impulse response functions (IRFs) for this new VAR system. The first row of Exhibit 4 depicts the response of relative risk premium (graphs 4.1 through 4.5), and the last (fifth) row depicts response of CMBS issuance (graphs 4.21 through 4.25). Examining the first row, the responses of relative risk premium (interest rate spread) reveals that all of our existing variables in our previous VAR system continue to behave in a similar manner and to have the same effect. The risk premium charged for hotel loans declines when aggregate earnings environment is expected to improve and as funding becomes available through CMBS issuance and capital supply increases. There are also several new insights:

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Graph 4.3: An increase in hotel revenues forecasts a lower relative risk premium (tightening interest rate spread). BUT a change in the interest rate spread does not predict a change in total hotel revenues (Graph 4.11).

Graph 4.12: An improvement in expected corporate profitability (PCTEPS) forecasts an increase in hotel revenues. This is consistent with economic intuition that hotel revenues are related to business activity.

Graph 4.13: Periods of higher revenues are followed by higher revenues; periods of declines tend to be followed by continued declines.

Graph 4.14: Hotel revenues are related to hotel demand as expected.

The response of total hotel demand (HOTDMDYR) to the variables in the system shown in the fourth row of Exhibit 4 are similar to the results for total hotel revenues. In particular, the risk premium differential does not forecast total hotel demand (Graph 4.16); however, forward EPS does forecast hotel demand (Graph 4.17).

To summarize the new findings: (1) our forward looking corporate profitability measure (PCTEPS) forecasts demand for hotel services (HOTREVYR and HOTDMDYR); and (2) the risk premium differential is unable to forecast the hotel demand variables (HOTREVYR and HOTDMDYR).

Given the preceding results, we next examine the information contained in DIFFSTDEV and UNEMPL relative to HOTREVYR, the latter being a more direct measure of hotel industry performance. Our new VAR system includes the following variables: (1) the difference in standard deviations (DIFFSTDEV), a measure of relative riskiness; (2) unemployment (UNEMPL) as a measure of economic conditions; (3) hotel revenues (HOTREVYR), a direct measure of the industry performance; (4) percent change in forward EPS (PCTEPS); (5) activity in the hotel CMBS market (CMBSISSU); and (6) our variable of interest, the risk premium differential (RISKDIFF).

Exhibit 5 shows the impulse response functions (IRFs) for this VAR system. The results are consistent with our prior findings regarding the respective roles that improving expected corporate profits and increasing CMBS issuance play in lowering the risk premium e.g., narrowing the interest rate spread for hotel loans relative to office loans. The new insight is that when hotel revenues (HOTREVYR), a direct measure of hotel market conditions, is included in the system, the significance of the other two risk variables - risk differential (DIFFSTDEV) and unemployment (UNEMPL) – declines in significance from the 5% level to the 10% level. In other words, using a direct measure of industry performance, hotel revenues, subsumes the informational role of the less direct measures (risk differential and unemployment).

We also examine the impulse response functions (IRFs) for the Risk Differential (DIFFSTDEV) to a unit standard deviation change in a particular variable (impulse response functions not shown for brevity). An increase in expected profits (forward earnings) predicts a decline in the risk differential. The risk differential picks up movements in unemployment; an increase in unemployment forecasts an increase in the risk differential. An increase in hotel revenues forecasts a significant decline in the risk differential. Overall, the results suggest that the risk differential variable contains both information on the economy (unemployment) and industry-specific information. When a direct measure of industry performance (hotel revenues) is included in the VAR system, it captures the role of less direct hotel performance measures. The risk differential variable also reflects information on overall economic conditions (unemployment) and industry performance. The inclusion of the risk differential variable thus represents a parsimonious way of reflecting information that is important for accounting for the variation in the interest rate spread.
The behavior of the interest rate spread (interest rate on hotels – interest rate on office buildings) is consistent with economic intuition. The spread responds to financial risk (DIFFSTDEV), expected financial performance (PCTEPS), overall economic conditions (unemployment, UNEMPL), supply of hotel capital (CMBSISSU), and hotel industry performance information (HOTREVYR). These variables thus capture risk and return information embedded in the risk premium differential (interest rate spread). Consequently, the interest rate spread (relative risk premium) represents priced systematic risk.

We also assess the relative contribution of our catalysts by performing a variance decomposition for each of our three VAR systems to see which variable(s) exerts a relatively greater influence in predicting the change in hotel credit spreads. Exhibit 6 shows the contribution of different variables to prediction of variation in the spread for the first VAR system. Each pie chart represents different forecasting horizon (3, 6, 9, and 12 months). For each pie chart, each slice of pie represents the portion of unexplained variation in the spread that a variable accounts for that is not explained by the hotel credit spread's own past values. For example, at 3 month horizon, CMBS Issuance has the largest relative contribution at 44.7%, followed by the risk differential (the difference in standard deviations) at 33.87%. Forward earnings per share and unemployment make relatively smaller incremental contributions, at 10.8% and 10.6%, respectively. CMBS Issuance remains the largest catalyst at all horizons followed by the risk differential. The role of forward earnings becomes more important as a catalyst as the length of the horizon increases. In contrast, the role of unemployment remains relatively stable.

We repeat this analysis for our second VAR system. In the second VAR model, hotel revenues and hotel demand (both hotel industry variables) replace risk differential and unemployment. Exhibit 7 shows the contribution of different catalysts (variables) in the prediction of the variation in the hotel credit spread for the second VAR system. CMBS Issuance continues to be the catalyst exerting the largest influence at both the 3 months and 6 months horizons followed next by hotel revenues. At longer horizons (9 and 12 months), a role reversal occurs with hotel revenues now the largest catalyst followed by CMBS Issuance.

Our third VAR system includes six variables: the risk premia differential, forward EPS, risk differential, unemployment, CMBS Issuance and hotel revenues. Exhibit 8 shows the contribution relative influence that each of these six catalysts exerts in predicting the variation in the hotel credit spread for the third VAR system. At all horizons (3, 6, 9, and 12 months), CMBS Issuance is the most influential catalyst followed by hotel revenues. As the horizon increases, however, the CMBS Issuance declines in importance as a driver of hotel credit spreads (from 72% at 3 months to 44% at 12 months) while hotel revenues becomes a more important driver (from 13% at 3 months to 32% at 12 months). The risk differential variable and forward EPS are the next two catalysts of hotel credit spreads.

**Summary and Practical Applications**

Since the loan spread is a metric (canary in the coal mine) for forecasting a change in relative delinquency levels for hotels, we take a look under the hood to see what are the catalysts that drive the hotel credit spread e.g., makes our canary sing or croak using a VAR framework.

We find that the incremental hotel risk premium (hotel interest rate – office interest rate) is systematically priced. In particular, there are four catalysts that drive an increase in the hotel risk premium differential.

- a deterioration of general economic conditions,
• a decline in expected corporate profitability,
• a reduction in capital availability
• a decrease in the demand for hotel services

In other words, these indicators are warning that our canary is about to croak or at least experience difficulties in continuing to sing. Which catalyst(s) exerts the most influence on our canary? CMBS issuance is the dominant catalyst with hotel revenue acting as the second most important driver of hotel credit spreads in general. However, the amount of influence that each of these two catalysts exerts as well as other catalysts also depends on whether the variation in hotel credit spreads is examined with respect to a shorter time horizon (3 or 6 months) or longer time horizon (9 or 12 months). At longer horizons, CMBS Issuance continues to remain the most influential catalyst, although its influence declines along with the role of risk differential while the role of hotel revenues and expected earnings both increase in importance. We also show that changes in the risk differential and unemployment incorporate information on the direction of hotel revenues, a direct measure of industry performance. Overall, the finding that interest rates rise when lenders anticipate greater economic uncertainty evidences that lenders price relative risk in the market where underlying properties (hotels) have particularly short-term leases.
Appendix A. Data.

To assess the relative importance of, and the degree of variation in, various revenue sources for hotels we obtained data from PKF Hospitality Research for our study period. This data is available on an annual frequency. The revenue breakdown for hotels is shown in Exhibit A1 below.

Exhibit A1. Revenue Breakdown in Hotels.

Source: Trends in the Hotel Industry. PKF Hospitality Research. San Francisco, CA. various years

In the remainder of the study all economic data are monthly. Differential Risk Premium (RISKDIFF) is computed as the SATO (spread over Treasury at the time of loan origination) for hotels minus the SATO for office properties,

\[
RISKDIFF_t = SATO_{Hotel} - SATO_{Office}
\]

The average spread for a property type over Treasury at the time of loan origination (SATO) for mortgage loans for hotels and office property types, is obtained from Lehman Brothers for the period starting July 1998 through January 2008. We update the SATO data using Cushman Wakefield Sonnenblick-Goldman survey of indicated spreads for conventional commercial mortgage loans over a 10-year Treasury bond beginning in February 2008 and ending in March 2011.

Since we use data from two sources, Lehman Brothers (LB) in earlier periods up to January 2008 and Cushman Wakefield Sonnenblick Goldman (CWSG) starting from February 2008 onwards (given the collapse of Lehman and subsequent non-reporting of SATO), a natural question which arises is to what extent the two series are comparable and combining the two is reasonable. To ascertain the comparability of the two series and to investigate the continuity of our data, we collect quarterly interest rate and loan to value data on office buildings and hotels from the American Council of Life Insurance Companies (ACLI) publication “Commercial Mortgage Commitments -
While the ACLI data is reported at quarterly frequency and thus is not appropriate for our main analysis which we conduct at a monthly frequency, it is useful to assess our combined data series. The correlation between ACLI interest rate for office and our data for office is 0.88, and the correlation for ACLI data for hotels and our hotel interest rate series is 0.81. This indicates that our overall data series is highly correlated with the data series from one source (ACLI).

The sources of other variables are given in the table below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description and Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference in Standard Deviation (DIFFSTDEV)</td>
<td>The difference in the standard deviation of total returns on Hotel REITs (real estate investment trusts) and Office REITs. To calculate the standard deviation for each property type a rolling twelve month window is used on the total return series for a given REIT property type. DIFFSTDEV = ( \sigma_{\text{Hotel}} - \sigma_{\text{Office}} ). Source: National Association of Real Estate Investment Trusts²¹</td>
</tr>
<tr>
<td>Differential Risk Premium (RISKDIF)</td>
<td>Difference in the spread at time of origination (SATO) between hotel and office property types; additional risk premium associated with hotel. Source: Lehman Brothers, Cushman &amp; Wakefield (<a href="http://www2.cushwake.com/sonngold/">http://www2.cushwake.com/sonngold/</a>)</td>
</tr>
<tr>
<td>Percent Change (Growth Rate) in Total Employment (EMPL)</td>
<td>Change in the number of employed persons from period to period. Source: U.S. Bureau of Labor Statistics (BLS) (via <a href="http://www.economy.com/freelunch">http://www.economy.com/freelunch</a>)</td>
</tr>
<tr>
<td>Percent Change in Forward Earnings per Share (PCTEPS)</td>
<td>( \text{PctEPS} = (\text{EEP}^t / \text{EEP}^{t-1}) - 1 ). Where EEP is Forward Earnings per Share, analysts estimates of earnings per share for the S&amp;P500. This is anticipated profits in contrast to actual corporate profits (see Corporate profits (PROFITS)). Source: <a href="http://www.yardeni.com">http://www.yardeni.com</a></td>
</tr>
<tr>
<td>Unemployment rate (UNEMPL)</td>
<td>Number of unemployed persons divided by the labor force, where the labor force is the number of unemployed persons plus the number of employed persons. Source: U.S. Bureau of Labor Statistics (BLS) (via <a href="http://www.economy.com/freelunch">http://www.economy.com/freelunch</a>)</td>
</tr>
<tr>
<td>Hotel Revenues Year-over-Year (HOTREVYR)</td>
<td>Year over year percentage change in total hotel revenues (all hotel classes). Source: Smith Travel Research</td>
</tr>
<tr>
<td>Hotel Demand Year-over-Year (HOTDMDYR)</td>
<td>Year over year percentage change in total hotel demand (all hotel classes). Source: Smith Travel Research</td>
</tr>
<tr>
<td>CMBS Issuance trailing twelve months (CMBSISSU)</td>
<td>Trailing twelve months CMBS Issuance. Source: CRE Finance Council, Compendium of Statistics²² (original source of data is Commercial Mortgage Alert)</td>
</tr>
</tbody>
</table>

²⁰In the few quarters where the interest rate information is not available for hotels, we use data from Trepp. We thank Jack Pong of Trepp for providing this data to us.
Appendix B: Vector Autoregression (VAR)

Vector Autoregression (VAR) is a system of simultaneous equations. In this system, all variables depend on all other ones, e.g., all variables are endogenous. That is, all variables can have a relationship with all other variables of a system. For example, we examine a system with five variables: (1) risk premium differential (RISKDIFF); (2) a percent change in the forward earnings per share (PCTEPS); (3) risk differential measured as the difference in standard deviations (DIFFSTDEV); (4) unemployment rate (UNEMPL); and (5) CMBS issuance. Two lags of each variable are included in the system. This system is written as follows,

\[
\begin{align*}
RISKDIFF_t &= \alpha_1 + \beta_{1,1}RISKDIFF_{t-1} + \beta_{1,2}RISKDIFF_{t-2} + \beta_{1,3}PCTEPS_{t-1} \\
&\quad + \beta_{1,4}PCTEPS_{t-2} + \beta_{1,5}DIFFSTDEV_{t-1} + \beta_{1,6}DIFFSTDEV_{t-2} \\
&\quad + \beta_{1,7}UNEMPL_{t-1} + \beta_{1,8}UNEMPL_{t-2} + \beta_{1,9}CMBS_{t-1} + \beta_{1,10}CMBS_{t-2} \\

PCTEPS_t &= \alpha_2 + \beta_{2,1}RISKDIFF_{t-1} + \beta_{2,2}RISKDIFF_{t-2} + \beta_{2,3}PCTEPS_{t-1} + \beta_{2,4}PCTEPS_{t-2} \\
&\quad + \beta_{2,5}DIFFSTDEV_{t-1} + \beta_{2,6}DIFFSTDEV_{t-2} + \beta_{2,7}UNEMPL_{t-1} \\
&\quad + \beta_{2,8}UNEMPL_{t-2} + \beta_{2,9}CMBS_{t-1} + \beta_{2,10}CMBS_{t-2} \\

DIFFSTDEV_t &= \alpha_3 + \beta_{3,1}RISKDIFF_{t-1} + \beta_{3,2}RISKDIFF_{t-2} + \beta_{3,3}PCTEPS_{t-1} \\
&\quad + \beta_{3,4}PCTEPS_{t-2} + \beta_{3,5}DIFFSTDEV_{t-1} + \beta_{3,6}DIFFSTDEV_{t-2} \\
&\quad + \beta_{3,7}UNEMPL_{t-1} + \beta_{3,8}UNEMPL_{t-2} + \beta_{3,9}CMBS_{t-1} + \beta_{3,10}CMBS_{t-2} \\

UNEMPL_t &= \alpha_4 + \beta_{4,1}RISKDIFF_{t-1} + \beta_{4,2}RISKDIFF_{t-2} + \beta_{4,3}PCTEPS_{t-1} + \beta_{4,4}PCTEPS_{t-2} \\
&\quad + \beta_{4,5}DIFFSTDEV_{t-1} + \beta_{4,6}DIFFSTDEV_{t-2} + \beta_{4,7}UNEMPL_{t-1} \\
&\quad + \beta_{4,8}UNEMPL_{t-2} + \beta_{4,9}CMBS_{t-1} + \beta_{4,10}CMBS_{t-2} \\

CMBS_t &= \alpha_5 + \beta_{5,1}RISKDIFF_{t-1} + \beta_{5,2}RISKDIFF_{t-2} + \beta_{5,3}PCTEPS_{t-1} + \beta_{5,4}PCTEPS_{t-2} \\
&\quad + \beta_{5,5}DIFFSTDEV_{t-1} + \beta_{5,6}DIFFSTDEV_{t-2} + \beta_{5,7}UNEMPL_{t-1} \\
&\quad + \beta_{5,8}UNEMPL_{t-2} + \beta_{5,9}CMBS_{t-1} + \beta_{5,10}CMBS_{t-2}
\end{align*}
\]

Each equation is for one dependent variable. For example, in the first equation the dependent variable is risk premium differential at time \( t \). There is one equation per dependent variable. Each equation looks like a regular multivariate regression equation, with 10 independent variables on the right-hand-side. The system account for the dependencies between all interrelated variables. Notice that equations include lagged (past) values of the dependent variable. For example, the first equation for the risk premium differential at time \( t \) on the right-hand-side includes risk premium differential at \( (t - 1) \) and at \( (t - 2) \). The system as shown has two lags.

The VAR technique is useful in examining complex relationships among variables when the variables are serially correlated e.g., past values tend to persist (for example, if occupancy (ADR) is high in the prior periods it is also high in the current period). Typically, VARs have little serial correlation in the residuals. This is helpful for separating out the effects of economically unrelated influences in the VAR. We use the VAR to reveal the evolution of the credit spread and the other economic variables as well as the dynamic interactions between the variables.

The VARs are analyzed by examining impulse response functions (IRFs). An impulse response function is a graph that shows how a given variable in the VAR system responds over time to a change (a shock) in every other variable in the system. A VAR provides a way of letting the data determine the dynamic structure of a model. Thus, after estimating a VAR, an impulse response
function characterizes its dynamic structure. The impulse responses do this by showing how shocks to any one variable filter through the model to affect every other variable, and eventually feed back to the original variable itself. We describe and explain the impulse response functions in more detail when we present our results.
Exhibit 1. Incremental Interest Rate Components for Hotels

Source: Federal Reserve, Cushman & Wakefield Sonnenblick Goldman, Lehman Brothers
Exhibit 2. The Risk in the Risk Premium:
The Difference in Standard Deviations of Hotel and Office Returns

Risk Premium Differential (Hotel - Office)

Difference(Rolling TTM StDev(TotRtns(Hotel-Office))}
Exhibit 3.
In Exhibit 3 we plot impulse response functions (IRFs) for the Risk Premium Differential to a unit standard deviation change in a particular variable, traced forward over a period of 12 months. Response to Cholesky 1 standard deviation. Dashed lines represent 95% confidence bands. The VAR system contains five variables: (1) risk premium differential (RISKDIFF); (2) a percent change in forward earnings per share (PCTEPS); (3) risk differential (DIFFSTDEV); (4) unemployment rate (UNEMPL); and (5) CMBS issuance.

Response to Cholesky One S.D. Innovations ± 2 S.E.

3.1. Response of Risk Premia Differential to a shock in Risk Premia Differential

3.2. Response of Risk Premia Differential to a shock in Percent Change in Forward EPS

3.3. Response of Risk Premia Differential to a shock in Risk Differential (StDev)

3.4. Response of Risk Premia Differential to a shock in Unemployment

3.5. Response of Risk Premia Differential to a shock in CMBS Issuance
Exhibit 4.
In Exhibit 4, we plot impulse response functions (IRFs) to a unit standard deviation change in a particular variable, traced forward over a period of 12 months. Response to Cholesky 1 standard deviation. Dashed lines represent 95% confidence bands.
Exhibit 5.
In Exhibit 5 we plot impulse response functions (IRFs) for the Risk Premium Differential to a unit standard deviation change in a particular variable, traced forward over a period of 12 months. Response to Cholesky 1 standard deviation. Dashed lines represent 95% confidence bands.

**Response to Cholesky One S.D. Innovations ± 2 S.E.**

- **5.1. Response of Risk Premia Differential to a shock in Risk Premia Differential**
- **5.2. Response of Risk Premia Differential to a shock in Percent Change in Forward EPS**
- **5.3. Response of Risk Premia Differential to a shock in Risk Differential (StDev)**
- **5.4. Response of Risk Premia Differential to a shock in Unemployment**
- **5.5. Response of Risk Premia Differential to a shock in CMBS Issuance**
- **5.6. Response of Risk Premia Differential to a shock in Hotel Revenues**
Exhibit 6. Each pie chart shows the relative contribution of different variables for explaining variation in risk premium differential that is left unexplained by the risk premium differential own past values. The VAR system contains five variables: (1) risk premium differential; (2) a percent change in forward earnings per share; (3) risk differential; (4) unemployment rate; and (5) CMBS issuance.

Exhibit 7. Each pie chart shows the relative contribution of different variables for explaining variation in risk premium differential that is left unexplained by the risk premium differential own past values. The VAR system contains five variables: (1) risk premium differential; (2) a percent change in forward earnings per share; (3) hotel revenues; (4) hotel demand; and (5) CMBS issuance.
Exhibit 8. Each pie chart shows the relative contribution of different variables for explaining variation in risk premium differential that is left unexplained by the risk premium differential own past values. The VAR system contains six variables: (1) risk premium differential; (2) a percent change in forward earnings per share; (3) risk differential; (4) unemployment rate; (5) CMBS issuance; and (6) hotel revenues.