Strategic and Structural Changes in Hotel Mortgages: A Multiple Regression Analysis

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abstract

This article demonstrates that corporate "A" bond rates and hotel mortgage interest rates are highly correlated. Specifically, bond rates in one calendar quarter are a reasonably accurate predictor of interest rates in the following quarter. The most effective analysis involves a multiple regression equation that accounts for recent strategic changes in participants in the hotel mortgage market and thus a structural shift in the market. The equation also accounts for federal tax policy as well as bond rates in estimating interest rates in the subsequent quarter. This model overcomes the concerns of timeliness for existing hotel mortgage rate estimates that are based on surveys of relatively few mortgagees.

Accurate estimates of current hotel mortgage costs are essential to estimating hotel value, particularly when commercial real estate appraisers apply the income capitalization approach.[1] Hotel mortgage cost estimates also play a role in determining whether a proposed hotel deal is actually feasible. Inaccurate estimates of mortgage costs can result in potential purchasers making unwise bids for hotel investments. Even slight upward or downward fluctuations in mortgage interest rates can have a substantial effect on debt service payments. Furthermore, mortgage interest rates are an important component of hotel values, as explained in previous research.[2] For these reasons, appraisers, analysts, owners, investors, lenders, and operators should strive to accurately assess hotel-financing costs.

This article presents a model that has proved highly accurate in determining the costs of hotel financing. The calculation employs corporate bond interest rates, which are reported daily by *Moody's Bond Survey*.[3] Thus, the user may continuously adjust financing estimates for fluctuations in the financial markets. This model is superior to lender surveys that are published by several hotel consulting and appraisal firms because that data is frequently neither timely nor accurate.[4] The data's timeliness problem arises because compiling the data—from the time that it is secured to the time the report is printed—consumes one to two months. The report is then not usually updated for another six to twelve months. The surveys' accuracy problem stems from the tendency of survey respondents (i.e., mortgagees) to respond with opening offers (i.e., asking prices) rather than with final negotiated and committed interest rates.[5]

1. Appraisal Institute, *The Appraisal of Real Estate,* 12th ed. (Chicago: Appraisal Institute, 2001).
2. John W. O'Neill and Stephen Rushmore, "Refining Estimates of Hotel-Financing Costs," *Cornell Hotel and Restaurant Administration Quarterly* 41, no. 6 (December 2000): 12–17.
3. Moody's, Inc., *Moody's Bond Survey* (New York: Moody's Investors Service, 1990–2002).
4. Stephen Rushmore and Carey Hirschman, "Estimating the Current Cost of Hotel Financing," *Real Estate Finance Journal* (Winter 1997): 6–10.
5. Ibid.

To overcome the problems inherent in investor surveys, the relationship of bond rates to hotel interest rates was analyzed. Bonds were chosen for comparison because of their numerous similarities to real estate. For example, both bonds and real estate mortgages are debt instruments that commence with an initial investment, have periodic cash flow, and have a terminal value.[6] Previous research found significant support for estimating hotel interest rates using corporate "A" bond rates (as published and distributed by *Moody's Bond Survey*) and conducting a linear regression analysis to arrive at an estimate of current hotel interest rates.[7] The primary benefit of this approach is that the Moody's information has wide and frequent distribution, whereas the distribution of hotel interest rate information is not as wide or frequent. Thus, the bond-based information is more accurate than compilations of hotel interest rate data.

In this article, hotel financing estimates are first refined by analyzing the extent to which corporate "A" bond rates (as reported by *Moody's*) are effective as predictors of hotel interest rates. Next, we analyze whether forms of regression analysis other than simple linear regression, including curvilinear and multiple regression analysis, would be appropriate techniques for such prognostications. Finally, the effects of recent changes in the strategies of participants in the hotel mortgage market are examined. These strategy changes appear to have resulted in structural changes to the market that have not been seen since the 1980s.

Applying Regression Analysis

Regression analysis is a mathematical technique for predicting a response or dependent variable (in this case, hotel interest rates), using a predictor or independent variable (in this case, corporate bond rates). Regression analysis predicts the value of a dependent variable, assuming a constant or straight-line relationship between the values of the dependent variable and those of the independent variable. Regression thus seeks to develop a "line of best fit" among the values as though the values were arrayed as points on a graph with a straight line running as close as possible through the midpoints of those values. Rushmore and Hirschman found support for using American Council of Life Insurance (ACLI) data as the dependent variable, indicating that it represents the only source of hotel mortgage interest rate information that has been compiled with reasonable consistency and over a relatively long period of time.[8] For regression analysis to be implemented with a high degree of reliability, a relatively large data set is necessary. While the ACLI data represents the longest-term and largest source of hotel mortgage rate information, this source has the disadvantage of including figures from only 20 major life insurance companies, which are primarily involved in relatively large, high-end hotel properties. Therefore, while ACLI's report represents the best data available for this study, it might not be representative of the entire universe of hotel lending, which would include relatively smaller lodging properties.

Like linear regression analysis, curvilinear regression analysis is a mathematical technique for predicting a dependent variable using an independent variable. However, curvilinear regression analysis offers a higher level of sophistication over simple regression analysis because it is capable of detecting curved trends between the independent and dependent variables. In cases where a curved trend exists, curvilinear regression analysis produces a higher regression coefficient (R^2) than produced by simple regression analysis. Curvilinear regression analysis has also been referred to as quadratic modeling or polynomial regression analysis.[9]

The analysis here used SPSS 11.0 for Windows to compare the corporate "A" bond rates with the ACLI data.[10] A total of 106 data points (calendar quarters) were examined for which there were both corporate "A" bond rates and hotel mortgage interest rates from ACLI. First, both linear and curvilinear analyses were conducted for those 106 quarters, starting with the first quarter of 1973 and continuing through the second quarter of 2002. Linear regression analysis resulted in a significant regression coefficient (R^2) of 0.928 ($F = 1357.09$, $p < .001$). The linear equation results indicate that corporate "A" bond rates are an excellent predictor of hotel mortgage interest rates. That is, the two variables

6. Ronald E. Copley, "The Similarities of Valuing Real Estate and Bonds, and the Diversification Benefits of Investing in Real Estate," *The Appraisal Journal* (July 1996): 304–309.
7. Rushmore and Hirschman.
8. Ibid; note that in 2000, the American Council of Life Insurance became the American Council of Life Insurers.
9. Mark L. Berenson and David M. Levine, *Statistics for Business and Economics,* 2d ed. (Englewood Cliffs, NJ: Prentice Hall, 1993).
10. *Statistical Package for Social Sciences*, Version 11.0 (Chicago: SPSS, Inc., 2002).

correlate by approximately 96% (the square root of 0.928) and approximately 93% of the variance in hotel interest rates can be predicted based on corporate "A" bond rates (0.928 rounded). The regression formula derived from the quarterly hotel mortgage interest rates and corporate "A" bond rates is as follows:

$$Y = 2.207 + 0.827 (X)$$

where:

Y = predicted hotel mortgage interest rate
X = corporate "A" bond rate

Corporate "A" bond rates and hotel mortgage interest rates are graphed in Figure 1, which indicates that the two are highly correlated, i.e., historically both have moved in roughly the same direction.

Curvilinear Analysis

Next, the 106 data points were analyzed for evidence of a curvilinear relationship. Curvilinear regression analysis resulted in a significant regression coefficient (R^2) of 0.928 ($F = 672.16$, $p < .001$). These results also indicate that corporate "A" bond rates are an excellent predictor of hotel mortgage interest rates when a quadratic equation is used. That is, as with linear analysis, approximately 93% of the variance in hotel mortgage interest rates can be predicted based on corporate "A" bond rates, given a polynomial equation. The curvilinear regression formula derived from the quarterly hotel mortgage interest rates and corporate "A" bond rates is as follows:

$$Y = 2.2542 + 0.8179 (X) + 0.0004 (X^2)$$

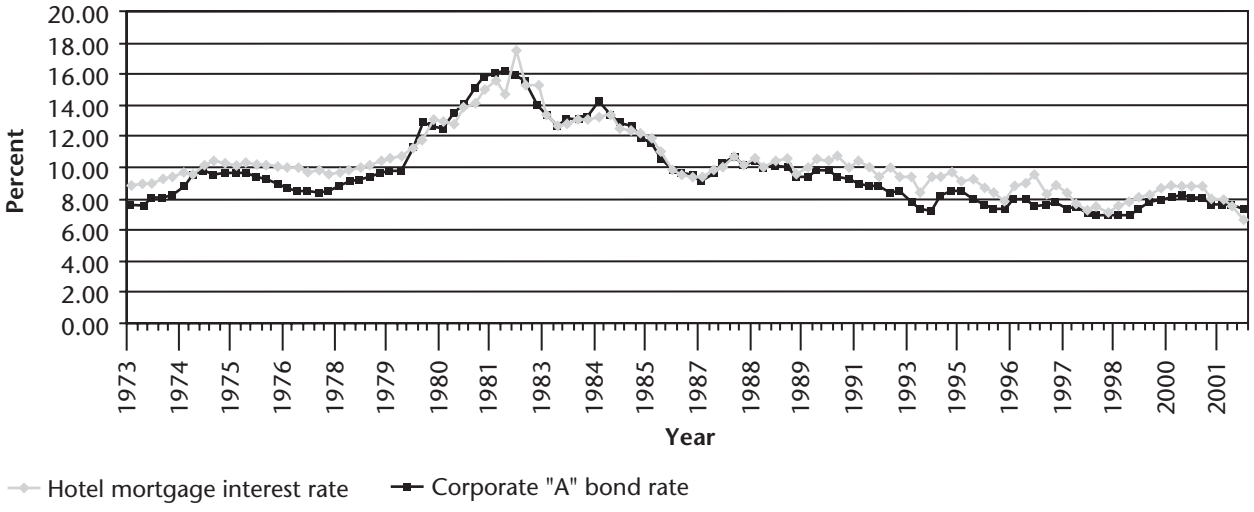
where:

Y = predicted hotel mortgage interest rate
X = corporate "A" bond rate

This equation has the same variables as the linear equation. However, because the X^2 coefficient is extremely small and the curvilinear analysis does not provide a higher R^2 value than linear analysis, it would appear that curvilinear analysis is not currently a superior methodology for analyzing these factors, even though previous research (conducted in 2000) found that curvilinear analysis was generally superior.[11] The current research confirms that finding. Specifically, over the past several years, curvilinear analysis has consistently resulted in R^2 values the same or greater than linear analysis. However, when the most recent data is included in the analysis, curvilinear analysis simply does not result in a higher R^2 value.

To determine whether corporate "A" bond rates are becoming increasingly better or worse predictors of hotel mortgage interest rates, regression coefficients were calculated using linear and curvilinear models. The data used starts with the first quarter of 1973 and runs through seven different ending periods: the fourth quarters of 1996, 1997, 1998, 1999, 2000, 2001, and the second quarter of 2002. This approach also allows for analysis of the relative strength of linear versus curvilinear regression analysis. Table 1 presents a comparison of hotel mortgage

Figure 1 Hotel Mortgage Interest Rates and Corporate "A" Bond Rates



11. O'Neill and Rushmore.

interest rates and corporate "A" bond rates, together with the regression coefficients for those variables.

As indicated in Table 1, regardless of the ending year of analysis, the regression coefficients for curvilinear analysis are generally higher than (or at least equal to) those of linear analysis. This finding provides some support for using a curvilinear regression to predict hotel mortgage interest rates in general. Furthermore, while Table 1 indicates that there has typically been some degree of fluctuation in regression coefficients calculated from both linear and curvilinear analyses, regression coefficients have generally increased with the inclusion of more recent data. This increase indicates that corporate "A" bond rates may generally be increasingly better prognosticators of hotel mortgage interest rates. Table 1 also appears to indicate, however, that while regression coefficients have generally increased in recent years for both linear and curvilinear analysis, there has been a slight decrease since about 2001. The effects of important strategic changes occurring in the marketplace since 2001 are examined later in this article.

Lead-Lag Analysis

In an effort to determine more about the predictive nature of corporate bond rates on hotel mortgage interest rates, the extent to which hotel interest rates might lag behind corporate bond rates was analyzed. For instance, would corporate bond rates predict hotel mortgage interest rates occurring one or perhaps two quarters later. To answer this question, first a linear and curvilinear regression analysis was conducted using quarterly corporate "A" bond rates as the independent variable and ACLI hotel mortgage interest rates for the subsequent quarter as the dependent variable. In other words, each quarterly corporate "A" bond rate was compared with the ACLI hotel mortgage interest rate for the following quarter. For example, the corporate bond rate for the first quarter of 1990 was compared to the ACLI hotel interest rate for the second quarter of 1990.

Linear regression analysis resulted in a significant regression coefficient (R^2) of 0.928 ($F = 1351.32$, $p < .001$). These results indicate that when a linear equation is used, corporate "A" bond rates are an excellent predictor of hotel mortgage interest rates in the subsequent quarter, comparable to the analysis involving the current quarter. The regression formula derived from the quarterly hotel mortgage interest rates for the subsequent quarter and corporate "A" bond rates is as follows:

$$Y = 2.180 + 0.829\ (X)$$

where:

Y = predicted hotel mortgage interest rate
X = corporate "A" bond rate

Next, the data points were analyzed for evidence of a curvilinear relationship. Curvilinear regression analysis resulted in a significant regression coefficient (R^2) of 0.929 ($F = 677.82$, $p < .001$). The curvilinear regression formula derived from the quarterly hotel mortgage interest rates and corporate "A" bond rates is as follows:

$$Y = 3.1207 + 0.6489\ (X) + 0.0081\ (X^2)$$

where:

Y = predicted hotel mortgage interest rate
X = corporate "A" bond rate

This polynomial equation indicates that as corporate "A" bond rates increase, hotel mortgage interest rates may increase at a faster rate. The debt market appears to assume that disproportionately greater levels of risk are associated with hotel mortgages when corporate "A" bond rates become relatively high. Similarly, the market appears to assume that disproportionately lower levels of risk are associated with hotel mortgages when corporate "A" bond rates are relatively low.

Table 1 Corporate "A" Bond Rates and Hotel Mortgage Interest Rates

	Regression Coefficients	
Ending Year of Analysis	**Linear Analysis**	**Curvilinear Analysis**
1996	91.1	92.1
1997	91.4	91.8
1998	92.9	93.0
1999	93.2	93.2
2000	93.3	93.4
2001	93.2	93.2
2002*	92.8	92.8

* Note that 2002 data is through midyear.

In addition, corporate "A" bond rates were analyzed relative to ACLI hotel mortgage interest rates recorded two quarters later. These analyses resulted in relatively lower R^2 values than did the equations testing a lag of just one quarter.[12] Thus, hotel mortgage interest rates appear to lag behind corporate "A" bond rates by no more than one quarter.

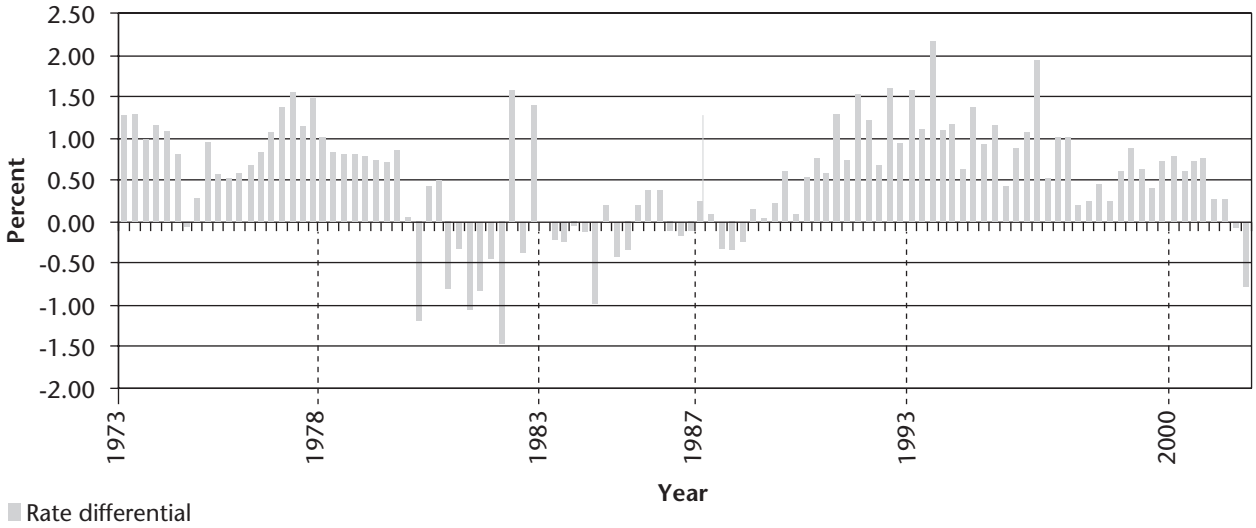
Rate Differentials

To better understand the historical relationship between corporate "A" bond rates and hotel mortgage interest rates, the historical rate differentials (spreads between the two rates) were analyzed. This analysis indicates that the two rates exhibit a high degree of similarity in movement, as illustrated in Figure 1. Corporate "A" bond rates have historically fluctuated from a low of 6.87% in 1998 to a high of 16.22% in 1982. Hotel mortgage interest rates (as reported by ACLI) have ranged from a low of 6.62% in 2002 to a high of 17.50% in 1982. Despite these great fluctuations, the two rates have generally been within two points of one another, as indicated in Figure 2.

Figure 2 illustrates that hotel mortgage interest rates have historically been higher than corporate "A" bond rates. An exception to this trend occurred in the 1980s when hotel rates were generally below or approximately the same as corporate "A" bond rates. That inversion ended within approximately one year after the U.S. Congress passed the Tax Reform Act of 1986. It appears that the debt market once again attributed greater levels of risk to hotel debt than to corporate bonds once the distortion caused by federal tax policy ended. One could argue that the favorable tax treatment in the 1980s had the effect of decreasing the risk of hotel investments.[13] This decreased risk occurred because carefully structured hotel syndications could capitalize on tax benefits, allowing investors to recoup their total outlay in the hotel's first year of operation and to reap additional benefits in the future, regardless of the actual economic success of the underlying hotel asset.[14] Consequently, at least some of the historical fluctuation in hotel rates that is not explained by changes in corporate "A" bond rates might be explained by changes in U.S. income tax regulations.

Interestingly, a similar trend has recently occurred. Since the third quarter of 2001, hotel mortgage interest rates have again trended lower than corporate bond rates. While at first, it appears that this change may be related to the September 11, 2001 attacks, we do not believe this to be the case. Even though September 11 most certainly negatively affected hotel values,[15] we believe that the trend seen here probably began prior to September 11, 2001 and has more to do with the overall crisis in confi-

Figure 2 Differentials Between Hotel Mortgage Interest Rates and Corporate "A" Bond Rates



12. Values for the linear regression were: $R^2 = 0.866$, F = 603.00, $p < .001$; values for the curvilinear regression were: $R^2 = 0.867$, F = 300.50, $p < .001$.

13. William J. Hoffman, "Lessons from the Hotel Trenches: Avoiding Another Crash," *Real Estate Finance Journal* (Spring 1997): 24–27.

14. Stephen Rushmore, *Hotels and Motels: A Guide to Market Analysis, Investment Analysis, and Valuations* (Chicago: Appraisal Institute, 1992).

15. John W. O'Neill and Anne R. Lloyd-Jones, "One Year After 9/11: Hotel Values and Strategic Implications," *Cornell Hotel and Restaurant Administration Quarterly* 43, no. 5 (October 2002): 53–64.

dence in American companies, which has been well documented. In other words, the market appears to have made a strategic and structural shift in perceiving there to be lower levels of risk associated with the investment in real estate (i.e., via hotel mortgages) than the investment in the actual corporations (i.e., via corporate bonds). In addition, the crisis in confidence in companies has probably resulted in reduced demand for investment in corporate bonds, thus resulting in relatively higher bond interest rates being offered by the market to induce increased demand. Similarly, due to reduced building and reduced hotel sale transactions,[16] there may be reduced demand for hotel mortgages, thus resulting in slightly lower mortgage interest rates being offered by the market to induce demand. Time alone will tell how long this shift will take place, but for the moment the shift is fairly evident. Specifically, Table 1 shows that without accounting for the strategic and structural shift occurring in the market since 2001, lower regression coefficients have resulted since 2001. Therefore, we believe that the optimal model for projecting hotel mortgage interest rates should take into account this strategic structural change occurring since 2001.

Multiple Regression Analysis

Due to the apparent market shift in the 1980s of U.S. income tax laws and the recent market shift on hotel interest rates, a multiple regression analysis was conducted to include the market shift factor. Multiple regression analysis allows the implementation of two independent variables to predict a single dependent variable.[17] In this instance, independent variables were corporate "A" bond rates (X) and a qualitative (yes–no) "dummy" variable (Z). The dummy variable consisted of a binary code, where 1 (no market shift) = periods prior to 1980 and between 1987 and 2001, and 0 (yes, market shift) = 1980 through 1987 and after 2001, to take into account the change in rate differentials during these two periods. This analysis resulted in a regression coefficient (R^2) of 0.941 ($F = 837.22$, $p < .001$). The multiple regression formula derived from the hotel mortgage interest rates is as follows:

$$Y = 0.539 + 0.944\ (X) + 0.778\ (Z)$$

where:

Y = predicted hotel mortgage interest rate
X = corporate "A" bond rate
Z = dummy variable

Finally, a multiple regression analysis was conducted using a one quarter lag between corporate "A" bond rates and hotel mortgage interest rates. This was done because earlier analyses found that including the one quarter shift resulted in a relatively higher regression coefficient (R^2). This analysis resulted in a regression coefficient of 0.943, the highest in the study ($F = 853.22$, $p < .001$). This regression coefficient means that hotel mortgage interest rates are correlated with the X and Z variables at an extremely high rate of 97.1% (the square root of 94.3). The multiple regression formula derived from the hotel mortgage interest rates is as follows:

$$Y = 0.296 + 0.962\ (X) + 0.859\ (Z)$$

where:

Y = predicted hotel mortgage interest rate
X = corporate "A" bond rate
Z = dummy variable

This model appears to be a very strong predictor of hotel mortgage interest rates and may be easily applied. Although we have managed to develop mathematical equations using variables that explain high degrees of variance in the fluctuation of hotel rates, other factors must exist that would explain the small amount of variance not explained here. Risk factors that debt markets may consider when arriving at hotel mortgage interest rates could include supply and demand trends (on both a macro and micro basis), barriers to competition, customer profiles, and business-mix trends.[18]

16. Ibid.

17. Berenson and Levine.

18. Lori E. Raleigh, "Asset Management," *Hotel Investments: Issues and Perspectives,* 2d ed. (Lansing, Mich.: Educational Institute of the American Hotel & Motel Association, 1999), 91–109.

Conclusion

This article supports earlier research that found that corporate "A" bond rates exhibit high levels of predictive ability in relation to hotel mortgage interest rates. This research expands on earlier work by presenting a polynomial model that appears to be equal to or superior to previous linear models. Furthermore, the results indicate that since 1996, corporate "A" bond rates have generally become more predictive for hotel mortgage interest rates. Finally, extremely high predictive capabilities using multiple regression analysis were shown, where corporate "A" bond rates from the previous quarter predicted hotel mortgage interest rates for the current quarter and where a recent market shift is taken into account. Future research should seek to further refine such mathematical modeling by evaluating the efficacy of including within these models other factors such as supply and demand trends, barriers to competition, customer profiles, and business-mix trends.

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