An Empirical Study of Ex Ante Risk Premiums for the Electric Utility Industry

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This study examines the relationship between interest rates and utility equity risk premiums. We found that an inverse relationship exists, with the equity risk premium changing by 37 basis points for each 100 basis-point change in the 30-year Treasury bond yield. The inverse relationship is stable; however, changes in the relative risk of debt and equity securities produce shifts in the level of risk premiums, regardless of the behavior of Treasury bond yields. We also found that the equity risk premiums were consistently positive over the study period, which conforms to the basic risk/return tenet of finance.

■ Several studies published in recent years support an inverse relationship between utility equity risk premiums and interest rates during the first half of the 1980s. Our study provides a more current examination of this relationship. Our findings support the conclusion that equity risk premiums for utility stocks continue to vary inversely with interest rates. Further, the inverse relationship between interest rates and risk premiums appears stable over the sample period; however, market behavior at certain points in the sample period appears to reflect changes in the market's evaluation of the relative risk of Treasury bonds and utility stocks. For instance, significant differences in the level of the risk premium were observed during certain periods, irrespective of the level of interest rates. Considering the dynamic nature of risk premiums, we discuss how the study may be applicable for estimating the cost of equity for utilities.

Section I provides background information and a literature review. Section II describes the research methodology and the data. Section III provides the empirical results. Section IV furnishes an example to illustrate the model's usefulness. Section V furnishes conclusions.

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I. Background and Literature Review

The determination of an appropriate cost of equity is a controversial issue in utility rate proceedings. Bond yields provide a readily observable, definitive measure of the market's required return on that investment; however, such a measure is not readily available for stocks. The indefinite life and uncertainty of a firm's future earnings make it necessary to employ theoretical models to arrive at an estimate of the cost of equity. All theoretical models have strengths and weaknesses, and the focus in utility rate proceedings is often on what is wrong with a particular approach rather than what is right. However, the nebulous nature of the true cost of equity provides no definitive way to assess the superiority of one method's results over another's. Consequently, several cost of equity models are typically used to develop a final estimate.

The risk premium method is an alternative approach to the prevalent discounted cash flow (DCF) model in estimating the cost of equity. A fundamental tenet of financial theory is that riskier investments should command a higher expected return than less risky investments. The risk premium may be defined as the difference, or spread, between expected returns on alternative investments. Financial textbooks usually illustrate risk premiums based on a theoretical risk-free rate and the rate for alternative-risk investments along the security market line.

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A widespread application of the risk premium method is based on an average of the realized spreads between total returns on equity and debt investments over some historical period. A refinement of this approach is to calculate the average spread between realized equity total returns and bond yields, in order to obtain a forward-looking measure of the required return on debt. Either type of average risk premium is then added to the current cost of debt to obtain a current cost of equity estimate. The assumption implicit in such approaches is that a constant risk premium is embodied in the current cost of equity. A corollary assumption is that the constant risk premium embodied in expected returns is equal to the average of risk premiums measured from realized returns. In actuality, the time period over which past returns are measured can result in significantly different risk premiums. However, many practitioners of this method argue that if the market risk premium is constant, then it is best approximated by realized returns over very long periods of time. These factors underlie the weaknesses of an ex post risk premium approach. Still, this method has cognitive appeal due to the almost tangible dimension added by the measurement of risk premiums from observed returns. There is also great practical appeal to this approach because it is easy to implement by using readily accessible data from sources like Ibbotson Associates (1993), which provide a regularly updated and consistently available compilation of various risk premiums based on holding periods beginning in 1926.

In recent years, an alternative risk premium model has been proposed. It relies on the expected cost of equity, rather than realized returns, as the appropriate basis for measuring risk premiums. Several studies empirically support the hypothesis that risk premiums, as measured by the expected cost of equity, are not constant but, instead, vary inversely with interest rates (Brigham, Shome, and Vinson, 1985; Harris, 1986; Harris and Marston, 1992; and Shome and Smith, 1988). Generally, studies supporting an ex ante risk premium approach are based on data from as early as the mid-1960s through the mid-1980s. The measurement of the ex ante risk premium holds conceptual appeal because it is consistent with the valuation of equity investments based on *expected* returns. However, a practical concern is the reliability of a risk premium measure that must be based upon an estimate of the cost of equity obtained by some other method, such as a DCF model. If problems exist in the formulation of the model used to estimate the cost of equity, those problems are transferred to the risk premium estimate.

An ex ante risk premium study by Brigham et al. (1985) supported the existence of an inverse relationship between interest rates and utility stock risk premiums from 1980 through the first half of 1984. To determine these risk premiums, they employed a two-stage DCF model to obtain monthly cost of equity estimates for utility stocks. Risk premium measures for each month were then derived by deducting an appropriate Treasury bond yield each month. They found that, prior to 1980, the relationship between equity risk premiums and interest rates had been positive. Shome and Smith (1988) obtained similar results, finding an inverse relationship between interest rates and electric utility risk premiums that continued through 1985. Both studies discussed factors that reduced the impact of regulatory lag on utility stocks from the late 1970s into the early 1980s. Both studies concluded that reduced regulatory lag contributed to shifting the relative risk relationship between debt and utility stocks from positive to negative.

These studies were by and large an outgrowth of the market climate of the early 1980s. During that time, the risk of debt instruments rose in both an absolute sense and compared to stocks. This environment led many to conclude that the risk premium had narrowed and some to even argue it was negative.

Shome and Smith (1988) note that while stocks and bonds are both considered to be hedges against anticipated inflation, common stocks are considered to offer a partial hedge against unanticipated inflation. Therefore, during periods of greater inflation uncertainty, Smith and Shome argue that it would seem reasonable that equity risk premiums would decline as interest rates rise (see Gordon and Halpern, 1976). Stated another way, the risk and required return of the less complete hedge (i.e., debt) would increase at a relatively greater rate than the more complete hedge (i.e., equity), thereby reducing the risk premium during periods of higher uncertainty. However, Carleton, Chambers, and Lakonishok (1983) furnish empirical evidence that risk premiums for utility stocks tend to rise with inflation and interest rates if regulatory lag severely hampers earnings and prevents dividends from keeping pace with inflation.

Harris (1986) also finds an inverse relationship between interest rates and ex ante risk premium measures during the early to mid-1980s, based on utility and broader stock market indices. In a more recent study, Harris and Marston (1992) find an inverse relationship between interest rates and ex ante risk premiums for stocks in the S&P 500, based on data from 1982 to 1991. Blanchard (1993) studied real, rather than nominal, risk premiums between 1926 and 1993. Blanchard hypothesized that the persistence of relatively high risk premiums from the late 1930s through the 1940s could have been due to the market's reaction to the high stock market volatility in the late 1920s and early 1930s. Blanchard also suggested that changes in inflation had a more temporal impact on the relative risk of debt and equity. He concluded that there was a declining trend in real risk premiums for the broad market since the 1950s, to a current level of about 2% to 3%. He also concluded that inflation contributed to a transitory increase above the trend in the 1970s and to a transitory decrease below the trend in the 1980s. However, Blanchard finds that real risk premiums were negative throughout much of the 1980s, which leads to the question as to whether the method he used to measure risk premiums is consistent with the basic risk/return tenet of financial theory.

II. Risk Premium Method and Data Sources

In our study, risk premiums for the electric utility industry are based on quarterly cost of equity estimates from 1980 through 1993 for a sample group of 30 electric utilities. Companies in the sample group met the following selection criteria over the review period: 1) principally remained an electric utility company, 2) did not file for Chapter 11 protection, and 3) continuously paid dividends.

Cost of equity estimates were obtained using the constant-growth form of the DCF model:

$$k_e = \frac{D_1}{P} + g \tag{1}$$

where

k_e = cost of common equity

D_1 = expected annual dividend per share in the coming year

P = current stock price

g = expected growth rate in dividends per share

Brigham et al. (1985) used a two-stage DCF model to estimate the cost of equity and noted that utility companies "meet the conditions of the constant-growth DCF model rather well." The DCF model is also appropriate for utility stocks, perhaps more than for other stocks, because a significant portion of a utility stock's required return is reflected in the dividend yield component.[1] Constant-growth forms of the DCF model were also used by Harris (1986) and Harris and Marston (1992).

[1] Hansen, Kumar, and Shome (1994) found that traditionally high dividend payout ratios in the electric utility industry provided a cost effective means to monitor and manage agency costs related to stockholder-manager and stockholder-regulator conflict.

Data for the DCF model were obtained from *The Value Line Investment Survey*. Part 1, the Summary and Index section of *Value Line*, contains an estimate of the expected dividend yield (D_1/P) over the next 12 months. The dividend yield for each sample company was based on the *Value Line* yield figure published in the last week of each quarter.

Each company's quarterly growth rate estimate was based on the average of three projected measures: *Value Line*'s projected growth rate in earnings and dividends per share and the projected percentage of common equity retained. The last of the three growth measures is equivalent to the familiar b(r) method of estimating a growth rate. *Value Line*'s growth rates represented a readily available and consistent set of projected growth rates over the study period. Projected growth rates were used in order to be consistent with the ex ante measurement of risk premiums for the study.

The three-month average yield on 30-year Treasury bonds was used as the reference rate. It was subtracted from each company's quarterly cost of equity estimate to derive a risk premium. The risk premiums for each company were then averaged to develop a quarterly risk premium for the electric utility sample.

III. Empirical Results

Figure 1 provides a graph of the observed risk premiums and interest rates. It shows a general inverse trend between the two measures over the period studied. We note that the trend closely resembles the one observed by Brigham et al. (1985). The average interest rate over the study period was 9.77%, and the average risk premium was 3.21%.

To estimate the relationship between electric utility risk premiums and interest rates, we fit a simple linear regression model. Model 1 specifies the regression equation. The risk premium is the dependent variable, and the 30-year Treasury bond yield is the independent variable.

A. Model 1

$$RP_t = \alpha + \beta(TB_t) + \varepsilon \tag{2}$$

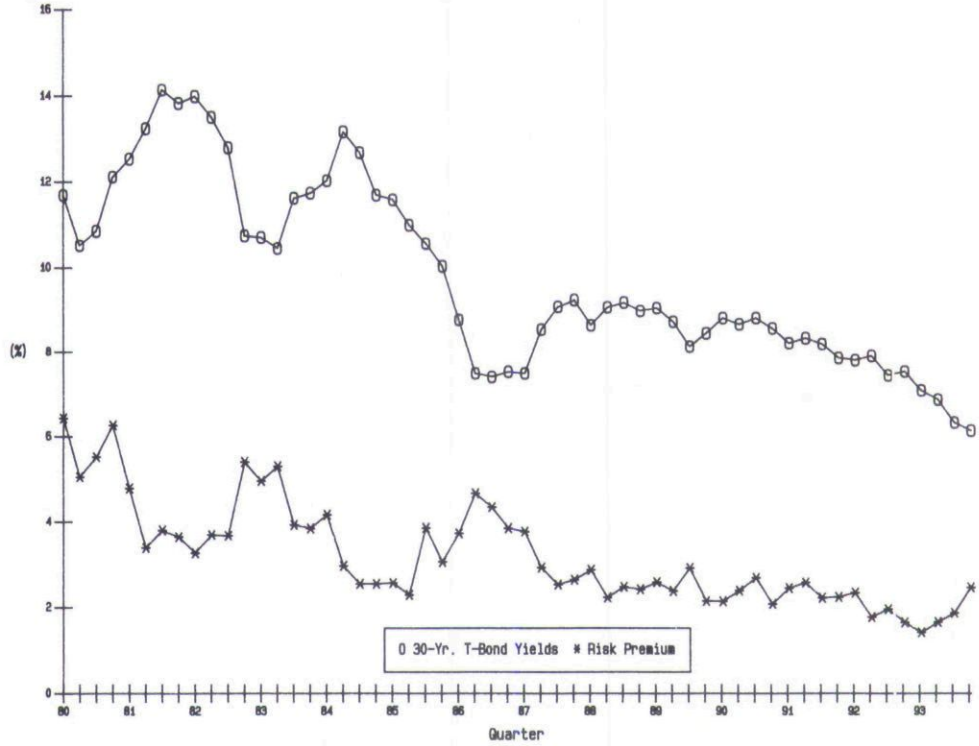
where

RP_t = quarterly average risk premium for all utilities

TB_t = quarterly average 30-year U.S. Treasury bond yield

Initially, we examined our data over the same 1980-1984 time period used by Brigham et al. (1985) and achieved similar results. Expansion of the study period through 1993 produced markedly different results. For example, the adjusted R^2 for Model 1 for the 1980-1993 period was only

Figure 1. Observed Risk Premiums and Treasury Bond Yields Over the Sample Period



0.22, which sharply contrasts with the 0.73 R^2 reported by Brigham et al. (1995) for the 1980-1984 period.

Figure 2 is a graph of all the risk premium data points in the study period for the electric utility industry, with respect to the interest rates at which they were observed. Figure 2 illustrates that there was a divergence in risk premiums that corresponded to interest rates of the same general level during the study period. If a single linear relationship held throughout the observation period, then one would expect very similar risk premium observations at the same general interest rates. This observation led to the hypothesis that perhaps the relative risks of debt and equity were changing over time.

Alternative models were tested to empirically capture the dynamic relationship between risk premiums and interest rates (see Johnston, 1984). We determined that the model specified below was more appropriate than Model 1 for estimating risk premiums over the study period because it would capture this dynamic relationship.

B. Model 2

$$RP_t = \alpha_0 + \alpha_1(D1_t) + \alpha_2(D2_t) + \alpha_3(D3_t) + \alpha_4(D4_t) + \beta(TB_t) + \varepsilon \quad (3)$$

where

RP_t = quarterly average risk premium for all utilities

$D1_t$ = binary variable equal to 1 for Quarter 2-1984 through Quarter 4-1993, and 0 otherwise

$D2_t$ = binary variable equal to 1 for Quarter 1-1987 through Quarter 4-1993, and 0 otherwise

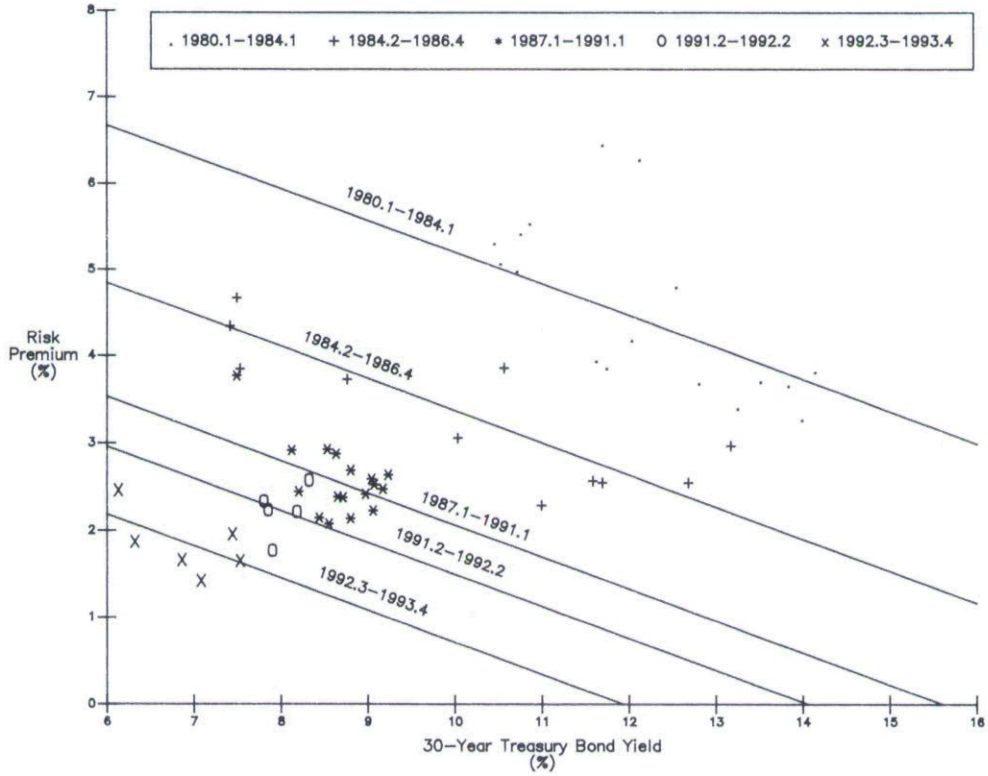
$D3_t$ = binary variable equal to 1 for Quarter 2-1991 through Quarter 4-1993, and 0 otherwise

$D4_t$ = binary variable equal to 1 for Quarter 3-1992 through Quarter 4-1993, and 0 otherwise

TB_t = quarterly average 30-year U.S. Treasury bond yield

The binary variables in Model 2 are included to account for major changes in the relative risks of debt and equity. These changes in relative risk would be reflected as shifts in the level or magnitude of the risk premiums, regardless of the behavior of Treasury bond yields. We did not attempt to determine specific factors that might account for such shifts. Cumulative sum of error tests (see Hall, Johnson, and Lilien, 1990) and break-point Chow tests (see Pindyke and Rubinfeld, 1991) were used to determine the placement

Figure 2. Observed Risk Premiums Plotted Against Treasury Bond Yields



of the binary variables. These tests indicated that significant shifts in the market's evaluation of the relative risk of debt and equity most likely occurred in 1984, 1987, 1991, and 1992.

Table 1 reports the results of fitting Equation (3). These results indicate an inverse relationship between ex ante risk premiums and interest rates over the sample period. A first-order autoregressive correction was made to adjust for the possibility of serial correlation during the sample period (see Johnston, 1984, pp. 321-324). The adjusted R^2 for Model 2 is 0.82. All variables are statistically significantly different from zero at the 0.01 level, except for D3 and D4, which are significant at the 0.05 level. As anticipated, the coefficient estimate of the Treasury bond variable is negative, which indicates the existence of a general inverse relationship between interest rates and risk premiums over the study period.

It is important to note that Model 2 identifies the basic relationship between risk premiums and interest rates, which is defined by the slope coefficient β, as statistically stable over the sample period. Stability of the Treasury bond slope coefficient over the study period was supported by statistical tests that permitted the slope coefficient to change.

C. Interpretation of Empirical Results

The inverse relationship indicated in Table 1 represents approximately 37 basis points for each 100 basis-point change in Treasury bond yields. This result is consistent with the Harris and Marston (1992) study, which found a 36 basis-point inverse relationship between long-term government bond rates and risk premiums for a broader sample of companies for the 1982-1991 period. However, our utility risk premium values are lower than those reported by Harris and Marston for the broader market. One might expect such a difference between the risk premium for utility stocks and the broader market, due to the relatively lower risk of utility stocks.

Harris and Marston found that changes in relative risk, as proxied by a yield spread variable, were important in explaining risk premium changes in subperiods between 1982 and 1991. They also noted, however, that the yield spread variable was more significant in the early 1980s and less significant in the latter 1980s. This phenomenon may be embedded within our intercept dummies, which also exhibited a declining level of magnitude and significance. Interestingly, the break-points for Harris and Marston's

Table 1. Model 2 Regression Results[a]

This table reports the results of fitting Equation (3). The risk premium is the dependent variable.

Variable	Coefficient	Standard Error	t-statistic
Intercept	8.880	0.776	11.444***
TB	-0.368	0.063	-5.878***
D1	-1.828	0.250	-7.318***
D2	-1.309	0.234	-5.598***
D3	-0.569	0.277	-2.051**
D4	-0.773	0.333	-2.320**
Adjusted R^2	0.815	Durbin Waston statistic	1.920

***Significant at the 0.01 level.
**Significant at the 0.05 level.

[a]Regressions were corrected for the possible existence of serial correlation using the Cochran-Orcutt method.

sub-periods closely approximate the break-points indicated by our tests.

Trends in the overall level of risk premiums provide one of the more intriguing comparisons between our results and those of Harris and Marston. Both studies support an inverse relationship throughout similar study periods. However, the late 1980s and early 1990s produced some of the highest risk premiums in Harris and Marston's study, while the same period produced some of the lowest risk premiums observed in our study. These results may be indicative of higher perceived risk for their broader sample relative to our utility stock sample during this period. Electric utility companies generally have significantly lower reported values for beta than would be reported for a broad market sample of companies. While beta is a somewhat controversial measure of risk, Harris and Marston report a significant positive relationship between beta and risk premiums.

Our results indicate that ex ante risk premiums for electric utility stocks remained inversely related to interest rates over the study period when changes regarding the market's evaluation of relative risk are taken into account. We acknowledge the limitation that our regression model is descriptive of the study period only; however, some measure of robustness would appear to be imparted by the fairly wide range of market climates in our study period.

During the study period, any number of events could have had an impact on the relative risks of debt and equity.[2] In all likelihood, this relationship will continue to be affected by innumerable future events. The projected growth rates for utility dividends and earnings during the early 1980s were viewed by some as too high to be sustainable and therefore not reasonable proxies for the long-run growth rate the DCF model requires. Interestingly, the projected dividend and earnings growth rates for the early 1990s have been viewed by some as too low. Therefore, results of a descriptive model developed from ex ante measures over a period of time can help to provide a reasonableness check concerning an estimate at one point in time.

IV. Usefulness of the Model

In developing cost of equity recommendations, the staff of the Virginia State Corporation Commission (VSCC) presently includes ex ante risk premium methods based on the information presented in this study as well as others. For example, the VSCC staff incorporated an earlier version of the model presented in this paper to formulate a cost of equity recommendation for The Potomac Edison Company in a 1993 rate case. At that time, the model included data from 1980 to 1991, which indicated two shifts in the level of risk premiums, one in the second quarter of 1994 and the other in the first quarter of 1987. The estimated slope coefficient at that time was -0.395, or roughly 40 basis points for each 100 basis-point change in interest rates.

Using the 6.3% average yield on 30-year Treasury bonds from July 1993 to September 1993, the model indicated a risk premium of 3.4%. Combined with the 6.3% interest

[2]Over the study period, the relative risks of debt and equity could have been affected by such factors as changing monetary policy, concern over the growing budget deficit, the savings and loan debacle, the Continental Illinois Bank crisis and other bank industry problems resulting from defaulted loans to developing countries, the leveraged buyout binge of the 1980s, and the 1987 stock market crash, to name a few.

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rate, this risk premium produced a 9.7% cost of equity estimate. The VSCC staff also adjusted the average risk premium for the study period based on the model's slope coefficient to obtain a cost of equity estimate for the current level of interest rates. Using this approach, the 3.9% difference between the average interest rate over the study period (10.2%) and the recent 3-month average rate (6.3%) was multiplied by the approximate slope coefficient of 0.4%. The resulting 1.6% was then added to the 3.4% average risk premium for the study period to incorporate the inverse relationship between Treasury yields and utility equity risk premiums. This approach indicated a current risk premium of 5.0%, which indicated a current cost of equity of 11.3% when combined with the 6.3% interest rate. A 10 basis-point flotation cost adjustment was added to both estimates, thus providing cost of equity estimates of 9.8% and 11.4% from the risk premium study. The Potomac Edison Company's requested rate increase reflected a 12.50% return on equity (and increased rates had been in effect on an interim basis subject to refund since September 28, 1993). Ultimately, the VSCC authorized a cost of equity range of 10.4% to 11.4% in its Final Order issued on November 18, 1994.

In addition to providing the basis for a supplemental cost of equity estimate, our risk premium study may be applicable in a more relaxed regulatory framework. For example, in its investigation of alternative regulatory methods for local telephone companies, the VSCC established a number of regulatory options for local telephone companies in Case No. PUE930036. The Earnings Incentive Plan option in that case included the provision for an annually authorized return on equity range that would span 300 basis points and be based on a risk premium approach that recognizes an inverse relationship between risk premiums and interest rates. The risk premium for the bottom of the range in each year would be established as 2.0%, plus 0.5 times the difference between 10.0% and the three-month average yield on 30-year Treasury bonds from September through November of the preceding year. The risk premium for the top of the range would be determined in the same manner, except that the calculation would start with a base level of 5.0%. The resulting risk premiums (subject to the constraint that they cannot be less than zero) are added to the same three-month average yield on 30-year Treasury bonds in the risk premium formula to produce the cost of equity range. The average interest rate and risk premium from a study such as ours could easily be incorporated within a plan like the one developed by the VSCC. While the VSCC's plan did not incorporate a provision for the sharing of earnings, one could be included so that returns above the banded range could be shared.

V. Conclusions

This study furnishes evidence that equity risk premiums are not constant. Our results indicate a statistically significant inverse relationship between interest rates and utility equity risk premiums. Yet, considering that our study covers a recent 14-year period, the hypothesis of a constant ex ante risk premium should also be tested over a longer period. It would also be interesting to test whether the long-term average of ex ante risk premiums converges with the long-term average of ex post risk premiums. ■

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