those produced by the CAPM or DCF models, as found by Ahern (2016). The attractive feature of the PRPM is that it is predicated on actual investor decisions rather than on judgmental investor expectations. The model can also be used to analyze the impact of individual events on the cost of equity, a change in bond rating for example, or the impact of adoption of a given risk-mitigator, similar to the use of "event studies" in financial analysis. One minor challenge is that the model requires a lengthy time series history of stock returns data to develop reliable and stable estimates of risk premia. The PRPM methodology is progressively becoming mainstream as part of the arsenal of techniques to estimate the cost of equity capital in regulatory proceedings.

It is fair to say that practitioners may find the modeling methods and the use of relatively advanced econometric methods rather cumbersome at first. But one should take comfort in the fact that the software for performing these estimations is readily available from two commonly available software packages: EViews© and SAS©.

5.7 Risk Premium Determinants

Fundamentally, the primary determinant of expected returns is risk. To wit, the various paradigms of financial theory, including the CAPM and the Arbitrage Pricing Model (APM) covered in subsequent chapters, posit fundamental relationships between return and risk. There are also secondary influences on the relative magnitude of the risk premium, however, including the level of interest rates, default risk, and taxes.

Risk Premium and Interest Rates

There is an abundance of academic research that supports the notion that the risk premium shrinks as interest rates decline. The reason for this relationship is that when interest rates rise, bondholders suffer a capital loss. This is referred to as interest rate risk. When interest rates rise, a previously issued bond paying a fixed contractual return will become a less desirable investment, falling in price. This is because any change in the bond's required return can only be accomplished through a capital loss, since the bond's contractually fixed interest payments do not vary over its life. Stockholders, on the other hand, are more concerned with the firm's earning power. So, if bondholders' fear of interest rate risk exceeds shareholders' fear of loss of earning power, the risk differential will narrow and hence the risk premium will shrink.

This is particularly true in high inflation environments. Interest rates rise as a result of accelerating inflation, and the interest rate risk of bonds intensifies more than the earnings risk of common stocks, which are partially hedged from the ravages of inflation. This phenomenon has been termed as a "lock-in" premium. Conversely in low interest rate environments, when bondholders' interest rate fears subside

and shareholders' fears of loss of earning power dominate, the risk differential will widen and hence the risk premium will increase.

Published empirical studies demonstrate that risk premiums vary inversely with the level of interest rates, rising when rates fell and declining when interest rates rose. Studies by Brigham, Shome, and Vinson (1985), Harris (1986), Harris and Marston (1992, 1993), Carleton, Chambers, and Lakonishok (1983), and Morin (2020), and others demonstrate that, beginning in 1980, risk premiums varied inversely with the level of interest rates — rising when rates fell and declining when interest rates rose.[23]

Harris (1986) showed that for every 100 basis point change in government bond yields, the equity risk premium for utilities changes 51 basis points in the opposite direction, for a net change in the cost of equity of 49 basis points. For example, a 100 basis point decline in government bond yields would lead to a 51 basis point increase in the equity risk premium and therefore an overall decrease in the cost of equity of 49 basis points, a result almost identical to the 0.46 estimate shown in Figure 5-4 from a 2020 rate case.[24] Similar results have been reported by several financial experts who examined the statistical relationship between risk premiums and interest rates using a sample of natural gas distribution utilities.[25]

The Harris and Marston (1990) study concluded that there exists a strong negative relationship between interest rates and risk premiums. The article observed that:

> *....Exhibit 6 shows that the market risk premium is affected by interest rate conditions. The large negative coefficient on government bond rates implies large reductions in the equity risk premium as interest rates rise.*

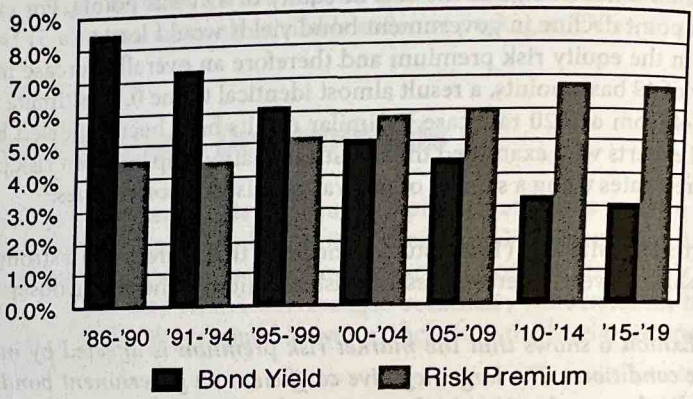
Harris and Marston also noted:

> *[T]here appears to be a significant negative link between the equity risk premium and government interest rates. The quarterly results in Exhibit 7 would suggest about a 50 basis point change in risk premium for each 100 basis point movement in interest rates. [T]he results suggest that use of a constant risk premium will not fully capture changes in investor return requirements.*

23. See, *e.g.*, Willard T. Carleton, *et al.*, "Inflation Risk and Regulatory Lag," 38 *The Journal of Finance* 419–43 (1983); Eugene F. Brigham, *et al.*, "The Risk Premium Approach to Measuring a Utility's Cost of Equity," 14 *Financial Management* 33-45 (1985); Robert S. Harris, "Using Analysts' Growth Forecasts to Estimate Shareholder Required Rates of Return," 15 *Financial Management* 58–67 (1986); Robert S. Harris & Felicia C. Marston, "Estimating Shareholder Risk Premia Using Analysts' Growth Forecasts," 21 *Financial Management* 63-70 (1992); and Farris M. Maddox, *et al.*, "An Empirical Study of Ex Ante Risk Premiums for the Electric Utility Industry," 24 *Financial Management* 89-95 (1995).
24. See Morin (2020)
25. See for example Gorman (2019), VanderWeide (2018) and McKenzie (2018)

The gist of the empirical research on this subject is that the cost of equity has changed only half as much as interest rates have changed in the past. The knowledge that risk premiums vary inversely to the level of interest rates can be used to adjust historical risk premiums to better reflect current market conditions. Thus, when interest rates are unusually high (low), the appropriate current risk premium is somewhat below (above) that long-run average. The empirical research cited above provides guidance as to the magnitude of the adjustment. The inverse relationship can easily be seen by a simple bar graph plotting the risk premium against the level of interest rates. Figure 5-5 shows the relationship in graphical form. As bond yields decrease (black bars), the risk premium increases (gray bars).

Figure 5-5
Risk Premium vs Interest Rates



Regulators have recognized this relationship as well. The California Public Utility Commission recognizes that the cost of equity does not move in tandem with interest rates, and its long-standing practice has been to adjust the cost of equity by one-half to two-thirds of the change in bond yields.[26] The widely-used risk premium formula used by Canadian regulators also assumes this inverse relationship between interest rate levels and the risk premium.

As articulated earlier, the reason for this relationship is that when interest rates rise, bondholders, whose interest rates are fixed, often suffered a decrease in the market value of their bonds, experiencing a capital loss. This is referred to as interest rate risk. Stockholders, on the other hand, are more concerned with the firm's earning power. If bondholders' fear of interest rate risk exceeds shareholders' fear of loss of earning power, the risk differential will narrow and hence the risk premium will shrink. This is particularly true in high inflation environments.[27] Interest rates rise as a result of

26. See for example CPUC Decision 08-05-035 (May 29, 2008).
27. Higher inflation rate is often the culprit for the rise in interest rates. Inflation has a more negative effect on bonds than on common stocks because common stocks offer a hedge against inflation through the ability to adjust prices in response to rising price levels. As a result, stocks are relatively less risky as inflation rates (and bond yields) rise, and the equity risk premium declines.

accelerating inflation, and the interest rate risk of bonds intensifies more than the earnings risk of common stocks, which are partially hedged from the ravages of inflation. This phenomenon has been termed as a "lock-in" premium by some analysts. Conversely, in low interest rate environments, as is the case currently, when bondholders' interest rate fears subside and shareholders' loss of earning power dominate, the risk differential will widen and hence the risk premium will increase.

Taxes

Significant changes in the relative taxation of returns received from stocks and bonds can also influence risk premiums. Measured risk premiums will in fact incorporate investor adjustments to relative taxation rates, since it is pre-tax risk premiums that are measured from capital market data rather than post-tax quantities.

Some analysts have therefore argued that there should be an adjustment for taxation differentials between securities and investors. This presents a gargantuan practical problem, however. If a regulatory commission were to seek to enable the utility to compensate investors for their after-tax returns, there could be as many returns as there are tax bracket variations, and they would defy analysis. It is impractical to determine the constellation of tax brackets for all the company's shareholders, and to determine the identity and tax bracket of the marginal price-setting investor. This argument ignores the fact that several institutional investors are not taxable, such as pension funds, and they engage in very large amounts of trading on security markets. Taxable retail investors are relatively inactive traders when compared to large non-taxable investors who have a substantial influence on capital markets.

Fundamentally, the core determinant of expected returns is not taxability, it is risk. Taxable investors will examine the risk-return tradeoff offered by various securities first, and as a secondary matter, the taxability issue.

Not only is it unrealistic to attempt to target tax clienteles in issuing securities but this presents investors with a serious practical dilemma. If a utility could target non-taxable investors only for bonds, it would follow that a coupon considerably less than the current return on common equity would be acceptable, since the bonds have much lower risk. But when the buyer of such bonds decided to sell securities, he or she would confront a serious dilemma because the taxable would-be buyers would require vastly higher returns (would be willing to pay a much lower price). The seller would face a large capital loss on resale, or would be forced to sell the bonds to other non-taxable investors. But the latter would have no incentive to trade with the seller, because they would have the opportunity of purchasing many other alternative securities providing a higher yield.