THE IMPACT OF THE MATURITY AND SOURCE OF THE RISK-FREE RATE IN EQUITY ESTIMATION UNDER THE CAPM

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There is divergence of opinion among academics and practitioners on the appropriate maturity and source of the risk-free rate when applying the Capital Asset Pricing Model (CAPM). For projects with betas near one, this divergence should be immaterial. What is not clear is how far project betas can diverge from one before these differences become significant. This cannot be readily ascertained perusing risk-free rate and market risk premium values published in textbooks and research since different data sets are used. Using standardised, readily available data sets and employing the methodologies proposed by three popular corporate finance textbooks, the results of this paper indicate that, except for a very narrow set of circumstances for betas near one, different risk-free rate maturity and source choices can significantly impact project selection via expected equity returns. However, even though statistically significant, for a given data source (current/historical) the maturity choice is well within cost of capital estimation variation expected by practitioners. For a given term, more variation occurs across source selection. Since the practitioner may have to justify the input parameters used for estimating equity costs for capital budgeting projects, this study focuses on the empirical consequences of choosing a particular set of CAPM input parameters over alternatives.

INTRODUCTION

This paper focuses on the consequences of using different estimators for the risk-free rate as input for the capital asset pricing model (CAPM), a core component of the weighted average cost of capital (WACC). There are competing schools of thought on the appropriate inputs, primarily focused on risk-free rate maturities and source. One school argues the risk-free rate should be as riskless as possible and espouses using T-Bills for input. Maturities of 90-days (Brealey, Myers and Allen (2011)) (BMA) or one-year (Ross, Westerfield and Jaffe (2013)), (RWJ) have been proposed. The other school argues that the maturities of the evaluated projects should be reflected in CAPM inputs and espouses a long-term risk-free rate such as a 10-year Treasury Note (Brigham and Ehrhardt, (2013)) (BE). In addition to a lack of consensus on maturity, there is divergence of opinion on the source of the risk-free rate. BE propose using current data for Treasury inputs whereas both BMA and RWJ suggest using a proxy T-Bill calculated using combined historical and current data. To assess which of these schools of thought is theoretically correct is a Sisyphean task. The major objective of this paper is to empirically assess the significance of selecting one risk-free rate over another from both a statistical and material viewpoint. For stocks with betas of one, the choice of risk-free rate and its source should be immaterial since it self effaces and the expected stock return depends on the expected market return. The selection of one term over another may be significant for stocks with betas other than one since for a given market return the use of the 90-day Treasury versus the 10-year in the CAPM can produce widely varying expected stock returns and affect project decisions. One purpose of this study is to determine just how far a stock's beta can diverge from one before this decision becomes statistically significant. Perusing textbooks provide little guidance since various data sources are used. By comparing the competing models using a standardised set of data inputs we find that, in general, with the exception of using the current MRP with betas surrounding one, the choice of both maturity and source for the risk-free rate produces results that are statistically different. While this result is not unexpected, to our knowledge, this is the first time that it has been statistically documented.

This knowledge can be important for finance professionals since their practices reflect the diversity of opinion found in academe. The Association of Finance Professionals (AFP) 2013 survey finds a range of Treasury maturities for the CAPM. The overwhelming majority of practitioners (64 percent) prefer longer term rates varying from 5 to 30 years, with the most predominant (39 percent) being 10-year. Twenty-nine percent use short-term rates (90-day and one-year). Current rates are the most popular source with just under half of the respondents using them. Thirty-one percent used a historical rate and 18 per cent used a forecasted rate. The divergence of academic opinion on CAPM input parameters is reflected in practice and supports the case for statistical knowledge of choice implications.

In addition to measuring the statistical ramifications of Treasury choices, this study also examines implications for the magnitude of the differences in expected stock returns generated using different treasury maturities and sources as inputs. For example, if company has a stock beta of 1.15 and it uses the 10-year Treasury, how different is the resulting CAPM expected return compared to using the one-year Treasury? If a company decides on the 10-year Treasury, how different is the result if current versus historical rates are used? Even if the statistical test component of this study determines that the differences are significant, how big are they and are they within acceptable tolerances?

Practitioners realise that CAPM, and by extension, WACC estimates are subjected to error and have opinions on its magnitude. According to the 2013 American Finance Professionals (AFP) survey, cumulatively 56 percent believe that their WACC is precise to within 50 basis points and 89 percent believe that their WACC calculation is correct to 100 basis points.[1] Put into perspective, even if the above-mentioned 1.15 beta stock has a statistically significant difference in CAPM expected returns when comparing current 90-day versus 10-year Treasuries, if the difference is 18 basis points, that is well within error tolerances accepted by most practitioners. Choosing one Treasury maturity over another may be statistically significant, but not so materially. Our results confirm most practitioners' beliefs that the relative accuracy of their WACC calculations is within 100 basis points. For the sample used in this study, for a given Treasury/Market return source (current/historical), the highest average divergence of CAPM derived stock returns between using 90-day, one-year and 10-year Treasuries is 55 basis points. In other words the effect of selecting a 90-day or 10-year Treasury as opposed to one-year has a minimal effect on equity estimation, and in turn, on WACC estimation. Differences are more pronounced when the data source for a given maturity range varies. The largest average return variation, 122 basis points, occurs when current versus historical 10-year Treasuries are used. This approaches the upper range of WACC estimation errors expected by practitioners. [2]

A corollary contribution of this paper is a succinct exposure to the reader of commonly- proposed alternatives to CAPM input parameter estimation that she may not have encountered in the classroom. This understanding is paramount for the practitioner to explain why the firm's adopted standard for CAPM input parameter selection is either superior to or compares with alternatives when questioned by peers, superiors, board members or others.

BACKGROUND

The WACC is the most widely used method of estimating project discount rates (Bruner, Eades, Harris and Higgins

(1998), Payne, Heath and Gayle (1999), Gitman and Vandenberg (2000), Graham and Harvey (2001), Ryan and Ryan (2002). Within the WACC, the CAPM is the most widely used method by practitioners to estimate the cost of equity (AFP survey, Graham and Harvey, Gitman and Vandenberg, Bruner, Eades, Harris and Higgins). The CAPM's estimation of stock returns, E(Rs) = Rf + β[E(RM) – Rf], comprises the following inputs: the risk-free rate (Rf), expected market return (E(RM)) and beta (β). The risk-free rate is used as a standalone input as well as for the determination of the MRP which is given by E(RM) – Rf. Treasury instruments are invariably used for the risk-free rate. For a given market return, there are two ways that the selection of the risk-free rate impacts expected returns. First, given a significantly sloping yield curve, the selection of short-term versus long-term Treasuries produces different returns and they are magnified as a stock's beta deviates from one. For betas of one, if the same Rf is used for the stand-alone rate and MRP calculation, the term cancels out and Treasury maturity shouldn't matter. Second, for a given beta and maturity selection a stock's return can vary by risk-free rate input if current risk-free rates are used for the stand-alone input and historical rates are used for MRP input. This study is designed to ascertain at what beta levels do stock returns significantly differ when different Treasury maturities and bases (current/historical) are inputs.

Textbook authors have espoused various reasons for choosing either short-term or long-term maturities for the Treasuries selected. BMA (p. 219) and RWJ (p. 404) both argue that the CAPM is a short-term model and requires short-term Treasury inputs. BMA choose the 90-day T-Bill and proxy it by deducting a historical risk premium of 1.5 percent from current long-term bonds (p. 220). Their justification is that T-Bills are extremely volatile compared to long-term Treasuries and their process adjusts for this. At press time their risk-free rate estimation was 1.8 percent (p. 220). [3]

RWJ have the same perspective as BMA but choose the one-year T-Bill. They proxy current one-year T-Bill rates by subtracting a historical risk premium of 2.5 percent from current 20-year Treasury bonds (p. 404).[4] Their estimate was 1.0 percent at press.[5]

In contrast BE argue that most projects are long-term and so should be the Treasury maturity for CAPM input (p. 370-371). They espouse using the current 10-year T-Note rates in the CAPM. Their estimate was 5.0 percent in the example demonstrated in their textbook.

While disagreeing on maturity, the authors agree that the stand-alone risk-free rate input in the CAPM (Rf) should be based on current Treasuries. However, only BE use the actual current Treasury rate. BMA and RWJ's risk-free rate is a hybrid of current rates and historical risk premiums. There are also variegated opinions on the second function of the risk-free rate, determination of the MRP: $(E(R_M) – R_f)$. It can be based on either current or historical data.

BMA (pp. 158-163) suggest that the MRP can be calculated using the historical difference between market returns and T-Bills (7.1 percent, p. 160). They note this can understate or overstate current risk premiums and suggest an alternative method based on inputting historical market returns into the dividend growth model (DGM): RM = D1 / P0 + g, where RM is return on the market, D1 is the next year's dividend, P0 is the current stock price and g is the expected dividend growth rate. They state that historical market dividend yields were 4.3 percent with a growth of 5.3 percent yielding a market return of 9.6 percent. When historical T-Bill rates of 3.0 percent are subtracted, the MRP is 6.6 percent. BMA's CAPM inputs are mixed with respect to the risk-free rate. BMA use proxied current rates for the stand-alone input and historical rates to calculate the MRP.

RWJ (pp. 404-405) suggest that the MRP can be calculated using the historical difference between market returns and T-Bills (7.0 percent). They also offer an alternative method based on inputting current market returns into the DGM. At their press time current market dividend yields were 2.1 percent with a growth of 6.0 percent yielding a market return of 8.1 percent. When proxied current one-year T-Bill rates of 1.0 percent are subtracted, their MRP is 7.1 percent. RWJ use proxied current rates for the stand-alone risk-free rate input and either proxied current or historical T-Bill rates for calculating the MRP.

BE (pp. 367-369) also note that the MRP can be calculated based on the historical difference between stock and T-bond returns (6.6 percent). They also suggest that a current MRP can be calculated by inputting S&P information into the DGM resulting in an RM of 6.56 percent in their text. When the current 10-year T-bond yield is subtracted they get a current (April 2012) MRP of 4.37 percent.

In summary, when future practitioners of corporate finance seek advice from academe on inputs into the CAPM, depending on the text they use, or even pages within the text, they get estimates from 1.0 percent to 5.0 percent for the risk-free rate and MRP estimates from 4.37 percent to 7.1 percent. These widely-dispersed estimates will obviously produce different capital costs, which could quite possibly change project net present values. One of the main causes of this disparity is that different data sources are used by the authors. This study seeks to determine if these disparities still exist when a common data set is employed to compare the competing risk-free rate input methods.

These divergent approaches are reflected in practice. The AFP survey finds quite a bit of diversity in Treasury maturity for the CAPM. Overall, 29 percent of practitioners opt for a short-term rate, with 17 percent preferring the 90-day Treasury and the remainder the one-year. The majority of practitioners (64 percent) prefer longer term rates. Thirtynine percent of respondent practitioners use the 10-year rate, 14 percent choose the 5-year rate, 7 percent prefer the 30-year bond, with 4 percent using the 20-year rate. With regards to source, current rates are the most popular source with 47 percent of the respondents using them. Thirty-one percent use a historical rate and 18 percent use a forecasted rate. Regarding the MRP, the AFP report is silent on the inputs used in its estimation. With respect to its magnitude, the MRP is quite dispersed with an approximately 20 percent distribution across: less than 3 percent, 3 percent to 4 percent, 4 percent to 5 percent, 5 percent to 6 percent and greater than 6 percent. In summary, among practitioners there is significant diversity of input selection not only between short-term and long-term Treasuries, but also within each category. This diversity is also present in the source of data and values for the MRP. These results further augur for a determination of the magnitude and significance of their differences.

Results of academic research parallels the AFP survey and highlights variation in the maturity and source of the risk-free rate used in the CAPM. Of the recent surveys on capital budgeting by Bruner, Eades, Harris and Higgins (1998), Payne, Heath and Gayle (1999), Gitman and Vandenberg (2000), Graham and Harvey (2001), Ryan and Ryan (2002), Jacobs and Shivdasani (2012) and Brotherson, Eades, Harris and Higgins (2013), only three, Bruner et.al, Jacobs et. al., and Brotherson et. al. query respondents on basis and maturity of the risk-free rate used in the CAPM. Overall the academic results parallel the AFP survey and indicate a dispersion of Treasury maturities from 90-days to thirty-years with some professionals preferring historical rates, others preferring current rates and still others preferring forecasted rates.

Advice on risk-free rate input into the CAPM dispensed by academe is inconsistent. Part of the problem is that different maturities are suggested. Another problem encountered is that published textbook examples occur at different times. A third issue is that the MRP may be calculated using either current or historical data. A fourth issue is that authors use different data sets and time horizons to determine Treasury spreads and historical market return premiums. This pedagogical diversity is reflected in practice. This study seeks to discover the effect on expected stock returns of Treasury maturity and basis (current/historical) by untangling some of the confounding issues via a standardised data set.

DATA AND ANALYSIS

To eliminate variability caused by using different data sources and time frames, standardised data sets are used to calculate inputs. Historical Treasury data was gathered from the St. Louis FRED® database and the market return data is derived from Ibbotson (2013). More specifically, monthly return data from 1957 to 2012 are used to calculate Treasury spreads and market returns. The beginning year was necessitated by the availability in the FRED® database. Current Treasury yields are obtained from the US Treasury. For consistency between beta calculations and CAPM inputs, December 2012 is considered current for Treasury yields and market returns. The current market yield is calculated using the DGM with the S&P 500 dividend yield obtained from www.multpl.com and estimated growth derived from money.cnn.com. CRSP monthly stock and market returns from 2008 to 2012 are used to calculate betas.[7] To eliminate outlier effects, we keep only betas from 0.55 to 1.55 for this study.

Assuming the same market return, when current risk-free rate data are used as the stand-alone input as well as to estimate the MRP, the maturity chosen should be immaterial for stocks of betas around one. This study seeks to determine at what, if any, beta levels do estimated costs of equity statistically diverge when different maturity Treasury rates are used in the CAPM. To accomplish this objective, betas are separated into 10 basis-point groups starting at 0.55-0.65 and ending at 1.45-1.55. This creates 10 paired groups of betas to test over. We then perform t-tests comparing calculated CAPM E(Rs) using current 90-day T-Bill inputs (BMA) to those using current one-year T-Bills (RWJ). Since these are both short-term rates and should produce comparable E(Rs) we should not expect much difference for betas near one. We then test the results from current 90-day T-Bill inputs to current 10-year T-Note inputs (BE). We would not expect to see much difference for betas of around one since the risk-free rate self effaces, but for other beta groups there should be differences. The real question is, how far is the deviation from one before significant differences occur? The expected stock returns using current one-year T-Bill inputs are then compared to current 10-year T-Note inputs. The results should be comparable to the 90-day / 10-year test.

These tests are repeated where the historical MRP is used in place of the current MRP. Since all the authors suggest using the current Treasury as the stand-alone risk-free estimator, and the equivalent maturity historical Treasury is used to calculate the historical MRP, the test results should differ from those above, possibly even for groups with betas near one.

The third set of t-tests compares beta-group sorted expected returns of current versus historical MRP inputs within each Treasury maturity range. The purpose of this test is to isolate the effect of choosing historical versus current MRPs. Finding no difference would indicate that the choice of MRP source is insignificant.

Table 1 summarises the risk-free rate and MRP estimator inputs. For BMA the proxied historical premium of 20-year T-Bonds over T-Bills of 1.59 percent is very near the 1.5 percent estimate that they suggest using, despite differences in the data sets used and time frame analysed. When subtracted from the current 20-year T-Bond (2.67 percent) the proxied 90-day T-Bill yield is 1.08 percent. For comparison purposes, in their text BMA calculate a

1.8 percent risk-free rate. The current 90-day T-Bill yield was 0.01 percent.

When the same process is applied for the one-year T-Bill, the spread was 1.07 percent, quite different from the 2.5 percent that RWJ find. Since the same data set is used by RWJ and this study, the difference is ascribed to the time frames utilised.[8] When subtracted from the current 20-year T-Bond (2.67 percent) the proxied one-year T-Bill yield is 1.60 percent. For comparison purposes, in their text RWJ calculate a 1.0 percent risk-free rate. The current value was 0.12 percent.

BE suggest using the current 10-year T-Bond rate of 1.98 percent, as opposed to a proxy. For comparison purposes, the authors use 5.0 percent in their text example.

To recap, the risk-free rates calculated in this study vary somewhat from those calculated by the authors at the times their texts were written. The yield curve produced using standardised data with the methodology suggested to estimate the risk-free rate espoused by the various authors is upward-sloping and has enough differences to suggest different returns for stocks with betas that vary from one. Again, the question is: how far is this variation before significant differences occur?

The current dividend yield of the S&P 500 was 2.13 percent with an expected 7.18 percent growth rate, providing a 9.31 percent market return utilising the DGM. When the respective current Treasury rates calculated above are subtracted, the respective current MRPs are 8.23 percent (BMA), 7.72 percent (RWJ) and 7.33 percent (BE). Historical market returns averaged 12.12 percent. The historical 90-day, one-year and 10-year Treasury rates were 4.58 percent, 5.10 percent and 5.95 percent, respectively. Subtracting the respective historical Treasury rates from market returns, the historical MRPs are 7.54 percent (BMA), 7.02 percent (RWJ) and 6.17 percent (BE).

In their examples of CAPM implementation, all the authors use a MRP of approximately 7.0 percent and acknowledge that it varies over time. Both the current and historical MRPs calculated in this study are close to this value and within acceptable tolerances. BMA believe that a range from 5.0 percent to 8.0 percent is reasonable. BE note that most analysts have MRPs that range from 4.0 percent to 7.0 percent. The authors' observations are consistent with practice reflected in the AFP survey.

Table 2 shows the means and standard deviations of expected returns by beta group using the risk-free rates and current and historical MRPs calculated in Table 1. As expected, when the current risk-free rate and MRP are used for the beta group surrounding one (0.95 – 1.05), expected return for the various authors is almost the same (9.32 percent – 9.34 percent). As the beta groups diverge from one, more variation is found in expected returns. For example, for the beta group 1.15 – 1.25 the returns vary from 10.76 percent to 10.84 percent. These results are consistent with the hypothesis that for a given beta group, equity returns will vary when different maturities are used for the risk-free rate.

Surprisingly, when historical MRPs (and current risk-free rate) are used the expected return for beta group 0.95 – 1.05 is the same (8.64 percent) for the 90-day (BMA) and one-year (RWJ) T-bills. This is due to the anomaly in the data set used in that the spread between the historical and proxied current 90-day T-bill (5.10 – 1.60 = 3.50 percent) is the same for the one-year (4.58 – 1.08 = 3.50 percent). Both are significantly different from the 10-year (5.95 – 1.98 = 3.97 percent). For beta groups diverging from one the difference is more significant. For instance, for the 1.15 – 1.25 beta group the expected returns vary from 9.37 percent to 10.01 percent.

Overall the summary data are supportive of the hypothesis that the selection of the risk-free rate in the CAPM will produce statistically significantly different expected returns for the same beta groups as these groups diverge from one. The summary data also supports the theory that for the same beta group and the same maturity risk-free rate the choice of current versus historical MRP's makes a significant difference. The question remains, where is the 'tipping point?'

Our inputs vary somewhat from what is found in the texts we are examining, which was expected given the different data sets and time frames used in the texts. Our standardised inputs allow us to focus on the effects of Treasury maturity selection. Table 3 shows the p-values for the tests holding the current and historical MRP values constant result in a difference in the stock expected return across textbooks. When we look at the results using the current MRP values, RWJ (one-year) is statistically similar to BMA (90-day) and BE (10-year) at the 10 per cent level of confidence for betas from 0.95 to 1.05. However, BMA and BE are statistically different. This latter result is surprising. Since the same (proxied) current risk-free rate is used as a stand-alone input and in the current MRP calculation, it should wash out for betas near one and results should be the same as for RWJ-BMA and RWJ-BE. This result suggests that the CAPM is very sensitive to risk-free rate maturity even for a beta group that varies only 0.05 from one. This conclusion is borne out by the fact that expected returns differ significantly for all other beta group comparisons using the current MRP and varying maturity Treasuries.

Using historical MRP values and stocks with betas between 0.95 and 1.05, the BMA methodology and the RWJ methodology produce similar results at the 10 percent level of significance. This result may be caused by the current-historical T-bill anomaly noted above. For all other tests, the expected return of the stock is statistically different for every beta grouping and Treasury maturity.

Overall these results document that, with some narrow exceptions for betas very close to one, the maturity chosen for the risk-free rate will significantly affect CAPM equity expected returns. We now turn our attention to the impact of using current versus historical MRPs within a given Treasury maturity.

Table 4 shows the statistical test for the difference in means using current and historical MRPs for the same Treasury maturity. In other words, for a given beta group using the same Treasury maturity, is there a significant difference in expected returns when using the current versus historical MRP? In every case, the difference in the expected return within each beta grouping is statistically different at any reasonable level of significance. The implication is that the choice of using the historical or current MRP for a given risk-free rate maturity will affect the expected return of the stock for any beta.

Taken together, the results document that the choices of risk-free rate maturity and historical versus current market returns are statistically important and can affect project selection. What is noteworthy is that the data source decision is more sensitive than the data maturity decision. We should note that these results are conditional on data used and subject to change as yield curve shifts and current versus historical rates converge or diverge. Additionally, our results are based on calculations using the same risk-free rate as a standalone input as well as the calculation of the MRP. Results can differ if an MRP value is selected using a different risk-free rate than the standalone.

Although the test results above validate the statistical differences in expected stock returns based on data source and Treasury maturity, the magnitude of the differences are within tolerances expected by practitioners. As reported in the AFP survey, cumulatively 89 percent of practitioners expect an error of up to +/- 100 basis points in their WACC calculations. However, not much of this estimation error is attributable to Treasury maturity selection within the CAPM. When the one-year historical Treasury is chosen over the 90-day, the average return difference is 13 basis points, the same difference when current rates are used (Table 5). The maximum deviation is 26 basis points and occurs for the largest beta group. When the 10-year historical Treasury is used over the one-year, the average difference is 51 basis points. The maximum deviation is 89 basis points and occurs for the largest beta group. When current returns are used, the average difference is 21 basis points with a maximum deviation of 45 basis points, again for the largest beta group. Results when the 10-year and 90-day Treasuries are compared are similar to the 10-year / one-year comparison, with a 55 basis points average return variation. For current returns the variation is 23 basis points. Overall the results indicate that for a given data source (historical/current) the effect of selecting a 90-day or 10-year Treasury as opposed to one year has a minimal effect on equity estimation, and in turn, on WACC estimation. Treasury maturity selection is not a major component of estimation variation in WACC calculations. These results suggest that most CAPM calculations used in practice produce downward biased NPV estimates since the majority of AFP survey respondents use long-term risk-free rates, which are usually higher than short-term.

More variation is found when the data source for a given maturity range varies. The average difference between current and historical returns using the 90-day T-Bills is 73 basis points with a maximum value of 103 for the largest beta group (Table 6). When current and historical returns are compared for the one-year T-Bill the average difference is virtually the same, 72 basis points with the maximum variation, 103 basis points occurring in the largest beta group. The difference becomes more pronounced when current versus historical 10-year Treasuries are used, with an average deviation across all beta groups of 122 basis points and a maximum of 173 basis points occurring for the largest beta group. These variations are at the upper range of WACC estimation errors expected by practitioners since WACC normally includes debt and possibly preferred stock as well. These results indicate that the downward project NPV bias produced by long-term interest rates is assuaged when current, as opposed to historical values are used.

Overall the results of Tables 5 and 6 indicate that the variation induced by the choice of the risk-free rate is in general within the tolerances expected by practitioners. The selection of the data source for a chosen Treasury maturity used for the risk-free rate in the CAPM is much more significant than the selection of a maturity within a particular data source.

CONCLUSION

There are two schools of thought regarding Treasury maturity inputs into the CAPM, short-term and long-term. Within each camp lies another decision as to the appropriate data source, current or historical. This study's contribution to our knowledge of finance is that, using a standardised data set and comparing various input selections, our statistical results confirm that except for stocks with betas near one, these choices create expected stock returns that differ statistically. They further confirm that the data source choice is more sensitive to variation that the maturity decision. However, statistical differences do not always foster consequential results. This study finds that for a given stock beta and data source (historical/ current) although differences encountered with the adoption of one maturity over another are statistically significant, the magnitude of the differences are within a range expected by practitioners. Larger differences are generated when the source for a given Treasury maturity varies. From a practitioner's standpoint, the data source decision is more important than the Treasury maturity one. The results of this study coupled with practitioner's beliefs can provide a fairly straightforward rule of thumb for project selection. A firm could calculate the Internal Rate of Return (IRR) on a project and compare that to its

WACC. If the IRR is greater than the WACC by 100 basis points or more, the firm can be reasonably confident of its WACC calculation regardless of Treasury inputs or source. Projects expected NPV may be somewhat inaccurate, but the basic decision to pursue or drop the project should be okay. Two other practices could further refine this process. First, just as textbooks cover project NPV scenario analysis based on different cash flow estimations, perhaps it is time to use two dimensional scenario analyses based on cash flow and WACC estimations. Second, just as accounting emphasises analysing budget variances to improve forecasting, perhaps finance could do the same thing for project selection based on the variances of estimated versus actual cash flows as well as discount rates.

In addition to a quantitative focus, this paper has a qualitative focus. When in school as students, textbooks normally espouse a particular (the authors' preferred) approach to CAPM inputs. This paper has summarised the nuances of the panoply of inputs for the CAPM. Practitioners should be well informed of alternatives when defending the rationale for the chosen corporate inputs.

NOTES

[1] These are cumulative totals. For 50 per cent it consists of those that believe the WACC is accurate without error, accurate to 25 basis points and accurate to 50 basis points. The same process holds for 100 per cent, it consists of those who consider their WACC accurate up to 100 basis points.

[2] In almost all cases, variations in CAPM stock return estimations are less than 100 per cent correlated with WACC variations since the WACC normally contains debt and possibly preferred stock components.

[3] BMA use returns data from 1900 to 2008 from Dimson, Marsh and Staunton (2002) with updates provided by the authors (p. 158).

[4] RWJ use returns data from 1926 to 2012 from Ibbotson SSBI 2012 Classic Yearbook (p. 310).

[5] The smaller risk premium (1.5) for BMA's historical 20-year 90-day Treasuries compared to RWJ's (2.5) 20-year one-year Treasuries should not occur for upward sloping yield curves. This is probably due to the authors' using different data sets.

[6] BE use returns data from 1926 to 2012 from Ibbotson SSBI 2013 Classic Yearbook (p. 246).

[7] This reflects standard industry practice as reflected in the 2013 AFP survey.

[8] Tests using the 90-day Treasury return in Ibbotson (the one-year T-bill is not in the data set) from 1926 to 2012 provide similar results.

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