Comment on the Cost of Capital
A Report for Envestra

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> A Comment on (1) the January 2011 Report by Professor Kevin Davis for the AER (Davis Report); (2) the January 2011 Report by Assoc. Professor John Handley for the AER (Handley Report); and (3) the "Envestra Ltd Access arrangement proposal for the Qld gas network 1 July 2011 – 30 June 2011" (Qld Gas Network Draft Decision).

1. This Comment is restricted to the implications of the Davis Report, the Handley Report and the Qld Gas Network Draft Decision for the conclusion contained in the Grundy Report titled "The Calculation of the Cost of Capital: A Report for Envestra." That conclusion was that estimates of the cost of equity obtained from the Sharpe CAPM as operationalized by the AER are downward biased for equities with betas less than one. Neither the Davis nor the Handley Report nor the Qld Gas Network Draft Decision contains any analysis that alters my initial conclusion.
2. I have been provided with and have read and complied with the Federal Court of Australian Practice Note CM7.

The Davis Report

3. Section 2 of the Davis Report considers a number of recent CAPM studies. Davis concludes that these studies

> …. suggest that there are alternate factors [to beta] which should be included in an unconditional CAPM reflecting either the conditional nature of the CAPM or the greater realism of the ICAPM. However, agreement on which additional factors are warranted has not been reached."

4. The empirical superiority of the Black CAPM over the Sharpe CAPM is consistent with the Black CAPM being a useful way of recognizing the additional factors that Davis concludes are missing from the Shape CAPM, irrespective of whether or not there is agreement on what those factors are.

5. The Davis conclusion does not suggest that the cost of equity should be determined by the implementation of the Sharpe CAPM proposed by the AER. The Davis conclusion does not address the empirical fact that the Sharpe CAPM exhibits a downward bias for low beta stocks.
6. The first paper considered in the Davis Report is Cohen, Polk and Vuolteenaho (2009). Cohen *et. al.* conclude that the CAPM may explain average returns provided that it is implemented using a method of estimating betas very different from that employed by the AER. The non-standard measure of beta risk proposed in Cohen *et. al.* is based on cash flow covariances (the covariation between the cash flows of a given firm and the aggregate cash flows of a large market index of firms) rather than the traditional measure of beta estimated from return covariances (the covariation between returns on the stock of a given firm and returns on a market index of stock returns). Cohen *et. al.* contains no analysis of the CAPM as implemented by the AER using betas estimated from return covariances. Even using the non-standard method for estimating betas it is not clear from the Cohen *et. al.* results that the Sharpe CAPM dominates the Black CAPM. In fact, the superiority of the Black CAPM is suggested by the results in Table V of Cohen *et. al.*: 17 of the 18 estimated values for the zero beta rate exceed the 4% average risk-free rate observed over the sample period. That one exemption is an estimated value of 3.7%. The other 17 estimates range as high as 13.9%, with 11 of the estimates being greater than 8%.

7. The second of the recent papers cited by Davis is Llewelyn, Nagel and Shanken (2010). Llewelyn, Nagel and Shanken report on page 187 that "[a]nnualized, the zero-beta rates range from 7.8% to 14.3% above the risk-free rate" and conclude that "[t]hese estimates cannot reasonably be attributed to differences in lending versus borrowing costs." Whatever the rational for their empirical finding, the finding itself is clear: Average returns are better described by the Black CAPM with a zero beta rate in excess of the risk-free rate than by the

Sharpe CAPM. Potential rationales for this empirical finding are discussed in paragraphs 20 and 21 of this Comment. An immediate implication of this empirical finding is that estimates of the cost of equity obtained from the Sharpe CAPM as operationalized by the AER are downward biased for stocks with betas less than one.

8. Davis also discusses Ray, Savin and Tiwari (2009). Ray *et. al.* report the results of a new statistical test. This new test fails to reject a null hypothesis that average returns are described by the Sharpe CAPM when the alternate hypothesis is not specified. The authors do not report any analysis of whether their new test would reject the Sharpe CAPM if the alternate hypothesis were specified as the Black CAPM. The Ray *et. al.* conclusion re the Sharpe CAPM (page 732) is itself interesting: "the evidence for the statistical rejection of the CAPM is weaker than the consensus view suggests." Ray *et. al.* accept that the consensus view among finance academics is that expected returns are not well-described by the Sharpe CAPM.

9. Campello, Chen and Zhang (2008) is another of the recent papers cited in the Davis Report. Campello *et. al.* develop a new measure of expected returns and examine whether this measure of expected returns is well-described by a model linking stocks' expected returns to their betas and their sensitivities to the other two Fama-French factors, namely a size factor and a market-to-book based factor. When Fama and French (1993) use average realized returns as the proxy for expected returns they conclude that only the size and market-to-book factors help explain differences in average returns. Using their alternate measure of expected returns, Campello *et. al.* conclude that all three of the Fama French factors are significant explanators of expected returns. In summary, Campello *et. al.* reject the CAPM in favour of the Fama-French model.

10. More importantly for the conclusion of the Grundy Report, Campello *et. al.* report the results of an analysis of the empirical link between expected returns and betas when betas are taken as the sole risk measure. Panel A of Table 7 reports that when returns are to be explained by beta alone (i.e., by some variant of the CAPM) the relation between beta and expected returns is flatter than that predicted by the Sharpe CAPM: The expected return on the market

in excess of the zero beta rate (3.39%) is substantially less than the expected return on the market in excess of the risk-free rate (7.54%). In short, Campello *et. al.* report that the Sharpe CAPM underestimates expected returns on low beta stock.

11. Echoing the classic Fama and French (1993) study, Adrian and Rosenberg (2008) conclude that a multi-factor asset pricing provides a better model of expected returns than is provided by the single factor CAPM in which differences in expected returns are explained solely be differences in betas. Adrian and Rosenberg conclude that expected returns are determined by both betas and sensitivities to shocks to systematic volatility. While Adrian and Rosenberg reject the single factor CAPM in favour of a multi-factor model, they do not compare alternate single factor models and do not ask whether expected returns are better described by the Black CAPM or by the Sharpe CAPM.

12. Pastor, Sinha and Subrahmanyam (2008) examine the time series relation between the implied cost of capital (ICC) for the market as a whole and the level of market risk. Pastor *et. al.* do not address the cross-sectional relation between expected returns and betas, save to note (page 2860) that "[s]ome studies find a positive relation between the ICC and market beta … , while others find this relation to be mostly insignificant … ." Like Adrian and Rosenberg (2008), Pastor *et. al.* simply do not consider the question of which of the Black CAPM or the Sharpe CAPM provides the better descriptor of expected returns.

13. The next paper cited in the Davis Report is Levy and Roll (2010). Levy and Roll also do not provide evidence that expected returns are well-described by the Sharpe CAPM. Rather, Levy and Roll note the Roll (1977) result that if a particular market proxy is itself an efficient portfolio with an expected return of $E\{r_m\}$ then it follows mathematically that the expected return on any asset $\underline{i}$, $E\{r_i\}$, must be linearly related to that asset's beta with respect to the market proxy, β_i.

$$E\{r_i\} = E\{r_z\} + \beta_i \left(E\{r_m\} - E\{r_z\}\right),$$

where $E\{r_z\}$ is the expected return on a portfolio with zero-beta with respect to the market proxy. Importantly Levy and Roll note (on page 2482) that

> [c]ommon practice substitutes a "riskless" rate, r_f , for r_z , but this is appropriate only when [the riskless asset] and [the zero beta asset] have the same mean return.

The Grundy Report's analysis of a set of papers (that were previously considered relevant by the AER when examining how well alternate models describe expected returns) concludes that the expected return on a zero-beta portfolio exceeds the risk-free rate.

14. Levy and Roll (page 2487) conclude (emphasis added) that

> … to obtain an improved expected return estimate for any stock, first calculate the adjusted mean return for the market index proxy *and for its corresponding zero-beta portfolio*. Plugging these numbers along with the sample beta (because it is close to the adjusted beta) into the usual CAPM formula delivers the improved estimate of expected return. Making the market index proxy mean/variance efficient produces useful betas for many practical purposes such as estimation of the cost of equity capital for a firm or of the discount rate for a risky project.

Levy and Roll are clear that the "usual CAPM formula" is their equation (4) (as set out in paragraph 12 immediately above); i.e., Levy and Roll are clear that expected returns should be determined from the Black CAPM, i.e., by a model in which the return on a zero beta asset need not equal the risk-free rate.

15. Subrahmanyam (2010) reviews a large set of papers which examine whether factors other than beta help explain differences in expected returns. Subrahmanyam notes that there is much evidence suggesting that conditional betas rather than unconditional betas help explain expected returns. Subrahmanyam also observes that the Fama-French factors as well as other risk factors consistent with an Intertemporal CAPM (ICAPM) and characteristics such as liquidity might all be related to expected returns. Subrahmanyam concludes (page 37) that

> Because of varying methods and varying controls it is difficult to clearly interpret the current state of the literature on the cross-sectional predictors of stock returns.

Subrahmanyam does not examine the large set of empirical evidence that the Black CAPM provides a better descriptor of expected returns than the Sharpe CAPM does and does not address this question.

16. Levy (2010) repeats the empirical observation of Levy and Roll (2010) that the Black CAPM can provide useful estimates of the cost of capital. Levy (2010) also argues (on page 68) that investor choices of mean-variance efficient portfolios (which in turn result in the market portfolio being mean-variance efficient) are "surprisingly valid in behaviour (sic) economics and psychologists paradigms even though expected utility is invalid". The market portfolio is a mean-variance efficient portfolio in both the Black and Sharpe variants of the CAPM and Levy (2010) thereby shows that both variants of the CAPM can be consistent with the paradigms of behavioural economics.

17. The final paper considered in the Davis Report is Da, Guo and Jagannathan (2010). Da *et. al.* examine estimated alphas, α_p, from the following 10 monthly regression regressions:

$$r_{pt} - r_{ft} = \alpha_p + \beta_p (r_{pm} - r_{ft}) + e_{pt}\,, p = 1, \ldots, 10.$$

In standard implementations of such an analysis, stocks are first ranked on their betas estimated over a prior period ending in the year preceding month *t*. Ten portfolios are then formed from the stocks in each beta decile. The 10 portfolios are thereby designed to have a wide dispersion in their true betas. Da *et. al.* also consider allocating stocks to portfolios based on betas estimated over a period ending two years prior to month *t* and describe this approach as using "aged betas". If the Sharpe CAPM is true, then each of the 10 estimated α_p should equal zero. If instead the Sharpe CAPM gives estimates of expected returns that are biased down for low beta stock and biased up for high beta stock, the estimated α_p will be positive for low beta stock and negative for high beta stock (as in Figure 1 below).

18. Panel B of Table 2 of Da *et. al.* reports results using the standard approach of ranking betas estimated over the years immediately preceding month *t*. The estimated α_p are in fact positive for low beta stock and negative for high beta stock and the Sharpe CAPM is rejected. Equivalently, the Sharpe CAPM underestimates (overestimates) expected returns on low (high) beta stocks. Panel C of Table 2 of Da *et. al.* shows that the same pattern in the estimated α_p is observed when portfolios are formed based on "aged betas" (i.e., positive for low beta and negative for high beta), but the use of "aged betas" when forming portfolios means that the Sharpe CAPM can no longer be rejected. It is important to note that Panels B and C report results for portfolios formed from a sample of stocks designed to exclude two groups of stocks for which the CAPM is known to be a poor predictor of expected returns, namely small stocks and past winner and past loser stocks (momentum stocks). Panel D reports results when the 10 portfolios are formed using "aged betas" but without first imposing the size and momentum filters on the set of stocks to be included in the analysis. The result for the full sample of stocks are that the Sharpe CAPM underestimates (overestimates) expected returns on low (high) beta stocks and the Sharpe CAPM is rejected as a descriptor of stock returns.

19. My conclusion from an analysis of the 10 papers considered in the Davis Report is therefore that they either
    a. contain no information about the relative superiority of the Black CAPM and the Sharpe CAPM as descriptors of expected returns (Ray, Savin and Tiwari (2009); Adrian and Rosenberg (1993); Pastor, Sinha and Subrahmanyam (2008); Levy (2010); and Subrahmanyam (2010));
    b. or contain the observation that the Black CAPM can provide a better descriptor than the Shape CAPM (Levy and Roll (2010));
    c. or contain information that the Black CAPM does provide a better empirical predictor of expected returns than the Sharpe CAPM does (Cohen, Polk and Vuolteenaho (2009); Llewelyn, Nagel and Shanken (2010); Campbello, Chen and Zhang (2008); Da, Guo and Jagannathan (2010)).

20. In addition to a discussion of new papers on asset pricing, the Davis Report comments on a number of observations in the Grundy Report. Davis notes (page 10) that a well-diversified equity index need not be mean-variance efficient. But in the event that the market proxy is not mean-variance efficient, expected returns will not be well-described by either the Sharpe CAPM or the Black CAPM.

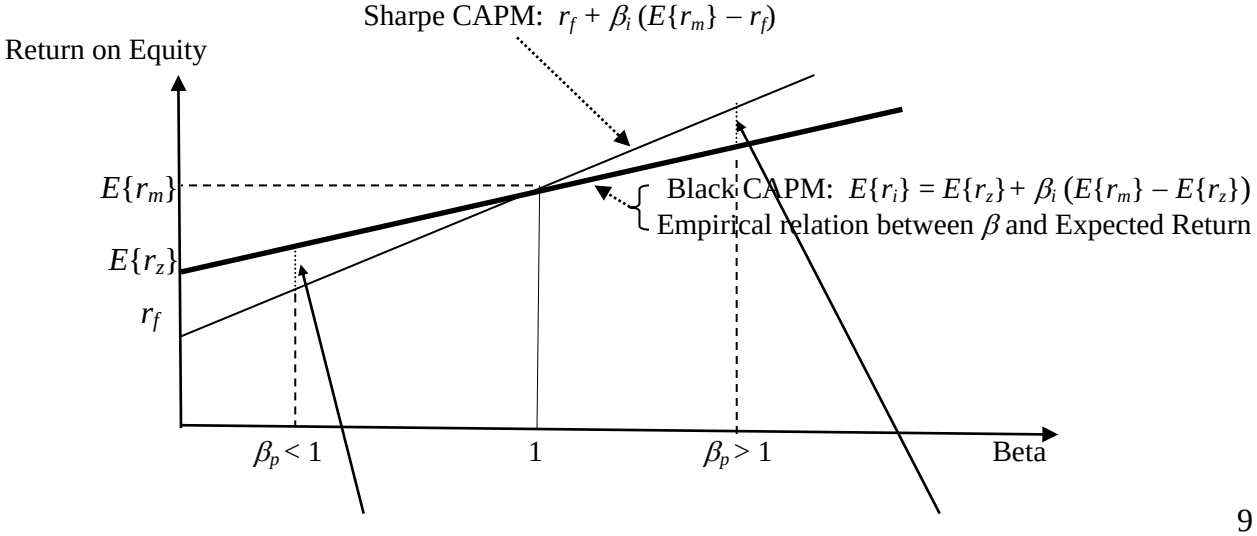
21. In discussing how different the Black CAPM and Sharpe CAPM models might be the Davis Report suggests on pages 10 and 11 that the zero beta rate should be no higher that the borrowing rate. The seminal Black (1972) paper established that a linear relation between expected returns and betas can be derived as an equilibrium asset pricing model under certain assumptions including an assumption that borrowing rates exceed lending rates. Given this set of assumptions the equilibrium expected return on zero beta assets will exceed the risk-free rate, but will not exceed the borrowing rate. But it is important to note that, as Levy and Roll (2010) show, expected returns must be linearly related to betas whenever the equity-index used as the market proxy is mean-variance efficient. And this is so whether or not the particular assumptions that yield the Black CAPM as an equilibrium model are in fact satisfied. The mean-variance efficiency of an equity-index places no restriction on the amount by which the zero beta rate with respect to that index exceeds the risk-free rate.

22. As page 20 of the Davis Report notes, differences in expected returns on assets can be driven by differences in liquidity as well as by differences in risk. More liquid assets command higher prices and investors valuing liquidity continue to hold these assets despite their lower expected returns. As a result the expected return on zero beta equities will be higher than the risk-free rate on relatively more liquid government bonds, despite the fact that both assets have zero betas. Similarly, as page 9 of the Davis Report also notes, higher bid-ask spreads and other transactions costs in equity markets will mean the expected return on zero beta equities will exceed the risk-free rate. In short, differences in borrowing and lending rates are not the only reason why the expected return on zero beta equities will exceed the risk-free rate.

23. Focusing on borrowing rates alone, page 11 of the Davis Report suggests that the margin by which borrowing rates exceed the risk-free rate is quiet small: The margin on 30 day borrowing from the RBA via 30 day repurchase agreements for government securities is reported as only 5 basis points. But the period over which the single-period CAPM is meant to apply is unclear. If that period is also the five-year period of a regulatory cycle, the question to consider is the size of margins on five year loans. Further, borrowers in both the Sharpe and Black CAPM models borrow in order to invest in the risky market portfolio, not in low risk short-term government securities. And the zero beta rate in the Black equilibrium CAPM reflects a weighted combination of the various borrowing rates available to all investors, not just the rate available to large institutions able to enter repurchase agreements with the RBA. A 5 basis point margin reflects not only those institutions' credit-worthiness but the low risk of a 30 day loan secured over government securities. In my opinion 5 basis points is a considerable underestimate of the margin that would be charged to any borrower who sought a five-year loan secured only by an investment in the stock market.

24. Page 12 of the Davis Report contains a table of five estimates of the value of the expected return on the market in excess of the zero-beta rate relative to the expected return on the market in excess of the risk-free rate. The five estimates are estimates of the slope of the thin line relative to the slope of the thick line in the Figure below and all five estimates are less than 1.

Figure 1*: The Sharpe CAPM (depicted by the more-steep thin upward sloping line) and the empirical relation between the cost of equity and beta (depicted by the less-steep thick upward sloping line).*



+ ive α_p i.e., $E\{r_i\} > r_f + \beta_i \left(E\{r_m\} - r_f\right)$ – ive α_p i.e., $E\{r_i\} < r_f + \beta_i \left(E\{r_m\} - r_f\right)$

On the *y*-axis of the figure above, $E\{r_m\}$is the expected return on the market, $E\{r_z\}$ is the expected return on zero-beta stock and r_f is the risk-free rate.

25. The five estimates are based on various results reported in Kothari, Shanken and Sloan (1995). The first of the reported estimates of 0.416345 is also contained in the Grundy Report. This is the relative value one obtains if one focuses on the result in Kothari *et. al.* that is derived when portfolios are formed solely on the basis of ranked betas. This method of forming portfolios is the most efficient under the null hypothesis that beta is the sole determinant of expected returns. This method produces the largest dispersion in portfolio betas and hence yields the most efficient estimate of the expected return on the market in excess of the zero-beta rate. Less efficient estimates are obtained when portfolios are formed by ranking on both beta and size.

26. The table on page 12 of the Davis Report contains four additional estimates of the expected return on the market in excess of the zero-beta rate relative to the expected return on the market in excess of the risk-free rate that are the result of forming portfolios by ranking of both beta and size. These four estimates are less efficient that the estimate contained in the Grundy Report. But the important conclusion to be drawn is that <u>all</u> five relative value estimates are below one and whichever relative value estimate is considered, the Sharpe CAPM will yield a downward-biased estimate of the expected return on low beta stocks.

27. In the final paragraph of page 12 of the Davis Report is a statement that the author is unable to find the data in the Da, Guo and Jagannathan (2009) paper that underlies the Grundy Report's calculation of the value of the expected return on the market in excess of the zero-beta rate relative to the expected return on the market in excess of the risk-free rate implied by Da, Guo and Jagannathan (2009). That value of 0.232 is calculated as

$$Average\ [\ r_m - r_z\ ]\ /\ Average\ [r_m - r_f\ ].$$

Column 1 of Panel D of Table 2 of Da, Guo and Jagannathan (2009) reports the results of averaging a set of regressions of the form

$$r_{pt} - r_{ft} = \lambda_{0t} + \lambda_{1t} \times \beta_p + e_{pt}.$$

The average relation is reported as

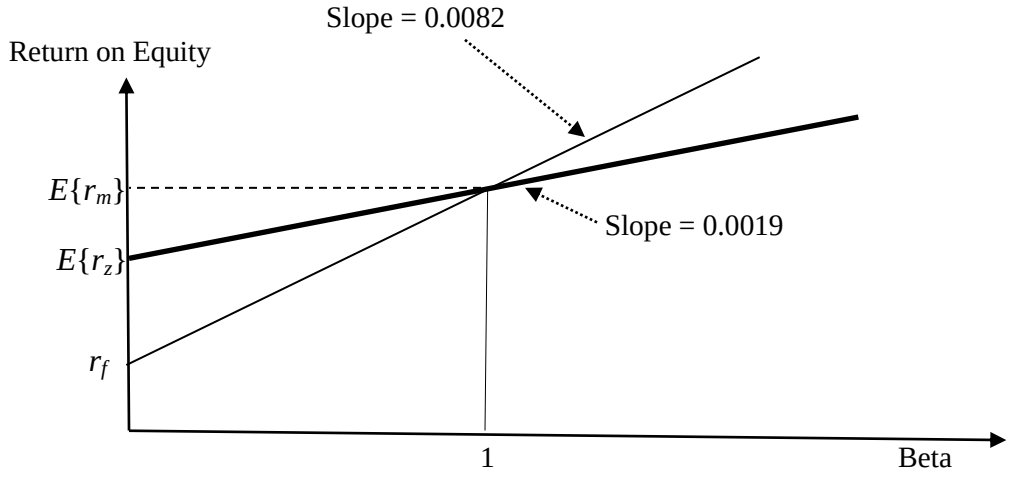
$$\overline{r_{pt} - r_{ft}} = \overline{\lambda_{0t}} + \overline{\lambda_{1t}} \times \beta_p = 0.0063 + 0.0019 \times \beta_p .$$

The beta of the market is 1 and hence we obtain

$$\overline{r_{mt} - r_{ft}} = \overline{\lambda_{0t}} + \overline{\lambda_{1t}} \times 1 = 0.0063 + 0.0019 \times 1 = 0.0082 .$$

Thus the *Average* $[r_m - r_f]$ = 0.0082. The empirical relation between beta and realized excess returns in period *t* is given by λ_{1t}. Hence the *Average* $[\, r_m - r_z \,]$ is given by $\overline{\lambda_{1t}}$ =0.0019. The slope of the empirical relation between returns and beta relative to the slope of the Sharpe CAPM relation between returns and betas is therefore equal to

0.232 = *Average* $[\, r_m - r_z \,]$ / *Average* $[r_m - r_f]$ = 0.0019 / 0.0082.



28. The final paragraph of page 12 of the Davis Report also states that the author is unable to find the results in the Da, Guo and Jagannathan (2009) paper that underlie the Grundy Report's calculation that the likelihood of observing that data analyzed in Da, Guo and Jagannathan (2009) is less than 0.002% under the null that expected returns are determined by the Sharpe CAPM. Under that null, the true value of $\lambda_{1t} = 0$ for all *t*. Column 1 of Panel D of Table 2 of Da, Guo and Jagannathan (2009) reports that the *t*-statistic associated with the observed value of $\overline{\lambda_{1t}}$ =0.0019 is 4.14. There is a less than 0.002% chance of observing such a high average value (i.e., such a high *t*-statistic) if the null hypothesis is true.

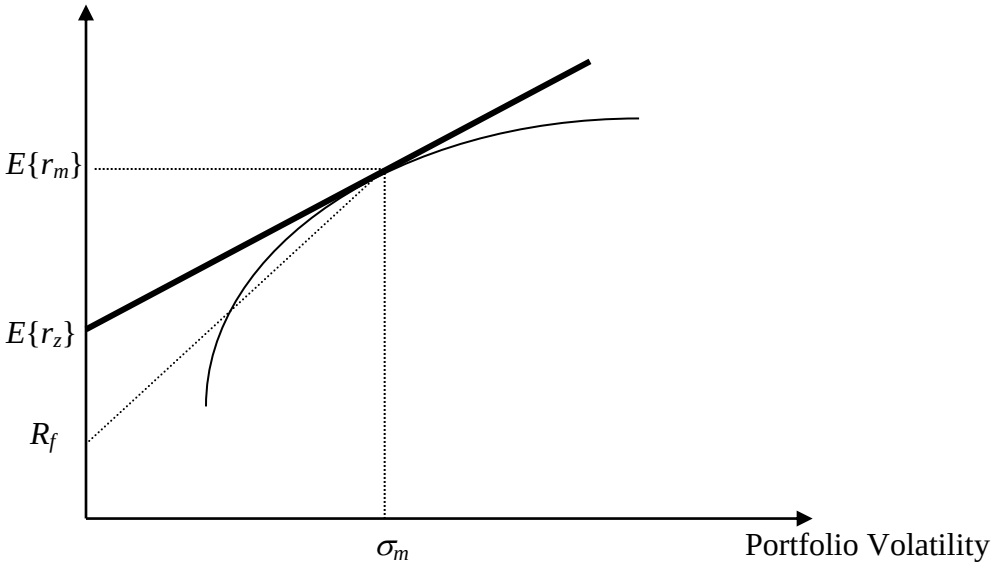
The Handley Report

29. Pages 2 and 3 of the Handley Report review the empirically documented low-beta bias in the Sharpe CAPM. But at the top of page 4 is a claim by Handley that Roll (1977) seriously questions whether the low-beta bias even exists. In fact, Roll (1977) proves that if a market proxy is mean-variance efficient then as a mathematical consequence the expected return on an asset *i*, $E\{r_i\}$, can be written as a linear function of that asset's beta with respect to the market proxy

$$E\{r_i\} = E\{r_z\} + \beta_i \left(E\{r_m\} - E\{r_z\}\right),$$

where $E\{r_z\}$ is the expected return on a portfolio with zero-beta with respect to the market proxy. Further Roll (1977) establishes that whenever the expected return on assets with zero beta with respect to the mean-variance efficient market proxy exceeds the risk-free rate, as in Figure 2 below, then rather than calling into question the existence of a low-beta bias the opposite is true and the Sharpe CAPM *must* as a mathematical consequence exhibit a low beta bias.

Figure 2: *The Set Efficient Portfolios and the Expected Return and Volatility of the Well-Diversified Equity Market as a Proxy for an Efficient Portfolio*



30. Since page 4 of the Handley Report errs in stating that Roll (1977) calls into question the existence of a low-beta bias in the Sharpe CAPM, the claim near the top of page 4 that "[a]ccordingly, CEG is incorrect to suggest that: *'The existence of bias in the AER implementation of the CAPM can reasonable be regarded as being universally accepted by those who have examined the empirical data'* " is itself an incorrect claim. The claim is incorrect since the basis for the 'accordingly' conclusion reflects a misunderstanding of Roll (1977).

The Qld Gas Network Draft Decision

31. Section 5.4.2.4 of the Qld Gas Draft Decision states that

> Grundy and CEG appear to select empirical evidence from the set of papers used in a previous AER decision, which was concerned with the evaluation of the FFM proposed by JGN. While clearly relevant to the evaluation of the FFM, it is not the case that these papers were selected to give an assessment of the empirical evidence on the CAPM. In contrast, Professor Davis surveys relevant recent academic literature on the CAPM itself.

The papers were selected by the AER as relevant to a comparison of the FFM (Fama-French Model) and the CAPM. If those papers are considered relevant to an assessment of the empirical validity of the FFM relative to the CAPM as empirical predictors of returns, it is disingenuous to suggest that the papers are not relevant to an assessment of the relative merits of the Sharpe CAPM versus the Black CAPM as empirical predictors of returns.

32. It is the empirical results contained in the set of papers previously considered relevant by the AER that underlies the conclusion of the Grundy Report that estimates of the cost of equity obtained from the Sharpe CAPM as operationalized by the AER are downward biased for equities with betas less than one. The claim in the Qld Gas Draft Decision that "In contrast, Professor Davis surveys relevant recent academic literature on the CAPM itself" is a similarly unhelpful choice of wording.

33. As summarized in paragraph 18 of this Comment, the empirical results in this set of "relevant recent" papers lead to the conclusion that estimates of the cost of equity obtained from the Sharpe CAPM as operationalized by the AER are downward biased for equities with betas less than one.

REFERENCES

Adrian, Tobias, and Joshua Rosenberg, 2008,**"**Stock returns and volatility: Pricing the short-run and long-run components of market risk,**"** *Journal of Finance* 63(6), pp. 2997-3030.

Black, Fisher, 1972, "Capital market equilibrium with restricted borrowing," *Journal of Business* 45(3), pp. 444–455.

Campello, Murillo, Long Chen and Lu Zhang Expected Returns, 2008, "Yield spreads and asset pricing tests," *Review of Financial Studies,* 21(3), pp. 1298-1338

Cohen, Randolph, Christopher Polk and Tuomo Vuolteenaho, 2009, "The price is (almost) right," *Journal of Finance*, 64(6), pp. 2739–2782.

Da, Zhi, Re-Jin Guo and Ravi Jagannathan, 2009, "CAPM: Interpreting the evidence," NBER working paper 14889.

Da, Zhi, Re-Jin Guo and Ravi Jagannathan, 2010, "CAPM for estimating the cost of equity capital: Interpreting the empirical evidence." http://ssrn.com.abstract=1571299

Fama, Eugene F., and Kenneth R. French, 1993, "Common risk factors in the returns on stocks and bonds,"*Journal of Financial Economics*, 33(1), pp. 3–56.

Levy, Haim, 2010, "The CAPM is alive and well: A review and synthesis," *European Financial Management*, 16(1), pp. 43–71

Levy, Moshe, and Richard Roll, "The market portfolio may be mean/variance efficient after all," *Review of Financial Studies,* 23(6), pp. 2464-2491.

Lewellen, Jonathan, Stefan Nagel and Jay Shanken, 2010, "A skeptical appraisal of asset pricing tests" *Journal of Financial Economics,* 96, pp. 175–194

Pastor, Lubos, Meenakshi Sinha and Bhaskaran Swaminathan, 2008, "Estimating the intertemporal risk–return tradeoff using the implied cost of capital," *Journal of Finance*, 63(6), pp. 2859-2897.

Ray Surajit D., N. Eugene Savin and Ashish Tiwari, 2009, "Testing the CAPM revisited," *Journal of Empirical Finance*, 16(5), pp. 721-733.

Roll, Richard, 1977, "A critique of the asset pricing theory's tests; Part I: On past and potential testability of the theory," *Journal of Financial Economics* 4(2), pp. 129–76.

Subrahmanyam, Avanidhar, 2010, "The cross-section of expected stock returns: What have we learnt from the past twenty-five years of research?" *European Financial Management*, 16(1), pp. 27–42.