Issues affecting the estimation of MRP

Report for Envestra

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Executive summary and conclusions

Instructions and overview

1. The Strategic Finance Group: SFG Consulting (SFG) has been engaged by Envestra Ltd. to examine a number of specific questions concerning the estimation of market risk premium. Specifically, we have been asked to:

   a. Clarify the comments in our previous report on this issue relating to whether a change to the estimate of theta should result in a consequential change to the estimate of MRP;

   b. Consider the extent to which risk premiums in financial markets may continue to be affected by the events of the global financial crisis (GFC);

   c. Consider whether an MRP estimate of 6.5% is a reasonable lower bound for point estimates in the prevailing conditions in the market;

   d. Consider whether, when estimating MRP from historical data, an arithmetic or geometric mean return should be used.

2. We have previously prepared a report on this matter:

   SFG, 2010, "The relationship between theta and MRP," 11 September. (**Previous report**).

3. A response to that report appears in the recent Draft Decision:

   Australian Energy Regulator (2011), "Draft Decision: Envestra Ltd: Access arrangement proposal for the SA gas network: 1 July 2011 – 30 June 2016," February, www.aer.gov.au. (**Draft Decision**).

Conclusions

4. Our conclusions are as follows:

   a. Any potential decrease in the estimate of MRP flowing from a decrease in the estimate of theta is tiny compared with the confidence intervals around the estimates and with the increase in the estimate of MRP that would flow from beginning the historical sample periods five years earlier. Therefore, changes in the estimate of theta should have no effect on the AER's forward-looking estimate of MRP for use in the CAPM;

   b. The turmoil in financial markets surrounding the GFC continues to have some effect on risk premiums in financial markets (as do recent world events):

      i. The GFC had a pronounced effect on market risk premiums during the height of the crisis;

      ii. All indicators suggest that this effect has reduced since the peak of the GFC; and

      iii. Some indicators remain materially above their pre-GFC levels.

   c. An MRP estimate of 6.5% is a reasonable lower bound for point estimates in the prevailing conditions in the market:

i. The point estimates of MRP using historical data from 1958 to 2010 (the period for which the most reliable data is available) are 6.6% and 6.4% using theta estimates of 0.65 and 0.3 respectively. These are long-run estimates of MRP over the economic cycle and indicate that 6.5% would be a reasonable estimate of MRP on a long-run average basis – even if one were to conclude that risk premiums in financial markets are currently in line with the long-run average;

ii. There is market evidence that the turmoil associated with the GFC, and more recent world events, are having a continuing influence on risk premiums in Australian financial markets. In this case, it would be appropriate to adopt a present estimate for MRP that is above the long-run average estimate. Consequently:

    1. If the long-run historical estimate of 6.5% is appropriate for "average" market conditions, a higher value would be appropriate in conditions where risk premiums are thought to be above average; and

    2. If an estimate of 6% is appropriate for "average" market conditions (consistent with the AER's conclusions in the SoRI), a higher value would be appropriate in conditions where risk premiums are thought to be above average. Given the imprecision in MRP estimates, increments of less than 0.5% are not normally used. Consequently, the minimum estimate that reflects higher than long-run average risk would be 6.5%.

iii. The AER compares a practitioner estimate of 6% with its own estimate of 6%. However, the AER's estimate is based on a theta estimate of 0.65 whereas the practitioner estimate is based on a theta estimate of 0. If the practitioner estimate was grossed-up to reflect the AER's estimate of theta, that estimate would be 7%; and

d. Given that the CAPM is silent on the length of the time horizon for this purpose, it seems sensible to follow standard valuation practice in using annual returns, in which case the appropriate estimate is the arithmetic mean of annual returns. Moreover, taking the geometric mean over an entire sample period is equivalent to assuming that the relevant time horizon is the entire length of that sample period. For example, using a geometric mean over the period 1883-2010 implies that the relevant time horizon is 128 years, which is inconsistent with accepted practice.

Relationship between theta and MRP

5. Our previous report addressed the question of whether the regulatory estimate of market risk premium would have to be adjusted if one were to adopt a different estimate of theta. Our report noted that estimates of MRP that are based on historical data do indeed depend on the assumed value of theta. These estimates also depend on the particular historical sample period that is selected. The only substantive point in our previous report was that the estimate of theta has a tiny impact on the historical estimate of MRP compared with the effect of making even small changes to the sample period that is used.

6. We illustrated this point by showing that:

   a. Changing the estimate of theta from 0.65 to 0.2 reduces the historical estimate of MRP by a small amount; whereas

   b. Changing the sample periods selected by the AER by beginning each one five years earlier results in a much larger *increase* in the historical estimate of MRP.

7. Our previous report then concluded that any adjustment to the estimate of MRP that might flow from the adoption of a different value of theta is tiny when compared with the estimation error that flows from the selection of slightly different sample periods.

8. In summary, the key point we were trying to make in our previous report is that the AER's historical MRP estimates vary materially depending on the precise sample period that is selected, and that starting the sample periods five years earlier results in increases in the MRP estimate that swamp any change to the estimate that would flow from the adoption of a different estimate of theta.

9. When considering the impact of this issue on the estimate of MRP, the recent Draft Decision states that:

> SFG suggested that the AER's sample periods were intentionally chosen to exclude years of high excess returns and produce downwards biased estimates.[1]

However, it was not our intention to suggest that the AER had intentionally selected which sample periods to report so as to downwardly bias the estimate of MRP. Rather, our intention was to illustrate the sensitivity of this estimate to relatively small changes in the sample periods that are chosen – and to contrast that with the sensitivity of the estimates to changes in theta.

10. Irrespective of the reasons behind the selection of the AER's sample periods, it remains the case that, as demonstrated in our earlier report:

    a. The start dates for the AER's sample periods have the effect of excluding a set of substantially positive observations from the samples that are being analysed; and

    b. Starting the AER's sample periods five years earlier would have the effect of producing materially higher estimates of MRP.

[1] Draft Decision, p. 279.

That is, changing the start dates of the sample periods does have a material impact on the estimates of MRP and that effect is many times larger than the effect of changing estimates of theta.

11. The Draft Decision also contains a reference to the potential link between theta and MRP estimates:

> SFG stated that adopting an assumed utilisation rate for imputation credits of 0.23 as opposed to a utilisation rate of 0.65 should not reduce the AER's estimate of the MRP. SFG stated that there is such imprecision in the estimate of the MRP that such an adjustment would be well within the bounds of error. To support this SFG stated that changing the sample periods considered by the AER would have a more significant effect on the estimates.[2]

12. However, the Draft Decision makes no specific conclusion on this point, as it maintains an estimate of 0.65 for theta:

> While the AER has maintained that 0.65 is an appropriate value for the utilisation rate, it highlights that changes in this value may affect the interpretation of historical excess returns when setting the MRP.[3]

13. In recent proceedings before the Australian Competition Tribunal, the AER has reached a more specific conclusion:

> …a change to theta from 0.65 to 0.5, 0.4 or 0.2, if considered in isolation, would not in itself constitute persuasive evidence for departing from the MRP of 6.5% adopted in the SORI.[4]

14. We agree with the AER's submission on this point – even large changes in the estimate of theta would not constitute persuasive evidence for reducing the estimate of MRP. The Tribunal has also accepted this submission.[5]

15. The AER has also submitted to the Tribunal that:

> …in future distribution determinations, the AER will consider all relevant matters together in determining whether there is persuasive evidence to depart from the MRP of 6.5% adopted in the SORI. These matters would include the effect of any change to theta on historical estimates of the MRP and the extent to which there is any ongoing effect of the global financial crisis.[6]

16. In our view, the estimate of theta and the effects of the global financial crisis (GFC) are independent issues that can, and should, be treated separately. The AER has previously stated that in a GFC environment the appropriate estimate of MRP is 6.5% and this is independent of the estimate of theta. The AER has also previously decided that in a non-GFC environment the

[2] Draft Decision, p. 86.
[3] Draft Decision, p. 86.
[4] AER (2010), "Theta and the market risk premium," submission to Australian Competition Tribunal, File Nos 2, 3, and 4 of 2010, 1 October.
[5] Application by Energex Limited (No 2) [2010] ACompT 7.
[6] AER (2010), "Theta and the market risk premium," submission to Australian Competition Tribunal, File Nos 2, 3, and 4 of 2010, 1 October.

appropriate estimate of MRP is 6.0%. Presumably, and for consistency, this would also be independent of the estimate of theta – there being no logical reason why theta would have a material impact on the estimate of MRP if that estimate turned out to be 6%, but not if that estimate turned out to be 6.5%. This position can be summarised as:

a. The estimate of MRP is 6% in a non-GFC environment and 6.5% in a GFC environment; and

b. Those estimates are independent of the estimate of theta.

17. Within this framework, it would be consistent to reduce the estimate of MRP from 6.5% to 6% on the basis that the effects of the GFC were no longer relevant (if that conclusion had been reached), but not on the basis of there having been a change to the estimate of theta. Changes in the estimate of theta should have no effect on the AER's estimate of MRP, regardless of whether that estimate is 6% or 6.5%, or even 8%, and regardless of whether the economy is suffering GFC effects or not.

Effects of global financial crisis and reasonableness of 6.5% estimate

Background and context

18. In its Review of WACC Parameters, the AER set out its view that the appropriate estimate of MRP in relatively stable market conditions is 6%:

> The AER considers that prior to the onset of the global financial crisis, an estimate of 6 per cent was the best estimate of a forward looking long term MRP, and accordingly, under relatively stable market conditions—assuming no structural break has occurred in the market—this would remain the AER's view as to the best estimate of the forward looking long term MRP.[7]

19. The AER then recognised that the global financial crisis had a material impact on financial markets in general, on the perceived risk of holding equities, and consequently on the return that investors require as compensation for each unit of risk. That is, the GFC led to an increase in risk premiums in financial markets and this led the AER to increase its estimate of MRP. To have concluded otherwise would have been unsupportable in the circumstances. Specifically, the AER concluded that:

> Accordingly, the AER considers that a MRP of 6.5 per cent is reasonable, at this time, and an estimate of a forward looking long term MRP commensurate with the conditions in the market for funds that are likely to prevail at the time of the reset determinations to which this review applies.[8]

20. There is widespread agreement that the AER was correct to increase its estimate of the MRP during the GFC. There is less agreement about the magnitude of this increase and about the method by which that magnitude was determined. In particular, the Final Decision of the Review of WACC Parameters provides no analysis of why the appropriate adjustment to the estimate of MRP (to reflect the effect of the GFC) is precisely 50 basis points. An adjustment of that size is very small relative to the confidence intervals around any estimate of MRP. The 50 basis point adjustment is not based on any calculations or modeling. Rather, the AER selected an estimate of 6.5% on the basis that:

> …having regard to the desirability of regulatory certainty and stability, the AER does not consider that the weight of evidence suggests a MRP significantly above 6 per cent.[9]

21. In its recent Draft Decision, the AER concludes that the effects of the GFC are no longer having a material impact on the MRP and that its estimate should be reduced to pre-GFC levels:

[7] Review of WACC Parameters, Final Decision, p. 238.
[8] Review of WACC Parameters, Final Decision, p. 238.
[9] Review of WACC Parameters, Final Decision, p. 238.

> In the WACC review, the AER considered the best estimate of the forward looking 10 year MRP was 6 per cent based on historical estimates, survey based estimates and past regulatory practice. However, given prevailing uncertainty about the potential impact on investor expectations of the GFC, the AER exercised its judgment to increase the MRP to 6.5 per cent. The latest evidence now indicates the AER's caution in raising the MRP to 6.5 per cent is no longer warranted. The significant uncertainty that characterised markets at the time the AER made the WACC review final decision has so substantially diminished that it is not reflected in prevailing conditions in the market for funds, nor is it expected to form part of forward looking expectations of returns over the next 10 years.[10]

22. The final conclusion on this point in the Draft Decision is that:

> Overall the available evidence on the MRP is imprecise and as a result the MRP is subject to a wide margin of variation. The AER has used its judgment to interpret the evidence currently before it and considers the available evidence both prior to, and following, the GFC supports 6 per cent as the best estimate of the forward looking 10 year MRP in the current market circumstances.[11]

23. In this report, we have been asked to address the question of whether an estimate of 6.5% for MRP is a reasonable lower bound for point estimates in the prevailing conditions in the market. There are two elements to this question:

a. Whether the GFC continues to have any effect on the prevailing conditions in the market; and

b. Whether an estimate of 6.5% is a reasonable lower bound for point estimates of MRP, given the conclusions about the effects of the GFC.

We address each of these questions below.

Does the GFC continue to have an effect on financial markets?

24. To determine the effect that the GFC may be having on the market risk premium, the usual approach is to examine a time series of variables that have been shown in the finance literature to be related to the market risk premium. One such variable is the implied volatility from options on the ASX 200 index. These implied volatilities are computed by determining the volatility that would have to be inserted into the Black-Scholes option pricing formula in order to reconcile the model price with actual traded market prices. Prices for short-term at-the-money call and put options are used for this purpose.

25. This series measures the market's perception of the forward-looking volatility of the ASX 200 index. It is therefore a measure of the *amount* of risk that market participants perceive. This is not a perfect measure of the CAPM MRP for two reasons:

a. It is based on options with a relatively short (3 month) time horizon; and

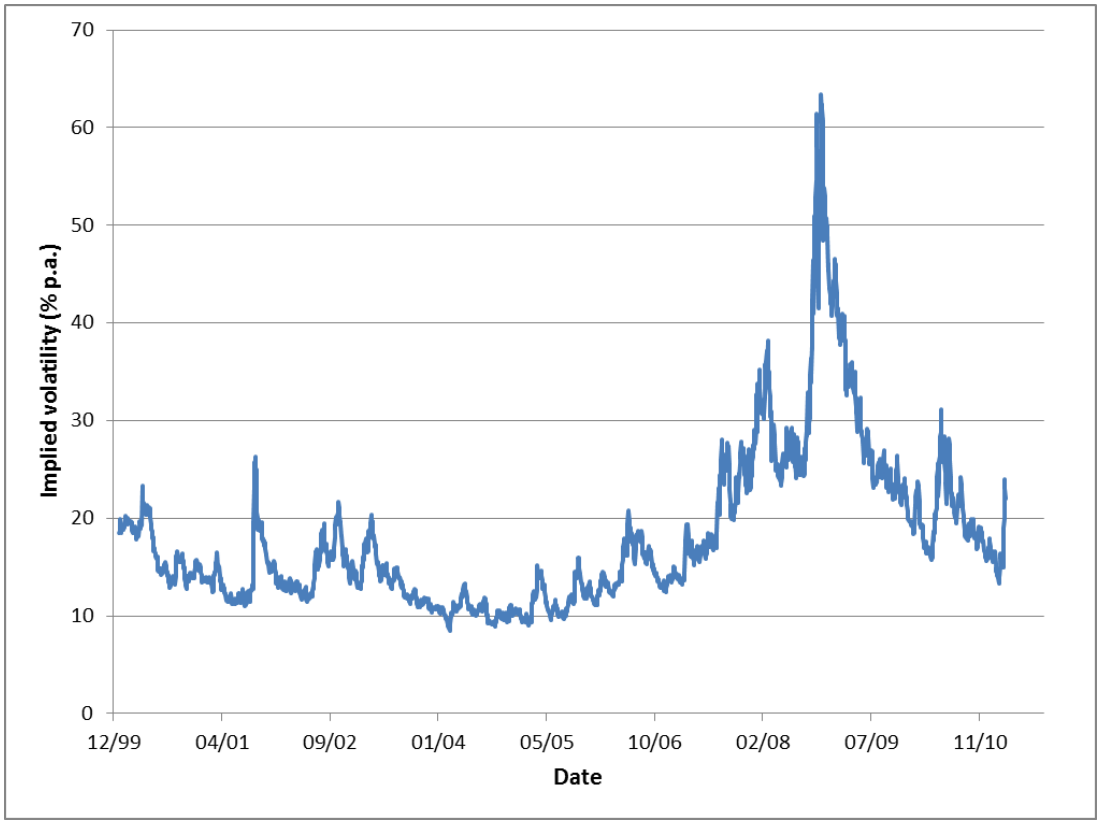
[10] Draft Decision, p. 92.
[11] Draft Decision, p. 92.

b. It reflects only the *amount* of risk, whereas the CAPM MRP also reflects the *price* of risk – the return that investors require for bearing each unit of risk. Both of these components, and hence the MRP, can vary over time.

26. Nevertheless, there is a relationship between implied volatilities and the forward-looking MRP and some of the relevant literature is discussed in the Draft Decision.[12]

27. A time series of these implied volatilities is set out in Figure 1, which shows that the implied volatility increased six-fold at the height of the GFC, has dissipated from the levels reached at the height of the GFC, but currently remains above pre-GFC levels.

Figure 1. Option implied volatilities



Source: Citibank ASX 200 implied volatility series, Bloomberg

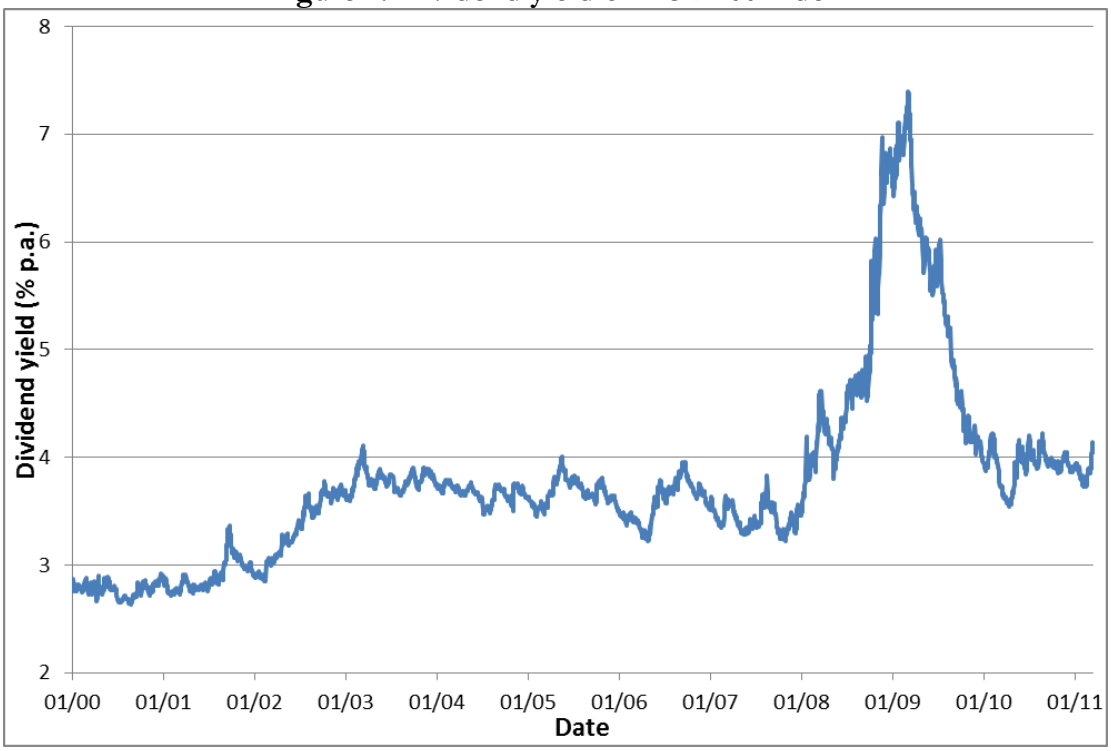
28. The finance literature also provides evidence that dividend yields and default spreads are positively associated with future equity market returns relative to Treasury bill rates (Fama and French, 1988 and 1989; and Keim and Stambaugh, 1986). This does not imply that equity market returns can be forecast with precision or that these variables provide investors with a trading strategy which generates abnormally high returns. What it does imply is that the bond and equity market prices appear to be affected by similar risk considerations. This means that low equity prices (relative to trailing dividends) and low corporate bond prices (relative to promised repayments) reflect investors' expectations for risk and therefore their required return for bearing that risk, in both the equity and debt markets.

[12] Draft Decision, pp. 282-285.

29. The dividend yield is the ratio of the cash flow to shareholders by way of dividends (including payments of a return of capital and payments in relation to loan notes) to the price of the stock. When dividend yields are high, a given set of cash flows is being discounted at a higher rate, indicative of higher equity risk premiums. Conversely, when dividend yields are low, a given set of cash flows is being discounted at a lower rate, indicative of lower equity risk premiums.

30. Figure 2 shows a time series of dividend yields from January 2000 to the present. There was a clear and dramatic increase in dividend yields during the height of the GFC. Yields have since fallen, but remain above the pre-GFC levels. The current dividend yield is approximately 4%, which is larger than 98% of the observations between January 2000 and December 2007 and 15% higher than the average dividend yield over that pre-GFC period.

Figure 2. Dividend yield on ASX 200 index

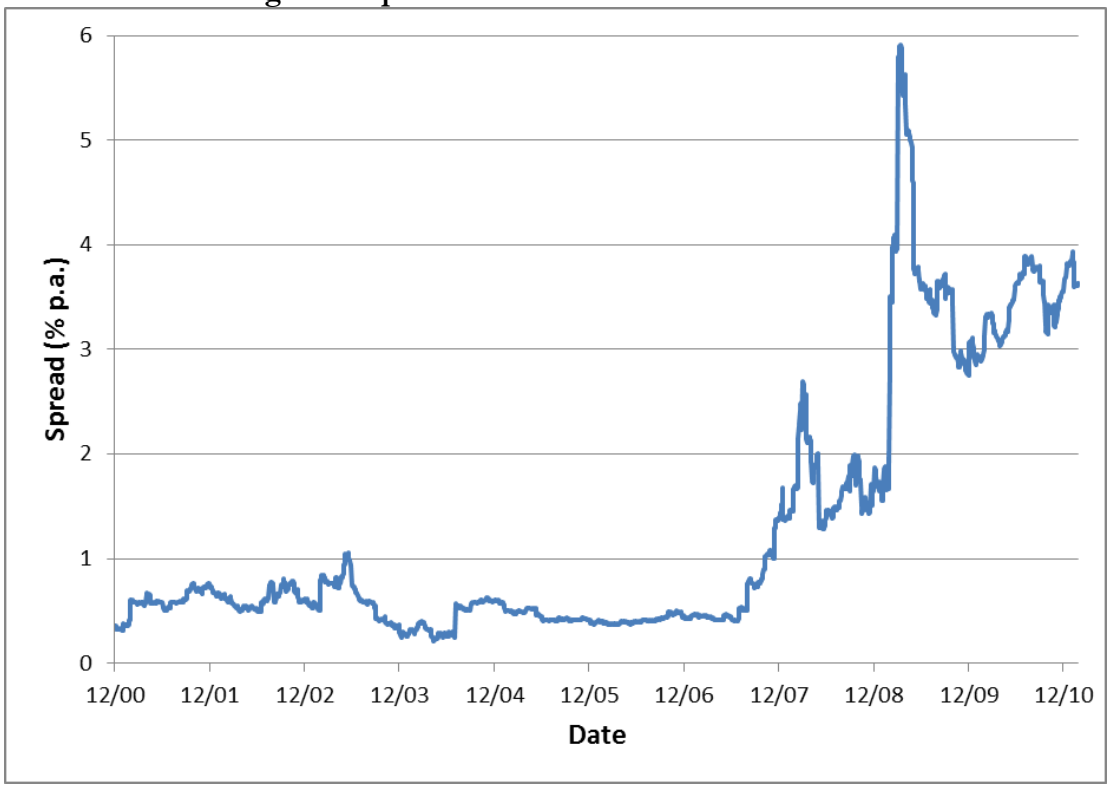


Source: Datastream

31. The default spread is measured as the difference between an index of the yield to maturity on BBB-rated bonds and a corresponding index of AAA-rated bonds. This spread proxies for credit or default risk, which increases during contractions and decreases during expansion. During economic expansions, the spread between the yields on higher- and lower-rated bonds tends to be low as risk premiums are also low. During recessions, however, the spread widens, commensurate with an increase in risk premiums generally.

32. Figure 3 below shows that the credit spread increased dramatically at the height of the GFC and has since declined, but remains well above (more than twice as high) as pre-GFC levels. In this regard, we note that the AER has, in its regulatory decisions, set a debt risk premium above the long-run average and pre-GFC levels. It is implausible that risk premiums in debt markets could remain elevated above long-term averages, while equity risk premiums were no higher at all than *their* long-run average.

Figure 3. Spread between AAA and BBB bonds



Source: Datastream

33. The conclusions that can be drawn from the analysis set out above are:

a. The GFC had a pronounced effect on market risk premiums during the height of the crisis;

b. All indicators suggest that this effect has reduced since the peak of the GFC; and

c. These indicators remain materially above their pre-GFC levels.

34. In our view, the available financial market data supports the conclusion that the effects of the GFC have reduced, but they have not vanished completely. The available financial market data does not support the conclusion that investors view the amount of risk involved in holding a broad portfolio of equities and the price of risk (the additional return that is required in relation to each unit of risk) as now being the same as before the GFC. In our view, the turmoil in financial markets surrounding the GFC continues to have some effect on risk premiums in financial markets.

Is 6.5% a reasonable lower bound for point estimates of the MRP in the current circumstances?

35. To determine whether 6.5% is a reasonable lower bound for point estimates of the MRP in the current circumstances, we consider a number of issues set out below.

Comparison with GFC estimate of MRP

36. It might be argued that if 6.5% was an appropriate estimate of the MRP during the height of the GFC, and if the effects of the GFC have reduced, then the current estimate of MRP should be

somewhat lower than 6.5%. However, this presupposes that 6.5% *was* an appropriate estimate of the MRP during the height of the GFC. But, as set out in Paragraph 20 above, the Final Decision of the Review of WACC Parameters provides no analysis of why the appropriate adjustment to the estimate of MRP (to reflect the effect of the GFC) was precisely 50 basis points. The 50 basis point adjustment was not based on any calculations or modeling. Rather, the AER selected an estimate of 6.5% "having regard to the desirability of regulatory certainty and stability." [13] Moreover, the 50 basis point increase is well within the bounds of statistical estimation error, which indicates that it was a relatively small adjustment given that almost every financial indicator of risk (including the three discussed above) were at their highest levels for decades. For these reasons, the 6.5% estimate should not be treated as any sort of theoretical or empirical maximum upper bound for MRP estimates.

Confidence intervals for statistical estimates

37. Handley (2011) provides point estimates and confidence intervals for his estimates of MRP from historical data. The point estimates of MRP using historical data from 1958 to 2010 (the period for which the most reliable data is available) are 6.6% and 6.4% using theta estimates of 0.65 and 0.3 respectively. These are long-run estimates of MRP over the economic cycle and indicate that 6.5% would be a reasonable estimate of MRP on a long-run average basis – even if one were to conclude that risk premiums in financial markets are currently in line with the long-run average.

38. Also, the confidence intervals reported by Handley (2011) are very wide. Given these wide confidence intervals, an estimate of 6.5% cannot be rejected on statistical grounds.

39. These, and other results from Handley (2011), are illustrated in Figure 4 below. In each case, the solid mark indicates the point estimate and the vertical line represents the 95% confidence interval. The first set of five lines on the graph represent the Handley (2011) estimates for the case where theta is set to 0.65, as in the Draft Decision, and the second set of five lines represents the case where theta is set to 0.3. The solid line across the figure denotes an estimate of 6.5%.

40. The conclusions that can be drawn from the figure are:

    a. The effect of changing the estimates of theta has a very small impact, and any changes in point estimates are tiny compared with the width of the confidence intervals. This is apparent by comparing the point estimate and confidence interval from each case in the first set of five estimates, with the corresponding values in the second set;

    b. The figure plots long-term average estimates, or estimates of average MRP over the economic cycle. Even in this context, 6.5% is a reasonable estimate in that:

        i. It certainly cannot be statistically rejected;

        ii. The point estimates using data from 1958 (which is when the higher-quality data begins) are 6.4% and 6.6% for theta set to 0.65 and 0.3 respectively; and

        iii. Those point estimates would be even higher if data from the few years prior to 1958 were also included.

    c. The confidence intervals are very wide relative to the point estimates. This means that it is statistically impossible to distinguish small differences in MRP estimates. For this reason,

[13] Review of WACC Parameters, Final Decision, p. 238.

increments of 50 basis points are usually used. If the best long-term average estimate of MRP is 6% (as the AER has concluded) then 6.5% represents the smallest feasible increment above this long-term average estimate.

41. For all of the reasons set out above, we conclude that 6.5% is a reasonable lower bound point estimate for MRP in the prevailing conditions in the market.

42. To adopt a 6% MRP estimate in the current conditions, one would need to be satisfied:

a. That 6% is an appropriate long-run average estimate; and

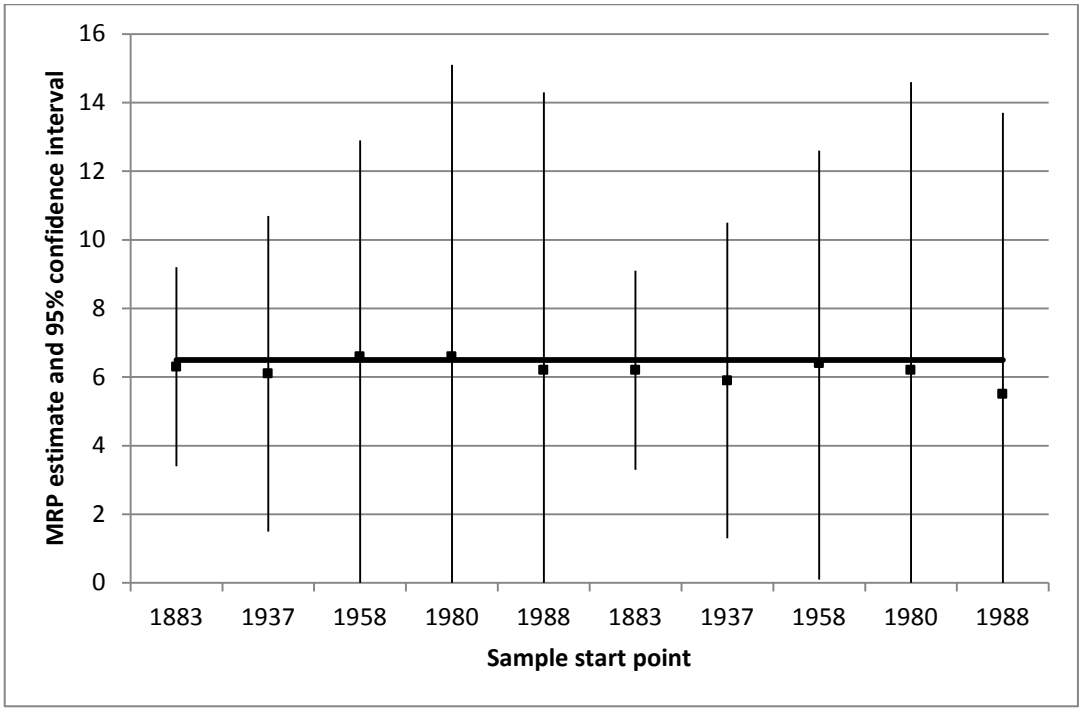
b. That risk premiums in financial markets are currently no different from their long-run average levels.

43. However, both of these conditions are difficult to establish given that:

a. The estimates of the long-run average MRP from the most reliable data period are 6.4% or 6.6% depending on the estimate of theta; and

b. The AER itself has set a debt risk premium at a level that is substantially above the long-run average and pre-GFC levels. It is implausible that risk premiums in debt markets could be substantially above their long-run mean, while equity risk premiums were no higher at all than *their* long-run means.

Figure 4
Historical MRP estimates and confidence intervals



Source: Handley (2011)

Survey evidence

44. The Draft Decision also considers survey evidence from market practitioners and academics:

> …the AER is of the view that survey based estimates should be considered when estimating the MRP for the purposes of this access arrangement review.[14]

45. In this regard, the Draft Decision refers specifically to a recent expert valuation report performed by Grant Samuel and a survey of market practitioners performed by Fernandez and Del Campo (2010). In our view, one should be cautious about placing heavy reliance on these sources because the valuation report is a single data point and the survey is based on only seven anonymous responses. Clearly, these results cannot be considered to be reliable in a statistical sense, and the anonymity of the survey respondents is further reason to place little weight on this data.

46. The Draft Decision interprets this survey evidence generally as supporting an MRP estimate of 6% in the current circumstances, corroborating the AER's estimate which is also 6%. For example:

> Grant Samuel noted in 2009 it has consistently adopted an MRP of 6 per cent and that in view of general uncertainty, this continues to be a reasonable estimate…Moreover, this evidence supports the view that 6 per cent is the best estimate of the forward looking MRP in the current circumstances.[15]

47. However, it is wrong to draw comparisons between these two figures as they are estimates of two different things – it is not a like-with-like comparison. In particular, the AER estimate is an estimate of the MRP including franking credits (where theta is set at 0.65) whereas the Grant Samuel estimate is an estimate of the MRP from dividends and capital gains only. To be comparable, one would have to "gross-up" the estimate in the same way as the AER grosses up its estimate to include the assumed value of theta.

48. The AER's process for determining the amount to add in relation to the assumed value of theta is as follows:

    a. Begin with the dividend yield across the broad market, which is currently approximately 4%;

    b. Multiply this by the proportion of dividends that are franked, which is currently approximately 90%. This gives the franked dividend yield of $0.9 \times 4\% = 3.6\%$.

    c. The franked dividend yield is then multiplied by the amount of franking credits that are attached to each dollar of dividends. At the current corporate tax rate of 30%, 43 cents of franking credits are attached to each franked dividend. Consequently the franking credit yield is $0.43 \times 3.6\% = 1.5\%$.

    d. Finally, each franking credit is assumed to have a value of theta. Using the AER's estimate of 0.65, the return to investors in the average firm from franking credits is $0.65 \times 1.5\% = 1\%$.

49. In summary, the practitioner estimate of 6% includes no value for franking credits. Using the AER's approach for determining how franking credits affect the MRP, and using the AER's estimate of theta produces a 1% grossing up adjustment. That is, the AER's 6% estimate should

[14] Draft Decision, p. 89.
[15] Draft Decision, p. 90.

be compared with a practitioner 7% estimate if a like-with-like comparison is to be made. Both of these estimates include returns from dividends and capital gains as well as returns from franking credits based on the AER estimate and method.

Conclusion

50. We conclude, for the following reasons, that an MRP estimate of 6.5% is a reasonable lower bound for point estimates in the prevailing conditions in the market:

a. The point estimates of MRP using historical data from 1958 to 2010 (the period for which the most reliable data is available) are 6.6% and 6.4% using theta estimates of 0.65 and 0.3 respectively. These are long-run estimates of MRP over the economic cycle and indicate that 6.5% would be a reasonable estimate of MRP on a long-run average basis – even if one were to conclude that risk premiums in financial markets are currently in line with the long-run average;

b. There is market evidence that the turmoil associated with the GFC, and more recent world events, are having a continuing influence on risk premiums in Australian financial markets. In this case, it would be appropriate to adopt a present estimate for MRP that is above the long-run average estimate. Consequently:

   i. If the long-run historical estimate of 6.5% is appropriate for "average" market conditions, a higher value would be appropriate in conditions where risk premiums are thought to be above average; and

   ii. If an estimate of 6% is appropriate for "average" market conditions (consistent with the AER's conclusions in the SoRI), a higher value would be appropriate in conditions where risk premiums are thought to be above average. Given the imprecision in MRP estimates, increments of less than 0.5% are not normally used. Consequently, the minimum estimate that reflects higher than long-run average risk would be 6.5%.

c. The AER compares a practitioner estimate of 6% with its own estimate of 6%. However, the AER's estimate is based on a theta estimate of 0.65 whereas the practitioner estimate is based on a theta estimate of 0. If the practitioner estimate was grossed-up to reflect the AER's estimate of theta, that estimate would be 7%.

Arithmetic vs. geometric averages

51. The Draft Decision contains a discussion of the differences between arithmetic and geometric averages and concludes that:

> Arithmetic means are generally used in estimating expected values and it is also likely that investors 'think' in terms of annual returns, which the AER noted in the WACC review final decision.[16]

52. We agree with the AER's consistent conclusion on this point, again confirming its previous conclusion on this point from the Review of WACC Parameters. We also agree with the reasons behind the AER's conclusion. In the CAPM, the MRP is the difference between the expected return on the market portfolio and the risk-free rate:

$$MRP = E[r_m] - r_f.$$

The estimation of the risk-free rate is relatively uncontroversial and is taken to be the yield on 10-year government bonds. Thus, the historical stock return data is used to form an estimate of the expected (or average) return on the market portfolio.

53. That is, we need an estimate of the return that investors might reasonably expect from an investment in the market portfolio. But this raises the question of the period for which this expectation is formed – do we need an estimate of the expected return over the next month, year, or longer period? The model we use is no help in this regard as it is well known that the CAPM is a one-period model that is silent on the length of the period. However, it is clear that the estimate of MRP must be consistent with the estimates of other WACC parameters and with the timing of cash flows. In the regulatory setting, it is standard practice to estimate the risk-free rate in annual percentage terms and to set out the cash flows using an annual frequency. Indeed this is standard valuation practice more generally. Consequently, what is required is an estimate of the return that investors might reasonably expect from investing in the market portfolio over the next year.

54. More precisely, what is required is an estimate of the expected (or average) return that would be obtained if an individual invested $100 into a broad market portfolio at the beginning of the year and then liquidated that investment at the end of the year. As the Draft Decision notes, we have 125 independent historical observations of exactly that quantity. That is, investors have had 125 independent chances to invest $100 at the beginning of a year and liquidate it at the end. The most appropriate statistical estimate in such a case is to take the arithmetic average, as recognised in the Draft Decision:

> Arithmetic means are more appropriate when observations are considered independent in a statistical sense.[17]

55. The Draft Decision also notes that, although it is standard commercial and regulatory practice to estimate parameters and cash flows at a yearly horizon, that horizon is not mandated by the CAPM. In this regard, the Draft Decision discusses the possibility of using a 10-year horizon. Here the relevant consideration is the expected return of an individual who invests $100 into a broad market portfolio that is liquidated 10 years later. While this longer time horizon is not

[16] Draft Decision, p. 281.
[17] Draft Decision, p. 281.

precluded by the CAPM, it is precluded by the availability of data. There are only a handful of non-overlapping 10-year periods:

> Therefore, it is not easy to calculate excess returns over a 10 year investment horizon with the available data.[18]

56. In summary, the two approaches above are both consistent with the CAPM:

a. Set the relevant time horizon to one year to be consistent with the estimates of other parameters, the forecasted cash flows, and with standard valuation practice. This requires an estimate of the expected (or average) one-year excess return. The statistically appropriate estimate is the arithmetic mean of the independent observations of one-year returns in the sample period; or

b. Set the relevant time horizon to ten years and estimate a ten-year, rather than an annual, required return. This requires an estimate of the expected (or average) ten-year excess return. The statistically appropriate estimate is the arithmetic mean of the independent observations of (non-overlapping) ten-year returns in the sample period.

57. Both of these approaches are consistent with the CAPM, which makes no prescriptions about the length of the time horizon. However, if one determined that the relevant time horizon is one year, it would not be consistent with the CAPM to use the geometric average of one-year returns as the basis for an estimate of MRP. When one has a set of independent observations of the exact quantity of interest, the statistically appropriate estimate of the expected value is the arithmetic mean of those independent observations, by definition. Indeed the standard statistical notation for the arithmetic mean, $E[r_m]$, is identical to the notation used in the CAPM.

58. Given that the CAPM is silent on the length of the time horizon for this purpose, it seems sensible to follow standard valuation practice in using annual returns, in which case the appropriate estimate is the arithmetic mean of annual returns.

59. Finally, we note that taking the geometric mean over an entire sample period is equivalent to assuming that the relevant time horizon is the entire length of that sample period. For example, using a geometric mean over the period 1883-2010 implies that the relevant time horizon is 128 years, which is inconsistent with accepted practice.

[18] Draft Decision, p. 281.

Declaration

60. In preparing this report, I have made all the enquiries that I believe are desirable and appropriate and no matters of significance that I regard as relevant have, to my knowledge, been withheld from the Court.

Professor Stephen Gray
21 March, 2010.

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