Response to the QCA approach to setting the risk-free rate

Report for Aurizon Ltd.

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1. Background and conclusions

Overview and instructions

1. SFG Consulting (**SFG**) has been retained by Aurizon Ltd to provide our views on the discussion paper *The risk-free rate and the market risk premium*, published by the Queensland Competition Authority (**QCA**) in late November 2012. Throughout this report, we refer to this discussion paper as the **Risk-free Rate Discussion Paper**. In the current paper we discuss the specific issue of the term to maturity of government bonds used to estimate the risk-free rate, which forms a component of both the cost of debt and cost of equity capital.

2. The QCA is currently undertaking a comprehensive review of its cost of capital methodology for regulated businesses. It plans to release a series of discussion papers covering various aspects of the cost of capital for public comment. The QCA will then prepare position papers on the key parameters in the cost of capital.

3. The Risk-free Rate Discussion Paper sets out the QCA's current approach to estimating the risk-free rate. In particular, the QCA estimates the risk-free rate as the yield on five-year Commonwealth government bonds, because this is consistent with the term of the regulatory period and, according to the QCA is "consistent with the Net Present Value = 0 principle."[1]

4. Throughout our report we refer to the QCA approach as "term matching" whereby the term to maturity on government debt used to estimate the risk free rate matches the length of the regulatory period. We also refer to the principle that the present value of expected cash flows should equal the asset value as the "NPV neutral" principle.

5. The QCA view is that term matching is necessary to satisfy the NPV neutral principle. It presents this as a statement of fact and debates the implications of using alternative terms to maturity, despite its view that these alternatives would not satisfy the NPV neutral principle. In other words, it considers whether or not a longer term government bond yield should be used to estimate the risk-free rate, despite this providing an abnormal return to investors.

6. We disagree with this assessment and contend that it is not the case that term to maturity matching is needed to achieve an NPV neutral position. This is a technical debate relating to valuation, and we consider that the QCA view only holds under an assumption that the forward curve represents an unbiased assessment of expected future interest rates. There is general agreement that this is not true.[2]

7. However, aside from the technical debate, there are a series of direct problematic implications from the QCA approach which do not arise if the QCA relies upon longer-dated bonds in estimating the risk free rate. These are summarised below.

[1] QCA Risk-free Rate Discussion Paper, p. v.

[2] Fama (1976) provided empirical evidence that forward rates predict future interest rates no better than spot rates. Lally (2007a). Lally (2007b) agrees that the empirical evidence is that forward rates do not equal expected future spot rates.

Summary of conclusions

Implications of the current QCA practice for determining the risk-free rate

8. The current approach of the QCA is to use a term to maturity of five years in estimating the risk-free rate component of the allowed return on debt and equity. This approach has the following implications:

    a) **Prices could be lowered without any cost to the firm simply by shortening the length of the regulatory period.** On average there is an upward-sloping yield curve such that yields on longer-dated government debt are higher than yields on shorter-dated government debt.[3] The QCA rationale is that when a five-year regulatory period is used, the average lower interest rate is appropriate for the lower risk the firm bears from having prices reset every five years rather than ten years. If this rationale were true, prices and risk could be lowered even further by simply resetting the regulated return more often. But no regulator or regulated entity is advocating this. Why? The answer is that risk and the cost of capital are actually **not** systematically lower simply by reducing the length of the regulatory period.[4]

    b) **The estimate of the market risk premium must necessarily be changed.** The QCA estimate of the market risk premium places substantial weight on the historical average of equity market returns compared to government bond yields.[5] In the QCA's MRP Discussion Paper the historical average excess return was reported as 6.21%.[6] Its final estimate, which incorporated survey estimates and a forward-looking estimate was 6.26%. At the time of writing, Australian 10-year government bond yields were approximately 3.61%, compared to 3.17% for five-year government bond yields.[7] The implication of the QCA approach is that if we had a 10-year regulatory period the QCA would expect the cost of equity for the average firm to be 9.87% but if we had a five-year regulatory period it would expect the cost of equity for the average firm to be 9.43%.

       If the QCA believes that the average firm would earn its estimated risk premium above the 10-year government bond yield it makes no sense to believe this estimate would change because an administrative decision was made that five-year regulatory periods were to be used. It should necessarily increase the market risk premium estimate by the current difference between 10- and 5-year government bond yields. This does not require an estimate

[3] Hall (2007) reports that over 30 years from 1977 to 2007 the average yields on government bonds with ten, five and two years to maturity were 9.9%, 9.7% and 9.3%, respectively. In its MRP Discussion Paper the QCA reports that, over five and a third years from July 2007 to October 2012, the average yield on ten year bonds was 5.5% compared to 5.2% for five year bonds.

[4] As presented in detail in Section 3 the reason for this is that merely re-setting prices more frequently does not alter the cost of capital investors apply to expected cash flows outside of that regulatory period. It merely alters the expected cash flows.

[5] The QCA places 25% weight on historical average equity returns relative to government bond yields from the Ibbotson data series, a further 25% weight on historical average equity returns adjusted for the QCA estimate of unexpected inflation and 25% weight on survey evidence, upon which it is unclear how much weight respondents placed on historical averages and contemporaneous market conditions in giving their response. Hence, somewhere from 50 – 75% weight is assigned to historical average values.

[6] QCA MRP Discussion Paper, Table 3.1, p. 11.

[7] On 13 March 2013 Bloomberg reported a yield to maturity on 10-year government bonds of 3.58% and a yield to maturity on 5-year government bonds of 3.15%. Assuming semi-annual coupon payments and bonds trading at par, this implies annualized yields of $(1 + 0.0358/2)^2 – 1 = 3.61\%$ and $(1 + 0.0315/2)^2 – 1 = 3.17\%$.

of the long-term average premium relative to five-year government bonds as the QCA claims.[8]

c) **The regulator is estimating a price below that which would prevail in a competitive market.** The basic objective in the regulation of networks is to estimate the price that would prevail in a competitive market. The mechanism by which the regulator attempts this task is to allow the firm, in expectation, to earn a regulated return which allows the firm to recover its cost of capital. This is the principle upon which the Authority relies, that the net present value of expected cash flows should equal zero.

   The length of the regulatory period represents a trade-off between administrative burden, regulatory certainty and timeliness of assumptions. It is entirely independent of the price which would prevail in a competitive market. But by linking the term to maturity of the risk-free rate estimate to the regulatory term, the regulator is, in essence, achieving a different objective. The regulator is now in the position of determining what is the "correct" price according to a criteria other than the price which it believes will prevail in a competitive market.

   In a competitive market it is reasonable to think that the owner of a network would finance its operations using long-term debt and that cost of this long-term debt would be reflected in competitive market prices. Yet in setting a 5-year term to maturity the regulator has, in effect, determined that a 5-year debt maturity is appropriate and provides the lower return associated with this shorter term to maturity.

The use of longer term debt to estimate the risk free rate does not violate the NPV neutral principle

9. Contrary to the QCA's statements, term matching is not required for an NPV neutral position and the use of longer term debt to estimate the risk free rate does not violate the NPV neutral position.

10. The debate on this issue is encapsulated in three papers published in the *Accounting Research Journal* in 2007. Lally (2007a) presents the argument that the term to maturity used to estimate the cost of debt must match the regulatory period. Hall (2007) contends that this conclusion only holds under one particular set of assumptions regarding future interest rates, that forward rates are an unbiased expectation of future spot rates. Further, as this assumption is inconsistent with the empirical evidence there is no need whatsoever to align the two periods. Lally (2007b) rebuts this contention, arguing that his paper required no assumption whatsoever about future interest rates.

11. The argument of Lally (2007a, 2007b) is that regulation over five years effectively immunises investors against interest rate fluctuations outside of this five-year period. We do not know what those future rates might be, but at the time of the regulatory reset there will be a new set of cash flows which reflect these interest rates, such that the value at the end of five years is effectively guaranteed.

12. This argument basically considers an investment in a regulated entity to be equivalent to a five-year corporate bond, in which the par value is repaid at the end of the fifth year, unless there is a default. But this does not characterise the risk that investors in the regulated entity are exposed to. At the time of their investment they will form expectations for cash flows over the entire asset life and discount

[8] The QCA states that, "from a practical perspective, there is a need to compromise and use the longest available data series, which means using a 10-year average of the market risk premium." This can still be used to form the QCA's view as to the expected return for the average firm in the equity market.

those cash flows at discount rates which reflect the risk of those cash flows. This is the argument made by Hall (2007).

13. Those discount rates are set by the market today. Just because the regulator changes the technique for estimating a series of cash flows does not change those discount rates. So if the regulator announced today that it will use lower interest rates to set the regulated rate of return, and there is no change in the discount rates set by the market, the value of the asset will fall. The only way the asset value can remain unchanged is if the fall in the regulated return is offset by a corresponding fall in the discount rate.

14. The argument of Lally (2007a, 2007b) is that this matching of regulated return and discount rates does occur, because whatever the interest rates are at the end of five years these will be the discount rates set by the market. The problem is that the value of the asset today will be determined by the market's expectations for future interest rates (which determine the expected cash flows) and the term structure of interest rates today (which determine how those cash flows are discounted). The term matching principle holds only under the assumption that the term structure of interest rates today provides a set of unbiased expectations for future interest rates. Empirical evidence shows that this assumption does not hold.[9]

15. The key point is that the QCA position is that the term of the regulatory period can be set to eliminate investors' exposure to interest rate movements outside of the regulatory period. Given an upward-sloping yield curve it could reduce the cost of capital and prices without any impact on firm value. We question this ability, and suggest that if this were true, regulators would have incorporated such considerations earlier. Surely the benefits would be substantial enough to devote a great study to the risks and benefits of this change. The QCA acknowledges that there are re-financing risks associated with the use of five year debt rather than ten year debt, so provides an allowance for debt raising costs.[10] However, this is well short of the analysis we would expect to see if, in reality, there was the chance to reduce the cost of capital even further, by shortening the length of the regulatory period and estimating the cost of debt with reference to bonds of the same maturity.

16. The answer to this question is that we can't arbitrarily reduce risk by changing the length of the regulatory period.

[9] Fama (1976), Lally (2007b).

[10] For example, see the discussion on pages 11 – 12 of the QCA draft decision on QR Network's Draft access Undertaking, December 2009.

2. Implications of the current QCA approach

Overview

17. The QCA has determined that the term to maturity of government bonds used to estimate the risk free rate needs to match the term of the regulatory period in order for the net present value of expected cash flows to equal zero. In the QCA case that term is five years. For ease of exposition we refer to this as "term matching."

18. The QCA has reached this conclusion on the basis of advice received over an extended period of time, which essentially uses the same technical argument presented in the published paper by Lally (2007a). What is not acknowledged in the Risk-free Rate Discussion Paper is that there are a series of three articles in the same journal which debate this issue (Lally, 2007a; Hall, 2007; and Lally, 2007b) in which there is disagreement about whether term matching is required to satisfy this principle.

19. The QCA also states that the rates on government debt vary with the term to maturity of the debt instrument, or in other words the term structure is not flat,[11] and presents data over a five-year period to show an average difference of 0.27% in yields on 10- and 5-year government debt.[12]

20. The technical advice is that regulation effectively immunises the business against interest rate changes outside of the regulatory period. At the end of five years, it is argued that regulated prices are reset, based upon interest rates prevailing at that time, so investors are only exposed to risks over the five-year regulatory period.

21. This advice is not correct. It is not the case that in order to satisfy the NPV = 0 principle that the term of the risk-free rate needs to match the term of the regulatory period. The QCA discussion paper presents the net present value statement as truth, and discusses consequences associated with the violation of this principle. This discussion is unnecessary because it is not the case that term matching is necessary to satisfy the NPV = 0 principle.

22. This is a technical debate relating to valuation, which we discuss in detail in Section 3. But before proceeding to the technical issues, it is worth noting the implications of adopting one conclusion versus another. These should be considered in conjunction with the technical debate, not as an aside to the technical debate. These implications are as follows:

    a) The first implication is that prices could be lowered without any cost to the firm, simply by shortening the length of the regulatory period. If the term matching approach were valid, why have regulators not taken this principle further and chosen to reset prices at even greater frequency than five years, based upon even shorter terms to maturity?[13] The benefits of an additional 0.1 – 0.3% reduction in the cost of capital would be substantial, yet there is not even a debate on this issue. Why? The answer is that a debate over whether to refer to five or ten year debt yields is convenient because one of these terms matches the regulatory period and the other term is the longest dated government bond yields reported on a daily basis. But

[11] QCA Risk-free Rate Discussion Paper, p. 4

[12] QCA Risk-free Rate Discussion Paper, Table 4.1, p.13

[13] There is a difference between more frequent updating of the cost of capital estimate with reference to debt with a long term to maturity, and more frequent updating matching the term to the length of the regulatory period. In some instances the regulator may update its cost of capital estimates more frequently than every five years, for example on an annual basis, but they do not use the one-year risk free rate in this update.

the reason this debate has not progressed further is that regulators have no well-defined rationale to determine the regulatory period which would provide the lowest cost of capital.

b) The second implication is that the estimate of the market risk premium must necessarily be changed. Prior to the QCA deciding to adopt term matching its view was that the average firm in the market would be expected to generate equity returns equal to the 10-year bond rate plus 6%. Subsequent to adopting term matching the QCA believes the equity market is expected to earn a return equal to the 5-year bond rate plus 6%. Why has the expected return on the average stock changed? The answer is it has not, so the market risk premium estimate should reflect the difference between 10- and 5-year bond yields at the time of the determination.

c) The third implication is that the QCA is setting prices below those which would prevail in a competitive market. Suppose that the competitive market outcome is that infrastructure assets are financed over a long period, and the cost of long-dated debt is reflected in competitive market prices. The QCA approach, on average, lowers prices below the competitive market outcome. The QCA contends that these lower prices reflect the lower risk to the firm associated with re-setting prices every five years rather than ten years.

Prices could be lowered without any cost to the firm, simply by shortening the length of the regulatory period

23. On average we observe an upward-sloping yield curve, so the typical case is a yield on 5-year debt which is less than the yield on 10-year debt. This is consistent with the yields over the last five years presented by the QCA which show an average difference of 0.27% between the yields on 10- and 5-year debt.[14] According to the QCA's rationale, we could adopt a 10-year regulatory period and have relatively high prices or a 5-year period and adopt relatively low prices. In both cases the firm would earn a return equal to its cost of funds so is unaffected. If this is true, then why not switch to a three-year period, or a one-year period, for setting the regulated rate of return? Compared to the potential economic benefits – lower prices at no loss of value – the administrative costs of estimating the regulated return would be small. But no-one is proposing that the regulated return be reset every year with reference to debt with one year maturity.

24. There is a plausible reason why the Authority has not advocated for an even shorter term reset period, aside from administrative cost. A shorter period exposes the firm to more hedging costs and/or refinancing risk. In order to offset its interest costs with the debt component of the regulated return, the firm typically participates in the bond and swaps markets in order to incur effective interest costs which approximate the debt component of the benchmark return. This increases hedging costs and exposes the firm to risk because the swaps market does not necessarily trade enough volume in a short space of time to achieve an effective hedge. An alternative is to refinance the debt portfolio at each reset period, but this approach typically exposes the firm to more risk of a mis-match between interest expense and debt allowance because of illiquidity in the bond market.

25. So, a shorter regulatory period has not been promoted as a means to lower prices without an economic loss, perhaps because of refinancing risk. But if refinancing risk is such a concern, why not reduce this even further and advocate for a ten-year regulatory period?

[14] QCA Risk-free Rate Discussion Paper, Table 4.1, p. 13

26. The answer is that we cannot have lower prices and no loss of value to the firm, merely by assuming a lower term to maturity for the risk free rate. Firm value is not independent of interest rates outside of the regulatory period. At the time of the regulatory reset, the market will value the firm as a function of two inputs – its expected cash flows for all periods and its expectations for all future discount rates. Both sets of expectation are formed at the time of the determination. The expected future discount rates are entirely independent of the regulator's determination as to what is incorporated in the expected cash flows. On the other hand, the expected cash flows are a direct function of the regulator's decision.

The estimate of the market risk premium must necessarily be changed

27. In all its determinations the QCA has adopted an estimate of the market risk premium of 6.00%, which is the most common assumption in regulatory determinations. It is also an assumption which exhibits very little variation across those determinations, despite material fluctuations in the assumed debt risk premium.

28. The reason for the stability of the market risk premium estimate is that, in comparison to the debt risk premium, it is more challenging to observe with precision. So the regulator places a large amount of weight in decision-making on the historical equity market returns relative to government bond yields and a low amount of weight on contemporaneous indicators of the premium. In the QCA's case this weight is between 50% and 75% depending upon whether survey estimates of the market risk premium are considered to be estimates of the contemporaneous risk premium or estimates of the long-term average.[15]

29. According to the QCA estimates the historical average return on equities relative to 10-year government bonds is 6.21%. The QCA also reports an estimate of 4.32%, which removes the effect of what it considers to be an unexpected component of inflation. This means that if the QCA had no information about risk premiums in current market conditions and no survey evidence it would assign a market risk premium of 5.27% as it places equal weight on each of these two assumptions.[16] We ignore the issue of rounding to the nearest per cent for the moment.

30. At the time the discussion paper was written the QCA considered a contemporaneous estimate of the market risk premium to be 8.70% and the estimate from survey evidence to be 5.80%. Taking account of each of these estimates with equal weight the average market risk premium estimate is 6.26%, which the QCA rounds to 6.00%.

31. There is no question that the QCA has made these estimates of the market risk premium with respect to the yield on 10-year government bonds. There is also no question that the market risk premium is an estimate of the return expected to be earned on the broader market, which is the same as the return expected to be earned on an investment with average systematic risk. Yet the QCA considers it to be inappropriate to make any adjustment to the market risk premium to account for the use of a five-year

[15] In survey responses it is difficult to determine whether the respondent is stating the cost of equity capital which is present in the market at that time (that is, which sets the present value of expected cash flows equal to the market price) or whether the respondent is stating the cost of capital he or she would use to arrive at a fair value. That fair value estimate may well be based upon a long-term average return. It is also not clear whether the respondent is considering a market risk premium for illustrative purposes or for investment purposes. For example, a professor might use a long-term average market risk premium estimate in class today which does not necessarily reflect today's market conditions, but an investor might use a different estimate today. For more discussion on this issue see SFG Consulting, 2013, *Response to the QCA Discussion Paper on risk-free rate and market risk premium*.

[16] QCA Risk-free Rate Discussion Paper, p. 10.

term to maturity for debt, and as such, is seemingly at a cross purposes. In other words, the QCA makes estimates of the MRP with reference to yields on ten year debt, yet considers it inappropriate to account for the use of five year term to maturity in setting the regulated rate of return.

32. At the time of writing the yield on 10-year government bonds was approximately 3.61%, compared to 3.17% for five-year government bonds. The implication of the QCA approach is that if we had a ten-year regulatory period it would expect the cost of equity for the average firm to be 9.87% (that is, a risk free rate of 3.61% plus a market risk premium of 6.26%). But if we had a five-year regulatory period it would expect the cost of equity for the average firm to be 9.43% (that is, a risk free rate of 3.17% plus a market risk premium of 6.26%).

33. If the QCA believes that the average firm would earn its estimated risk premium above the ten-year government bond yield it makes no sense to believe this estimate would change because an administrative decision was made that five-year regulatory periods were to be used. It should necessarily increase the market risk premium estimate by the current difference between ten- and five-year government bond yields.

34. This does not require an estimate of the long-term average premium relative to five-year government bonds as the QCA claims. The QCA states that the use of a long-term average estimate made with respect *to* ten-year yields allows it to use the longest period of available data so is a reasonable compromise.[17] The issue is not about measuring the risk premium with respect to a different risk free rate. It is simply about reaching a decision as to the expected return on an investment with average systematic risk, and then subtracting the QCA's estimate of the risk-free rate.

35. The QCA's reluctance to use a market risk premium relative to five-year bond yields is associated with its view on statistical imprecision, the basis for which it rounds its market risk premium estimate to the nearest percent. The QCA contends that the imprecision in the market risk premium estimate is large, relative to the difference between five- and ten-year bond yields. The leads to its view that, if it cannot be established with statistical reliability that the market risk premium estimate should be 6.26% instead of 6.00% then it should maintain the 6.00% assumption.

36. This is a misapplication of the notion of statistical estimation error. Suppose that the two bond yields are observed with precision, but the market risk premium is estimated with error. In that case, the error associated with the cost of equity capital is exactly the same as the error associated with the market risk premium. In statistical terms, assuming a ten-year term to maturity, the mean estimate for the cost of equity capital is 9.87% and it has a standard error of x%. We don't know with certainty the value for x% but we will see that it does not matter. For the purposes of the exercise, let us assume it is 0.50% so one standard error either side of the mean provides a range of 9.37% to 10.37%.

37. Then, the QCA changes its assumption for the risk-free rate but holds constant its expectation for the market risk premium. Under a five-year term to maturity, the authority changes its conclusion to a mean estimate of 9.43%. But the standard error has not changed from 0.50%. So the range of one standard error either side of the mean is 8.93% to 9.93%.

38. In essence, the QCA's view is that the two means are not statistically different from each other so it should remain with its default estimate of a 6.00% market risk premium. But the Authority has actually changed its best estimate of the cost of equity capital. It previously believed that its best estimate of the cost of equity in the broader market was 9.87%. Now it believes that its best estimate of the cost

[17] QCA Risk-free Rate Discussion Paper, p. 6.

of equity in the broader market is 9.43%. And this occurs simply because current practice is to adopt a regulatory period of five-years instead of ten-years.

39. The QCA also makes reference to commentary from Lally (2004) that increasing the market risk premium by the difference between the five- and ten-year bond yields implicitly assumes that the term structure for equity is flat. It does not invoke this assumption and in any event is irrelevant to the discussion and a distraction from the issue. The issue is that the QCA forms a view as to the expected return that the average stock will earn over the next five years. It is not possible that this expectation will depend upon the term of the regulatory period.[18]

The regulator is setting a price below that which would prevail in a competitive market

40. The basic objective in the regulation of networks is to estimate the price which would prevail in a competitive market. The mechanism by which the regulator attempts this task is to allow the firm, in expectations, to earn a regulated return which allows the firm to recover its cost of capital. This is the principle upon which the Authority relies, that the net present value of expected cash flows should equal zero.

41. The length of the regulatory period represents a trade-off between administrative burden, regulatory certainty and timeliness of assumptions. If the regulatory period is very long, there is low administrative burden, high regulatory certainty but a high risk that the assumptions which underpin the determination are no longer appropriate by the end of the period. If the regulatory period is very short, assumptions are timely but there is an increased administrative cost and reduced business confidence about revenues outside of the regulatory period.

42. The selection of the regulatory period is entirely independent of the price which would prevail in a competitive market. But by linking the term to maturity of the risk-free rate estimate to the regulatory term, the regulator is, in essence, achieving a different objective. The regulator is now in the position of determining what is the "correct" price according to a criteria other than the price which it believes will prevail in a competitive market.

43. To some extent, the nature of regulation will impact upon the firm's behaviour. The firm will operate in a manner which maximises value for shareholders, conditional upon the regulatory framework in which it operates. But the concept involved here is different to other relationships between regulation and firm behaviour.

44. In a competitive market it is reasonable to think that the owner of a network asset would finance its operations using long-term debt, given its tangible assets and relatively stable operational cash flows. It is for these very reasons that the regulator assumes the firm can finance its operations with 60% debt. Thus, in the absence of regulation, the firm would incur debt costs associated with ten-year maturity debt rather than five-year maturity debt.

45. Instead, the regulator determines that a five-year debt maturity is appropriate and provides the lower allowance associated with this shorter term to maturity. All else being equal, the regulator allows for lower prices than would prevail in a competitive market. The regulator believes this is the fair return for risk, because the underlying rationale is that the regulated return is the cost of capital. So the regulator has determined that the five-year regulatory period has lowered the firm's risk and consequently allows for lower prices than would otherwise prevail.

[18] QCA Risk-free Rate Discussion Paper, p. 6 and Appendix A, p. 20.

46. The consequence of this is that the regulator has determined that allowing a lower return/lower risk price (compared to the competitive market price) has more economic benefits than allowing for the price which would prevail in a competitive market. Yet there has been no analysis of the potential consequences of this choice. Furthermore, if it was optimal to reduce the cost of funds and therefore reduce the regulated price below the competitive market price, why would this principle not be taken further? According to the Authority's rationale, the administrative choice of a five-year regulatory term implies lower risk to the firm than a ten-year regulatory term, because this choice flows through to an average lower cost of funds. Why not implement a series of administrative choices which also reduce the cost of funds and therefore result in even lower prices?

47. The answer is that the regulatory framework is designed with the objective of replicating competitive market outcomes, and in particular the price which would prevail in that competitive market. Regulation itself changes the interaction between the firm and the market – it increases some risks and decreases others – but the intention is that the average impact on price is neutral. In adopting the shorter term to maturity in the risk-free rate assumption, the price impact is not neutral. If the Authority believes that the normal borrowing arrangement for the firm would be the issuance of long-dated debt, then adopting a short-term risk-free rate assumption necessarily implies a price below that which would prevail in a competitive market.

3. Valuation issues

Overview

48. The debate on this issue is encapsulated in three papers published in the *Accounting Research Journal* in 2007. Lally (2007a) presents the argument that the term to maturity used to estimate the cost of debt must match the regulatory period. Hall (2007) contends that this conclusion only holds under one particular set of assumptions regarding future interest rates, that forward rates are an unbiased expectation of future spot rates. Further, as this assumption is inconsistent with the empirical evidence there is no need whatsoever to align the two periods. Lally (2007b) rebuts this contention, arguing that his paper required no assumption whatsoever about future interest rates.[19]

49. This section is devoted to the technical aspects of this debate, specifically about whether the term to maturity of the risk free rate needs to match the regulatory period in order for the present value of expected cash flows to equal the asset base. We do not believe there needs to be any relationship between these two terms in order for this NPV neutral position to hold.

50. The argument of Lally (2007a, 2007b) is that regulation over five years effectively immunises investors against interest rate fluctuations outside of this five-year period. We do not know what those future rates might be, but at the time of the regulatory reset there will be a new set of cash flows which reflect these interest rates, such that the value at the end of five years is effectively guaranteed.

51. This argument basically considers an investment in a regulated entity to be equivalent to a five-year corporate bond, in which the par value is repaid at the end of the fifth year, unless there is a default. But this does not characterise the risk that investors in the regulated entity are exposed to. At the time of their investment they will form expectations for cash flows over the entire asset life and discount those cash flows at discount rates which reflect the risk of those cash flows.

52. Those discount rates are set by the market today. Just because the regulator changes the technique for estimating a series of cash flows does not change those discount rates. So if the regulator announced today that it will use lower interest rates to set the regulated rate of return, and there is no change in the discount rates set by the market, the value of the asset will fall. The only way the asset value can remain unchanged is if the fall in the regulated return is offset by a corresponding fall in the discount rate.

53. The argument of Lally (2007a, 2007b) is that this matching of regulated return and discount rates does occur, because whatever the interest rates are at the end of five years these will be the discount rates set by the market. The problem is that the value of the asset today will be determined by the market's expectations for future interest rates (which determine the expected cash flows) and the term structure of interest rates today (which determine how those cash flows are discounted). The term matching principle holds only under the assumption that the term structure of interest rates today provides a set of unbiased expectations for future interest rates. Empirical evidence shows that this assumption does not hold.

54. To simplify the analysis, both Lally (2007a and 2007b) and Hall (2007) consider the case where the asset life is two years and the regulatory period is one year. So there are two regulatory periods in the life of the asset. The two questions are:

[19] The QCA also cites Schmalensee (1989) in support of the more general principle that the regulated price should cover the firm's efficient costs, including the cost of capital. But this does not necessarily imply term matching.

a) Is there a restrictive assumption which underpins the term matching principle?

b) What is the regulated return which satisfies the present value principle which does not rely upon a restrictive assumption?

55. We address these questions below but reiterate that the issue is not simply about the technical debate. In the prior discussion we presented three implications of accepting the term matching argument – that we could lower prices and risk further by even shorter regulatory periods, that the market risk premium must rise and the regulated price being below the competitive market price. But these are not implications to be considered as a trade-off to violating the NPV neutral principle. It is still the case that the present value of expected cash flows will equal the asset base if the regulated rate of return is set with reference to the term to maturity which would actually be used in an unregulated firm. In short, using yields on ten-year bonds does not violate the NPV neutral principle.

General case

56. Consider the case where an investment of C dollars is funded by L proportion of debt and $(1 - L)$ proportion of equity. So, we want to know whether the present value of expected cash flows to equity holders equals the initial equity investment of $(1 - L) \times C$.

57. The expected cash flow to equity holders in year one is the sum of four components. The symbols used below correspond to those used in Lally (2007) apart from the symbol for the regulated return, which we express as ret_1 and ret_2 for the regulated return adopted for year one and two, respectively. Once we set up the framework we will adopt specific assumptions for the way the regulated return is set. The cost of debt and equity capital are the same in this analysis. The expected cash flow to equity holders in year one (F_1) is:

a) The return of capital – the asset base (C) multiplied by the depreciation rate (k); plus

b) The return on capital – the asset base (C) multiplied by the regulated return (ret_1); less

c) The repayment of debt – the leverage ratio (L) multiplied by the asset base (C) multiplied by the depreciation rate (k); less

d) The interest expense on debt – the leverage ratio (L) multiplied by the asset base (C) multiplied by the interest rate on debt (which is the same as the regulated return because in this analysis the cost of debt and equity capital are the same) (ret_1).

58. Expressed as an equation we have:

$$\begin{aligned} F_1 &= Return\ of\ capital + Return\ on\ capital - Repayment\ of\ debt - Interest\ expense \\ &= Ck + Cret_1 - LCk - LCret_1 \end{aligned}$$

59. The appropriate discount rate to apply to this expected cash flow is the one-year interest rate prevailing at time 0 (R_{01}). So the present value of the first year expected cash flow is:

$$\begin{aligned} PV(F_1) &= \frac{Ck + Cret_1 - LCk - LCret_1}{1 + R_{01}} \\ &= \frac{Ck(1-L) + Cret_1(1-L)}{1 + R_{01}} \end{aligned}$$

$$= \frac{C(1-L)(k+ret_1)}{1+R_{01}}$$

60. Now consider the second year expected cash flow. This comprises the same four components, but with a lower investment base. The four components are:

a) The return of capital – the asset base [$C \times (1-k)$]; plus

b) The return on capital – the asset base [$C \times (1-k)$] multiplied by the regulated return in year two (ret_2); less

c) The repayment of debt – the leverage ratio (L) multiplied by the asset base [$C \times (1-k)$]; less

d) The interest expense on debt – the leverage ratio (L) multiplied by the asset base [$C \times (1-k)$] multiplied by the regulated return (ret_2).

$$\begin{aligned} F_2 &= Return\ of\ capital + Return\ on\ capital - Repayment\ of\ debt - Interest\ expense \\ &= C(1-k) + C(1-k)ret_2 - LC(1-k) - LC(1-k)ret_2 \\ &= C(1-k)(1 + ret_2 - L - Lret_2) \\ &= C(1-k)[(1-L) + ret_2(1-L)] \\ &= C(1-k)(1-L)(1+ret_2) \end{aligned}$$

61. As with the expected cash flow in the first year, we need to discount this expected cash flow to time zero. The discount factor in the denominator accounts for the year one year discount rate (R_{01}) and the expected one-year discount rate in year two (R_{12}). This means that the present value of year two expected cash flows is as follows:

$$PV(F_2) = \frac{C(1-k)(1-L)(1+ret_2)}{(1+R_{01})(1+R_{12})}$$

62. So if we sum the two present value computations we have the following equation:

$$PV(F_1) + PV(F_2) = \frac{C(1-L)(k+ret_1)}{1+R_{01}} + \frac{C(1-k)(1-L)(1+ret_2)}{(1+R_{01})(1+R_{12})}$$

63. So the issue becomes, is there a technique for specifying the regulated rates of return (that is, ret_1 and ret_2) which sets the right-hand side of the equation equal to the equity investment of $C(1-L)$?

Term matching

64. One approach would be to set the regulated return with reference to the yield on one-year debt. This is the proposal of Lally (2007a, 2007b). For the first year, this is observable. The yield is R_{01}, so we would set ret_1 equal to R_{01}. The issue is what happens in the second year. The argument of Lally is that, if term matching is adopted, it does not matter what happens to interest rates between now and the end of the first regulatory period. Any movement in the regulated return (ret_2) will be matched by movement in the second year discount rate (R_{12}). If the discount rate in the second year and the regulated return in the second year are aligned at R_{12} then we have the following present value equation:

$$
\begin{aligned}
PV(F_1) + PV(F_2) &= \frac{C(1-L)(k+R_{01})}{1+R_{01}} + \frac{C(1-k)(1-L)(1+R_{12})}{(1+R_{01})(1+R_{12})} \\
&= \frac{C(1-L)(k+R_{01})}{1+R_{01}} + \frac{C(1-k)(1-L)\cancel{(1+R_{12})}}{(1+R_{01})\cancel{(1+R_{12})}} \\
&= \frac{C(1-L)(k+R_{01}+1-k)}{1+R_{01}} \\
&= \frac{C(1-L)(1+R_{01})}{1+R_{01}} \\
&= C(1-L)
\end{aligned}
$$

65. As highlighted in the equation, the present value of expected cash flows is equal to the initial investment because the two expressions ($1 + R_{12}$) are off-setting. But it is at this point where the divergence of opinion arises. We have a different view to Lally (2007a, 20007b) as to what R_{12} represents. The views can be summarised as follows.

 a) Lally contends that, at the end of year one, we observe the year two interest rate and this is both the discount rate to apply to year two and the regulated return. So the interest rates will always be equivalent. Hence, setting the term to maturity equal to the regulatory period ensures the present value equation is satisfied.

 b) We disagree. Both the regulated return in year two (ret_2) and the discount rate for the second year (R_{12}) have an expected value today. If the regulator adopts a different technique for estimating the return in year two, this does not affect the market's expectation today for the discount rate in year two. This means that the present value equation above only holds under one specific assumption – that the *expectation* for the regulated return equals the *expectation* for the one-year rate in one year's time.

66. In the words used in Hall (2007) we state that, under term matching, the present value equation is satisfied only if the expectation for the next one-year rate is equal to the one-year forward rate for one-year borrowing. If, instead, the market believed that one-year interest rates were going to be the same as today's one-year rate (that is, if $ret_2 = R_{01}$) then the present value equation would be as follows:

$$
\begin{aligned}
PV(F_1) + PV(F_2) &= \frac{C(1-L)(k+R_{01})}{1+R_{01}} + \frac{C(1-k)(1-L)(1+R_{01})}{(1+R_{01})(1+R_{12})} \\
&= \frac{C(1-L)(k+R_{01})}{1+R_{01}} + \frac{C(1-k)(1-L)\cancel{(1+R_{01})}}{\cancel{(1+R_{01})}(1+R_{12})} \\
&= C(1-L)\left(\frac{k+R_{01}}{1+R_{01}} + \frac{1-k}{1+R_{12}}\right) \\
&= C(1-L)\left[\frac{k+R_{01}+kR_{12}+R_{01}R_{12}+1-k+R_{01}-kR_{01}}{(1+R_{01})(1+R_{12})}\right] \\
&= C(1-L)\left[\frac{1+2R_{01}+kR_{12}+R_{01}R_{12}-kR_{01}}{(1+R_{01})(1+R_{12})}\right] \\
&= C(1-L)\left[\frac{(1+R_{01})(1+R_{12})+(R_{01}-R_{12})(1-k)}{(1+R_{01})(1+R_{12})}\right] \\
&= C(1-L)\left[1+\frac{(R_{01}-R_{12})(1-k)}{(1+R_{01})(1+R_{12})}\right]
\end{aligned}
$$

67. The implications are that, if we assume that the yield curve next year is that same as this year's yield curve (so that $ret_2 = R_{01}$) then:

a) If the year two discount rate is higher than this year's interest rate ($R_{12} > R_{01}$) then the expression in the square brackets is less than one and the present value of expected cash flows will be less than the equity investment. This will happen if the yield curve is upward-sloping which, on average, is true.

b) If the year two discount rate is equal to this year's interest rate ($R_{12} = R_{01}$) then the expression in the square brackets is equal to one and the present value of expected cash flows is equal to the equity investment.

c) If the year two discount rate is lower than this year's interest rate ($R_{12} < R_{01}$) then the expression in square brackets is greater than one and the present value of expected cash flows will be greater than the equity investment.

68. In sum, the term matching principle does not guarantee that the present value of expected cash flows to equity holders equals the equity investment. This holds only under the following assumption – that the expected interest rate in the next regulatory period is the same as the discount rate applied to that interest rate. Alternatively, if the current interest rate is the expected rate next period, then an upward-sloping yield curve will result in a loss of equity value and a downward-sloping yield curve will result in a gain.

What is the correct regulated return?

69. The previous sub-section demonstrates that term matching only provides the correct regulated return if the market's expectation for the next one-year rate is equal to the current discount rate appropriate for year two. If the market expected next year's one-year rate to be the same as this year's rate, the present value equation no longer holds. This prompts the question as to what is the appropriate regulated return?

70. To answer this question, we rearrange the general equation to solve for the regulated return in period 1 (ret_1). We have:

$$C(1-L) = \frac{C(1-L)(k+ret_1)}{1+R_{01}} + \frac{C(1-k)(1-L)(1+ret_2)}{(1+R_{01})(1+R_{12})}$$

$$1 = \frac{k+ret_1}{1+R_{01}} + \frac{(1-k)(1+ret_2)}{(1+R_{01})(1+R_{12})}$$

$$1+R_{01} = k+ret_1 + \frac{(1-k)(1+ret_2)}{(1+R_{12})}$$

$$ret_1 = 1+R_{01} - k - (1-k)\frac{(1+ret_2)}{(1+R_{12})}$$

$$ret_1 = R_{01} + (1-k)\left(1 - \frac{1+ret_2}{1+R_{12}}\right)$$

71. Recall that this is a general equation. It simply expresses the regulated return in the first year as a function of the current one-year rate (R_{01}), the year two discount rate (R_{12}), the depreciation rate (k), and the expected regulated return in year two (ret_2). If the year two discount rate is the same as the expected regulated return in year two, then the regulated return in year one collapses to the one-year rate. However, if the market expects the return in the second year to be equal to the current one-year rate – so the yield curve does not change – then the regulated return which solves the present value equation is as follows:

$$\begin{aligned} ret_1 &= R_{01} + (1-k)\left(1 - \frac{1+ret_2}{1+R_{12}}\right) \\ &= R_{01} + (1-k)\left(1 - \frac{1+R_{01}}{1+R_{12}}\right) \end{aligned}$$

Numerical example

72. In this numerical example, the yield to maturity on one-year debt is 5% (R_{01} = 0.05), and the yield to maturity on two-year debt is 6% (R_{02} = 0.06). This means that the discount rate applying to the second year is 7.01%, computed as $(1 + R_{02})^2 \div (1 + R_{01}) - 1 = (1.06)^2 \div 1.05 - 1 = 1.1236 \div 1.0500 - 1 = 0.0701$. The investment base is $1.00, leverage is 60% and the depreciation rate is 50%. Applied to the general equation, the present value of expected cash flows is:

$$\begin{aligned} PV(F_1) + PV(F_2) &= \frac{C(1-L)(k+ret_1)}{1+R_{01}} + \frac{C(1-k)(1-L)(1+ret_2)}{(1+R_{01})(1+R_{12})} \\ &= \frac{1.00(1-0.60)(0.50+ret_1)}{1.0500} \\ &\quad + \frac{1.00(1-0.50)(1-0.60)(1+ret_2)}{1.0500 \times 1.0701} \\ &= \frac{0.40(0.50+ret_1)}{1.0500} + \frac{0.20(1+ret_2)}{1.1236} \end{aligned}$$

73. The key point is that the discount factors in the denominators of the above equations are present at the time of the determination. The expectations for cash flows in years one and two could be altered by changing the regulatory process. But this would not change the discount factors. This contrasts with the view of Lally (2007a, 2007b) who contends that, under term matching, the second period discount rate is aligned with the second period regulated return. We disagree. Under term matching, the expectation for the regulated return in the second period is the market's view as to what the one-year rate will be in a year's time. This is not necessarily the same as the discount rate the market would apply today to that rate.

74. To quantify the impact on equity value, suppose that we applied term matching and assumed that the market's expectation for next period's regulated return was the same as the year two discount rate (so the market believes the yield curve represents an unbiased expectation of the next short-term rate). In this case the present value of the expected cash flows to equity holders is $0.40 as shown below:

$$\begin{aligned} PV(F_1) + PV(F_2) &= \frac{0.40(0.50+ret_1)}{1.0500} + \frac{0.20(1+ret_2)}{1.1236} \\ &= \frac{0.40(0.50+0.05)}{1.0500} + \frac{0.20(1.0701)}{1.1236} \\ &= 0.2095 + 0.1905 \end{aligned}$$

$$= 0.4000$$

75. However, equity holders under-recover if the market actually expects the yield curve next year to be the same as the current yield curve. If the market expects next year's one-year rate to still be 5%, equity value falls by 1%.

$$\begin{aligned} PV(F_1) + PV(F_2) &= \frac{0.40(0.50 + ret_1)}{1.0500} + \frac{0.20(1 + ret_2)}{1.1236} \\ &= \frac{0.40(0.50 + 0.05)}{1.0500} + \frac{0.20(1.05)}{1.1236} \\ &= 0.2095 + 0.1869 \\ &= 0.3964 \end{aligned}$$

76. Alternatively, suppose that the regulated return was set according to the equation presented in the previous sub-section. In this instance, given the assumption that the yield curve does not change, we have:

$$\begin{aligned} ret_1 &= R_{01} + (1-k)\left(1 - \frac{1 + ret_2}{1 + R_{12}}\right) \\ &= R_{01} + (1-k)\left(1 - \frac{1 + R_{01}}{1 + R_{12}}\right) \\ &= 0.05 + (1 - 0.50)\left(1 - \frac{1.0500}{1.0701}\right) \\ &= 0.05 + 0.50 \times 0.0188 \\ &= 0.05 + 0.0094 \\ &= 5.94\% \end{aligned}$$

77. If this regulated return were incorporated into the present value equation in year 1, and if the expected return in year two is 5% (because the yield curve does not change) then the present value of expected cash flow is:

$$\begin{aligned} PV(F_1) + PV(F_2) &= \frac{0.40(0.50 + ret_1)}{1.0500} + \frac{0.20(1 + ret_2)}{1.1236} \\ &= \frac{0.40(0.50 + 0.0594)}{1.0500} + \frac{0.20(1.0500)}{1.1236} \\ &= 0.2131 + 0.1869 \\ &= 0.4000 \end{aligned}$$

Conclusion

78. The key point is that term matching only sets the present value of expected cash flows equal to the investment base *if* the expected regulated return in the next period is equal to the discount rate for that period which the market observes today. The general equation we present does not rely upon this restrictive assumption. We can solve for the correct regulated return in the first period as a function of expected future interest rates.

79. According to the term matching approach, if there is an upward-sloping yield curve and if this upward-slope is expected to continue, equity holders will not recover their investment in the present

value of expected cash flows. In contrast, if the regulated return is set according to all future interest expectations, the present value equation will be satisfied.

80. Furthermore, if the regulator had to choose between setting the regulated return at the five-year bond yield or the ten-year bond yield (rather than determine the return with reference to all rates) the estimation error will be considerably lower if the regulator refers to the ten-year bond yield. In general, the life of the regulated asset will be considerably longer than ten years. In theory, the correct regulated return will be a function of interest rates over the entire life of the asset. So if we could observe yields at maturities longer than ten years, and even if these yields did not rise above the ten-year yields, the weighted average yields over the entire asset life will be considerably closer to the ten-year bond yield than the five-year bond yield.

4. Conclusions

81. The QCA considers that the term to maturity used to estimate bond yields for setting the regulated return must equal the regulatory period. The basis for this conclusion is that it is only under this assumption that the present value of expected cash flows matches the asset base. This is not correct. The present value relationship is still satisfied without this requirement. Furthermore, when the yield curve is upward-sloping this will result in the present value of expected cash flows falling below the investment base.

82. Implicit in the advice to the QCA is an assumption that the discount rate series we observe today is a reliable indicator of future regulated returns. This is not necessarily true. If the current yield curve is an unbiased estimate of future yields, and if there is an upward-sloping yield curve, then the firm will continue to receive regulated returns below the cost of capital.

83. Furthermore, under the QCA's approach, there are three implications which necessarily follow and which suggest there is some underlying assumption which does not make sense. We have identified that underlying assumption and illustrated the technique which allows the regulator to determine the appropriate regulated return under any specified set of expectations for interest rate movements. This technique can be expanded to any number of periods, with the result being a rate much closer to the ten-year bond yield than the five-year bond yield.

84. The three implications of term matching are:

    a) Given an upward-sloping yield curve, regulated prices could be immediately lowered without any value loss to the firm, simply by reducing the length of the regulatory period. According to the arguments for this approach, the firm is not exposed to the risk of interest rate fluctuations subsequent to this period because these are entirely offset by changes to the discount rate. If this is true, why not eliminate the risk altogether by having the shortest regulatory period possible?

       A counter-argument to this implication is that the risk and price reduction benefits of even shorter regulatory periods would be offset by increased refinancing risk. But there has been no analysis to suggest that five-year regulatory periods represent a better outcome than one, two, three or four years according to this rationale. The reason this has not been analysed is because, in reality, we cannot arbitrarily reduce the risk of the firm simply by shortening the regulatory period. Given an upward-sloping yield curve there will simply be lower regulated returns under term matching and a reduction in equity value.

    b) The estimate of the market risk premium must necessarily be changed. The cost of equity capital for the average firm is not contingent upon the administrative choice of the regulatory period or the decision of the regulator to align the term to maturity of the debt estimate with that period. If the risk-free rate input is lowered, unless the regulator has in fact altered the view as to the required return to equity holders in the Australian market, the market risk premium estimate must rise.

       Discussion about statistical imprecision in the measurement of five versus ten-year risk premiums, or about whether the term structure for equity returns is flat are not relevant. In reaching a decision on the regulated rate of return, the QCA incorporates an assumption about expected equity market returns. Its expectation for returns in the equity market can't be different depending upon whether an administrative choice is made to reset prices for a regulated entity every three, five, ten years or any other time.

c) The regulator would no longer estimate the price which would prevail in a competitive market. As a general principal, the regulator is attempting to estimate the price which would prevail in a competitive market. We see no reason why this competitive market outcome would be related to the administrative choice as to the regulatory period. Clearly, the regulatory framework interacts with firm risks and firm behaviour. We cannot ignore this interaction. However, there does not seem to be a sensible reason to set low prices in jurisdictions with short regulatory periods and high prices in jurisdictions with long regulatory periods, when in both cases the ultimate objective is to estimate a competitive market price.

85. In short, the present value relationship is not breached when the regulator refers to ten-year bond yields and none of the implications mentioned above are triggered.

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