Term to maturity of the risk free rate estimate in the regulated return

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1. Introduction

SFG Consulting has been engaged to advise QR Network on the appropriate term to maturity of government bonds used to estimate the risk free rate in setting the regulated rate of return by the Queensland Competition Authority ("the QCA" or "the Authority"). In its 2010 determination the Authority adopted a term to maturity of five years (QCA, 2010). In the draft decision the risk-free rate proposed by the Authority was 5.19% based on a 20-day average of the yield to maturity on 5-year government bonds. The corresponding average for 10-year government bonds was 5.60%.

However, the Authority also acknowledged that, were QR Network to borrow with a five-year term to maturity, it would be exposed to refinancing risk. In turn, in the debt allowance it allowed for the difference between 10-year bond yields and five-year bond yields as a proxy for the costs of hedging. It indicated that, at the next regulatory reset, it would review this assumption. The use of a five-year term to maturity in estimating the risk-free rate has been adopted in New South Wales (IPART, 2011) and in Western Australia. The regulators in those jurisdictions have relied upon the same rationale as the Authority. In this paper we contend that the underlying rationale is incorrect.

The view of the Authority that a five-year term is appropriate is based on the principle that, for the net present value of expected cash flows to equal zero, the term to maturity must equal the length of the regulatory period. In support of this specific principle, the Authority cites Lally (2004, 2007a, 2007b and 2010). It 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.

In this paper we demonstrate that the length of the regulatory period is entirely independent of the selection of the term to maturity for estimating the risk free rate. These two periods do not need to be the same for the net present value to equal zero. The assumption which underpins the Authority's previous advice is that, at the end of the regulatory period, the expected value of the regulatory asset base is independent of interest rate expectations outside the first regulatory period. The assumption is that we do not know what interest rates will be after the first regulatory period, but it does not matter because whatever they are will be reflected in the regulated cash flows. We demonstrate that this assumption is not correct and that, once that assumption is removed, there is no need for the term to maturity of the bonds used to estimate the risk-free rate to equal the regulatory period.

2. Implications

2.1 Introduction

This is a technical debate relating to valuation. 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. The technical basis for setting these two terms to be the same is that, according to the Authority's advice, it is the *only* assumption that results in the net present value of expected cash flows to equal zero. We contend that this assumption is not required to satisfy the net present value criteria and document the explicit reasons for this in Section 3.

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

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. According to the Authority's rationale, we could adopt a 10-year regulatory period and have relatively high prices or a five-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 three-year regulatory 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 a one-year reset for the regulated return.

There is a plausible reason why the Authority has not advocated for an even shorter term reset period (aside from administrative cost). Perhaps a shorter period exposes the firm to more hedging cost or refinancing risk, as acknowledged in the prior determination. 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 regulated 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.

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 10-year regulatory period?

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.

2.3 The estimate of the market risk premium must necessarily be changed.

In its prior determination the Authority 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. 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.

Even when the Authority altered its assumed risk-free rate, it held constant the assumed market risk premium of 6.00%. Recall that, at the time of the determination, the 10-year bond yield was 5.19% and the 5-year bond yield was 5.60%. The regulated return for QR Network reflects the authority's best estimate of the weighted average cost of capital ("WACC"). The authority has not provided an allowance for asymmetric consequences of setting returns below or above the WACC. So it follows that if we had a 10-year regulatory period, the Authority would expect the cost of equity for the market to be 11.60%, but it only expects a return of 11.19% because the regulatory period is five years.

The Authority rejects this argument on the basis of statistical imprecision. It contends that the imprecision in the market risk premium estimate is large, relative to the difference between 5- and 10-year bond yields. In other words, if it cannot be established with statistical reliability that the market risk premium estimate should be 6.31% instead of 6.00%, then it should maintain the 6.00% assumption.

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 10-year term to maturity, the mean estimate for the cost of equity capital is 11.60% 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 11.10% to 12.10%.

Then, the authority changes its assumption for the risk-free rate but holds constant its expectation for the market risk premium. Under a 5-year term to maturity, the authority changes its conclusion to a mean estimate of 11.19%. But the standard error has not changed from 0.50%. So the range of one standard error either side of the mean is 10.69% to 11.69%.

In essence, the Authority'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 11.60%. Not it believes that its best estimate of the cost of equity in the broader market is 11.19%. And this occurs simply because current practice is to adopt a regulatory period of five years instead of ten years.

2.4 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 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.

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 uncertainty 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.

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.

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.

In a competitive market it is reasonable to think that the owner of the rail network 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 10-year maturity debt rather than 5-year maturity debt.

Instead, the regulator determines that a 5-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 5-year regulatory period has lowered the firm's risk and consequently allows for lower prices than would otherwise prevail.

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 prevailing 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 5-year regulatory term implies lower risk to the firm than a 10-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?

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

3.1 Introduction

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.

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:

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

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

3.2 General case

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 $(1 – L) \times C$.

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:

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

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

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

4. 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).

Expressed as an equation we have:

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

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:

$$PV(F_1) = \frac{Ck + Cret_1 - LCk - LCret_1}{1 + R_{01}}$$
$$= \frac{Ck(1-L) + Cret_1(1-L)}{1 + R_{01}}$$
$$= \frac{C(1-L)(k + ret_1)}{1 + R_{01}}$$

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

1. The return of capital – the asset base *(C × (1 – k)]*; plus

2. The return on capital – the asset base *(C × (1 – k)]* multiplied by the regulated return in year two *(ret_2);* less

3. The repayment of debt – the leverage ratio *(L)* multiplied by the asset base *(C × (1 – k)]*; less

4. The interest expense on debt – the leverage ratio *(L)* multiplied by the asset base *(C × (1 – k)]* multiplied by the regulated return *(ret_2)*.

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

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:

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

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

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

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 $C(1 – L)$?

3.3 Term matching

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). 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:

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

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 (2007) as to what R_{12} represents. The views can be summarised as follows.

- 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.

- 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.

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:

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

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:

- 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.
- 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.
- 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.

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 .

3.4 What is the correct regulated return?

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?

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

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

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

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

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

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

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:

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

3.5 Numerical example

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:

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

The key point is that the discount factors in the numerators 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 (2007) 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.

To quantify the impact on equity value, suppose that the 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:

$$
\begin{aligned}
PV(F_1) + PV(F_2) &= \frac{0.40(0.50+ret_1)}{1.0500} + \frac{0.20(1+ret_2)}{1.1236} \\
&= \frac{0.40(0.50+0.05)}{1.0500} + \frac{0.20(1.0701)}{1.1236} \\
&= 0.2095 + 0.1905 \\
&= 0.4000
\end{aligned}
$$

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%.

$$
PV(F_1) + PV(F_2) = \frac{0.40(0.50+ret_1)}{1.0500} + \frac{0.20(1+ret_2)}{1.1236}
$$

$$
\begin{aligned}
&= \frac{0.40(0.50+0.05)}{1.0500} + \frac{0.20(1.05)}{1.1236} \\
&= 0.2095 + 0.1869 \\
&= 0.3964
\end{aligned}
$$

Alternatively, suppose that the regulated return was set according to the equation presented in sub-section 3.2.3. In this instance, given the assumption that the yield curve does not change, we have:

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

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:

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

3.6 Conclusion

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 in sub-section 3.2.3 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.

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.

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

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.

Implicit in the advice to the Authority 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.

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.

The three implications of term matching are:

1. 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?

   The Authority suggested in its prior determination that this was offset by increased refinancing risk. But there has been no analysis of the optimal regulatory period which balances risk reduction versus refinancing risk. 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.

2. The estimate of the market risk premium must necessarily be changed. The cost of equity capital 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.

3. 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.

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.

5. References

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