The Debt Maturity Issue in Access Pricing

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Abstract:

There has been substantial debate and disagreement over the appropriate debt maturity to be used in determining the cost of debt for use in access pricing decisions in Australia. Some regulators have used a debt maturity corresponding to the length of the regulatory reset period (typically five years). Others have used a longer maturity based on the argument that the assets being financed are long lived. In this paper it is demonstrated that in order to meet the objectives of access pricing the nature of interest rate risk arising from the price or revenue determination process under access pricing implies that a debt maturity corresponding to the regulatory reset period should be used.

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Access pricing involves a regulator setting a maximum price or revenue stream for an owner of a network asset who has some degree of monopoly power. The objective is to ensure that prices are set to generate output (usage of the service) consistent with economic efficiency and provide the owner with a "fair" expected return from investment in the asset over the life of the asset, thus inducing efficient investment.[1] Typically access pricing decision making occurs at regular discrete intervals (hereafter assumed to be five years, which is common) when the allowable expected revenue stream for the forthcoming regulatory period of five years is determined based on current economic and financial data and projections of demand, operating costs and other relevant variables. Generally, the asset in question has a substantially longer life than the regulatory horizon of five years.

The divergence between the five year regulatory reset period and the much longer asset life has led to debate in Australia over the financial data which should be used in the regulatory determinations. Specifically, there is ongoing debate over whether the cost of five year debt (corresponding to the regulatory reset period) or cost of much longer term debt (perhaps corresponding to the asset's expected life) should be used in estimating the access provider's cost of capital. Typically this is posed as a choice between using five or ten year debt. (Even though the asset life is generally much greater, in practice there is virtually no corporate debt issuance in Australia beyond a ten year maturity).

Recently, for example, the Australian Energy Regulator (2009) undertook a review of the WACC parameters for electricity transmission and distribution services. In its draft decision it had proposed use of a five year bond rate for the cost of debt (consistent with the regulatory period), but in the final decision opted for a 10 year bond rate. Ten years had previously been the debt maturity used by the Australian Energy Regulator and also by the Australian Consumer and Competition Commission. IPART (2011), the regulator for access pricing in the State of NSW,

[1] A fair return includes both the return on capital invested as well as return of capital. Schmalansee (1989) shows that if net revenues (after operating costs) over the life of the asset provide (a) a full return of capital and (b) the required rate of return each period on the remaining capital at the start of the period, the investment has a zero net present value.

decided to shift from a ten to five year bond rate in its determination of WACC. The Queensland Competition Authority has also assumed a five year maturity (see, for example, QCA, 2010).[2]

The argument of this paper is that the debt maturity used in cost of capital estimation in access pricing should correspond to the regulatory reset period. The argument is based on the following premises. First, allowable expected cash flows should be set such that after making allowance for required debt repayments, the expected return to equity should equal its required return. Second, the allowable debt repayments should be the minimum possible which the access provider can achieve without creating additional risk for itself beyond that which is allowed for in the regulatory determination. (This is to ensure lowest cost pricing of access services, and avoid the possibility that abnormal profits accrue to the access provider from arbitraging any gap between allowed debt repayments and the minimum accessible). Because cash flows are reset each five years for the subsequent five years taking into account both risk free interest rates and credit spreads prevailing at that time, it is only when the cost of five year debt is used by the regulator that these two conditions are met.

The intuition behind this argument (which is developed formally in the next section) can be explained by noting the similarity (albeit with an important difference discussed in the next paragraph) between determination of allowable cash flows on an access asset and cash flows on a floating rate bond. The latter involves coupon cash flows being reset in line with movements in some market indicator rate at regular intervals until maturity. Consider a floating rate bond which has the coupon reset at a fixed margin over the market indicator rate each period. If such a floating rate bond is purchased, and the fixed margin remains appropriate for the issuer credit risk at the next reset, funding it by successive issuance of one period bonds with the same coupon rate is a perfect hedge (and a zero net present value position). The reason is that the floating rate bond price will be equal to its par value at the next reset date. However, if the margin is no longer appropriate for the credit risk, the market price will no longer equal par value at the reset date, and the hedging strategy fails.

[2] See also the discussion, and alternate views expressed in section 16 of the Franks, Lally and Myers (2008) report to the New Zealand Commerce Commission.

In access pricing the expected net cash flows (after operating costs) of the asset can be logically divided into one part to compensate the cost of equity finance and a second to compensate the cost of debt finance.[3] Focusing solely on the debt financed component, the principal difference with the floating rate note is that cash flows are reset at regular dates by the regulator in line with movements in both risk free interest rates and the credit spread facing the asset owner-borrower.[4] Then, by issuing debt of the same maturity as the reset period with the same coupon as applied by the access regulator, the asset owner will have financed and perfectly hedged the current period cash flows. Moreover, at the next reset date, the asset owner will be able to reissue one period debt at par with the same coupon rate as that reset for the debt financed component of the asset by the regulator. Thus, if the regulator resets asset cash flows in line with the one period cost of borrowing (using the one period risk free rate and one period credit spread) the asset owner is able to meet debt financing costs and be perfectly hedged by a succession of one period borrowings.

The following sections of this paper outline this argument using a simple example. While that example assumes an asset with a life of two periods and each period (when a regulatory reset occurs) comprising only one year, the argument can be generalized to a five year reset period or longer asset life – but at the cost of algebraic complexity. The argument is also made clearer by focusing upon the return to equity (by subtracting the debt cash flows from allowable cash flows) rather than using the weighted average cost of capital approach commonly found in the access pricing "building block" model.[5] This involves a simple algebraic rearrangement of the "building block" model. Again the argument could be expressed using the weighted average cost of capital approach, but at the cost of algebraic complexity.

[3] For simplicity, tax cash flows are ignored.

[4] Another potential difference lies in the fact that floating rate notes generally involve full repayment of principal only at maturity whereas access pricing involves return of principal over the life of the asset. This difference does not affect the logic of the following argument, since it simply requires the succession of one period debts issued to decline in size in line with the amount of capital returned in asset cash flows.

[5] The "building block" approach is specified in legislation for use by some regulators. See for example, AEMC (2012, Section 6.4.3) and Davis (2006). The Brattle Group (2000, Appendix 6) provides an overview of alternative variants of the "building block" approach..

Lally (2007a) also addresses this issue of the appropriate debt maturity assumption in access pricing in the context of a two period model, but assumes that the only source of risk is interest rate risk. (See also the response by Hall, 2007, and rejoinder by Lally, 2007b). While he allows for variation in the credit risk premium faced by the access provider, as well as in the risk free rate, he does not consider the effect of the regulator regularly re-setting the allowed credit risk premium as well as the risk free rate. The results of this paper confirm those of Lally, but within a more general framework which allows explicitly for other types of risk additional to interest rate risk. The importance of providing a more robust proof of the proposition are evident from the ongoing debate over choice of appropriate debt maturity such as found in submissions to access pricing regulators in Australia, such as by Grundy (2011), Lally (2010) and the summary of such arguments in QCA (2011, Chapter 2).

1. *The Model*

Assume that an access provider has, at date 0, purchased an asset with a life of two periods for a price of \$2, which it intends to finance with \$1 of equity and \$1 of debt.[6] Expected net cash flow (after operating costs), c_1, for date 1 will be set by the regulator at date 0 as:

$$c_1 = r_e^0 + r_d^0 + D_1$$

where r_e^0 and r_d^0 are the cost of equity and debt assumed by the regulator respectively at date 0 and D_1 is the return of capital (depreciation) provided at date 1. For algebraic simplicity, assume that there is no return of capital at date 1.[7] Hence:

$$c_1 = r_e^0 + r_d^0$$

Given the assumption that there is no return of capital at date 1, expected net cash flow (after operating costs), c_2, for date 2 will be set by the regulator at date 1 as:

$$c_2 = r_e^1 + r_d^1 + D_2 = r_e^1 + r_d^1 + 2$$

[6] The assumption of a two dollar cost and debt/equity ratio of unity is made to simplify the arithmetic and could be generalised without affecting the results.

[7] Davis (2004) shows that the choice of depreciation schedule does not affect the validity of the building block model. A return of capital at date 1 could be assumed, but would complicate the arithmetic.

Here, r_e^1 and r_d^1 are the cost of equity and debt respectively assumed by the regulator at date 1 and D_2 =2 is the return of capital (depreciation) provided at date 2. Taking the debt cash flows to the LHS of the equations (and noting that in period two this will be $1+r_d^1$ to allow for repayment of principal) we have allowable expected cash flows to equity which, if the assumed cost of debt equals the true cost, match the required rate of return (and return of capital) of:

$e_1 = c_1 - r_d^0 = r_e^0$

$e_2 = c_2 - 1 - r_d^1 = 1 + r_e^1$

If the actual debt cost of the firm differs from that assumed by the regulator (r_d^0, r_d^1), then expected return to equity will differ from the required rate of return. We now examine how that may happen by considering alternative borrowing strategies by the firm in conjunction with alternative regulatory approaches to determining allowable borrowing costs.

Consider the situation facing the regulator and the regulated firm at date 0. Assume that the regulator and firm agree on the appropriate cost of equity r_e^0. There are a number of possible options facing the regulator and the firm regarding the debt financing maturity assumed by the regulator and implemented by the firm. Consider first the debt financing options facing the firm. Five choices, covering realistic options, are illustrated in Table 1, where r_{ij} is the risk free rate prevailing at date *i* for maturity *j*, and s_{ij} is the credit spread faced by the firm at date *i* for maturity *j*. The total borrowing cost is the sum of the risk free rate and the credit spread ($r_{ij} + s_{ij}$). Option 1 involves financing by a succession of one-year borrowings, while option 4 involves financing by issue of two year fixed debt. Option 3 corresponds to financing by issuing a two year floating rate note (or equivalently by issue of a two year fixed rate debt and entering a two year swap to receive fixed and play floating).[8] Option 2 involves financing by issuing a succession of one-year borrowings and entering a two year swap to pay fixed and receive floating, thereby locking in the risk free rate component of borrowing costs but leaving an exposure to credit risk component

[8] Duffie and Liu (2001) demonstrate that the difference between the credit spread on fixed rate debt and on a floating rate of the same maturity is minimal. Hence, no distinction is made here and s_{02} used in both case.

changes. Option 5 involves issuing longer term (two year) debt and redeeming it when it has one year remaining at a market price $P(r_{ij},s_{ij}) = (1+r_{02}+s_{02})/(1+r_{12}+s_{12})$ and repeating this strategy the following year. These alternatives involve different combinations of exposures of the firm to changes in the risk free rate and in credit spreads.

TABLE 1: Alternative Borrowing Strategies

Strategy		Debt Cashflows	
		Date 1	Date 2
1. Short term debt	Date 0: Borrow for one period at $r_{01}+s_{01}$ Date 1: Borrow for one period at $r_{12}+s_{12}$	$-1- r_{01}-s_{01}$ $+1$ $=- r_{01}-s_{01}$	$-1- r_{12}-s_{12}$
2. Fix long term risk free cost, with variable credit spread	Date 0: Borrow for one period at $r_{01}+s_{01}$ Date 0: Enter swap, to pay fixed r_{02}, receive floating r_{01}, r_{12} (latter uncertain at date 0) Date 1: Borrow for one period at $r_{12}+s_{12}$	$-1- r_{01}-s_{01}$ $-r_{02}+r_{01}$ $+1$ $=- r_{02}-s_{01}$	$-1 – r_{02}-s_{12}$
3. Long term floating rate note	Date 0: Borrow for two periods at $r_{02}+s_{02}$ Date 0: Enter swap to receive fixed r_{02}, pay floating r_{01}, r_{12} (latter uncertain at date 0) Equivalently: issue a two period floating rate note	$-r_{02}-s_{02}$ $+r_{02}-r_{01}$ $=-r_{01}-s_{02}$	$-1-r_{12}-s_{02}$
4. Long term fixed rate debt	Date 0: Borrow for two periods at $r_{02}+s_{02}$	$-r_{02}-s_{02}$	$-1-r_{02}-s_{02}$
5. Rolling early redemption and reissue of long term debt	Date 0: Borrow for two periods at $r_{02}+s_{02}$ Date 1: Redeem debt at P = $(1+r_{02}+s_{02})/(1+r_{12}+s_{12})$ and borrow for two further periods at $r_{12}+s_{12}$ Date 2: Redeem outstanding debt at $P(r_{23},s_{23})= (1+r_{13}+s_{13})/(1+r_{23}+s_{23})$	$-r_{02}-s_{02}$ $-P(r_{12}, s_{12}) +1$	$- r_{13}-s_{13} – P(r_{23},s_{23})$

The regulator has four potential choices for determining the allowable cost of debt financing (noting that the repayment of principal also occurs at date 2).

Use the one period cost of debt: set date 1 debt cash flows as $r_{01}+s_{01}$ at date 0 and set date 2 debt cash flows as $1+r_{12}+s_{12}$ at date 1.

Use the two period cost of debt: set date 1 debt cash flows as $r_{02}+s_{02}$ at date 0 and set date 2 debt cash flows as $1+r_{13}+s_{13}$ at date 1.

Use the initial two period cost of debt and do not reset: set date 1 cash flows as $r_{02}+s_{02}$ and date 2 cash flows as $1+r_{02}+s_{02}$ at date 0.

Use the residual asset maturity to set the cost of debt: set date 1 debt cash flows using the two period cost of debt as $r_{02}+s_{02}$ at date 0, and set date 2 debt cash flow using the one period cost of debt as $1+r_{12}+s_{12}$ at date 1.

Of these options (a) and (b) are the alternatives under consideration here and correspond to using the one period and the two period borrowing costs respectively. Option (c) would involve fixing the cost of borrowing for the life of the asset and not resetting it at regulatory reset dates. It is not difficult to show that unless the access provider can borrow for the same maturity as the life of the asset this increases the risk facing the access provider.[9] Option (d), where the allowable maturity of debt is set equal to the residual asset life does not appear to have been seriously considered in access pricing, and would involve considerable practical complications. In the case of both options (c) and (d) practical complications would arise in that each asset would need to be considered separately rather than aggregated into the regulatory asset base.

2. Borrowing Strategies and Expected Returns

The task now is to consider what debt maturity strategy the access provider might follow, and the consequences of that, given the choice of allowable debt costs made by the regulator. Consider first option (a) above where the regulator consistently uses a one period cost of debt. Table 2 takes the information on cash flows from alternative strategies in Table 1 and derives the expected cash flows to equity (e_1, e_2).[10]

[9] To illustrate, consider a case where interest rates increase permanently after the asset is purchased. At some date, the firm will need to rollover its debt at higher interest rates, but without regulatory resets of allowable cash flows it does not get correspondingly higher cash flows..

[10] Strategy 5 is not considered in this table – its inclusion in possible strategies is only relevant in the case of the regulator using a long term debt rate considered in Table 3.

TABLE 2: Debt Strategies and Equity Cash Flows: regulatory use of short term cost of debt			
Regulator allows $r_d^0 = r_{01}+s_{01}$ at date 1 and $1+r_d^1 = 1+r_{12}+s_{12}$ at date 2.		Equity Expected Cashflows	
		$e_1 = r_e^0 - r_d + r_d^0$	$1+e_2 = r_e^1 - r_d + r_d^1$
Strategy	Company actual debt cash flows ($-r_d$, $-1-r_d$)	Date 1	Date 2
1, Short term debt	Date 1: $- r_{01} - s_{01}$ Date 2: $-1 - r_{12} - s_{12}$	r_e^0	$1 + r_e^1$
2. Fix long term risk free cost, with variable credit spread	Date 1: $- r_{02} - s_{01}$ Date 2: $-1 - r_{02} - s_{12}$	$r_e^0 + r_{01} - r_{02}$	$1 + r_e^1 + r_{12} - r_{02}$
3. Long term floating rate note	Date 1: $-r_{01} - s_{02}$ Date 2: $-1 - r_{12} - s_{02}$	$r_e^0 + s_{01} - s_{02}$	$1 + r_e^1 - s_{12} - s_{02}$
4. Long term fixed rate debt	Date 1: $-r_{02} - s_{02}$ Date 2: $-1 - r_{02} - s_{02}$	$r_e^0 + r_{01} + s_{01} - r_{02} - s_{02}$	$1 + r_e^1 + r_{12} + s_{12} - r_{02} - s_{02}$

What is immediately apparent from Table 2 is that by borrowing for one period (strategy 1), matching the regulatory approach, the access supplier does not assume any additional risk and has an expected return on equity equal to its required return. And while the company can adopt any of strategies 2, 3 or 4, doing so involves it in assuming risk (because r_{12} and s_{12} are not known at date 0). Strategy 2 may provide a higher return to equity in the first period if the risk free yield curve is downward sloping ($r_{01} > r_{02}$) but exposes it to second period risk because of the uncertainty associated with r_{12}. Strategy 3 would provide a higher first period return to equity in the unusual event that short term credit spreads exceeded longer term spreads ($s_{01} > s_{02}$), but would expose it to second period risk because of the uncertainty associated with s_{12}. Strategy four would provide a higher return to equity in period 1 if short term borrowing costs were higher than long term costs, but would involve exposure to second period borrowing costs.

Consequently, if the regulator chooses a one period cost of borrowing: (a) the firm's expected return on equity equals the required return if one period borrowing is undertaken; (b) the firm can adopt a different borrowing strategy based on its interest rate view which may lead to a higher expected return on equity, but involves interest rate risk.

Consider now the situation if the regulator chooses option (b), ie using the two period cost of debt observed at date 0 and date 1 in determining allowable expected cash flows. Table 3 sets out the consequences if the company adopts the various strategies available to it.

TABLE 3: Debt Strategies and Equity Cash Flows: regulatory use of long term cost of debt

Regulator allows $r_d^0 = r_{02}+s_{02}$ at date 1 and $1+r_d^1 = 1+r_{13}+s_{13}$ at date 2.		Equity Expected Cashflows	
		$e_1 = r_e^0 - r_d + r_d^0$	$1+e_2 = r_e^1 - r_d + r_d^1$
Strategy	Company actual debt cash flows (r_d, $1+r_d$)	Date 1	Date 2
1, Short term debt	Date 1: $-r_{01}-s_{01}$ Date 2: $-1-r_{12}-s_{12}$	$r_e^0+r_{02}+s_{02}-r_{01}-s_{01}$	$1+r_e^1+r_{13}+s_{13}-r_{12}-s_{12}$
2. Fix long term risk free cost, with variable credit spread	Date 1: $-r_{02}-s_{01}$ Date 2: $-1-r_{02}-s_{12}$	$r_e^0+s_{02}-s_{01}$	$1+r_e^1+r_{13}-r_{02}+s_{13}-s_{12}$
3. Long term floating rate note	Date 1: $-r_{01}-s_{02}$ Date 2: $-1-r_{12}-s_{02}$	$r_e^0+r_{02}-r_{01}$	$1+r_e^1+r_{13}+s_{13}-r_{12}-s_{02}$
4. Long term fixed rate debt	Date 1: $-r_{02}-s_{02}$ Date 2: $-1-r_{02}-s_{02}$	r_e^0	$1+r_e^1+r_{13}+s_{13}-r_{02}-s_{02}$
5. Rolling early redemption and reissue of long term debt	Date 1: $-r_{02}-s_{02}-P(r_{12}, s_{12})+1$ Date 2: $-r_{13}-s_{13}-P(r_{23},s_{23})$	$r_e^0-P(r_{12}, s_{12})+1$	$1+r_e^1+1-P(r_{23},s_{23})$

What is immediately apparent from Table 3 is that there is no debt strategy which gives an expected return to equity equal to the required return. While strategy 4 (borrowing for two periods) gives a first period expected return to equity equal to the required return, the company is exposed to interest rate risk in period 2 (due to changes in the risk free rate or credit spreads at date 1). Similarly strategy 5 (borrowing for two periods but redeeming after one period) leaves an exposure due to the possibility that the market value at the early redemption date is not equal to the face value.

3. *Conclusion*

The equity cash flows for strategy 1 provide a clue as to why access providers generally argue for use of the longer term cost of borrowing in the setting of allowable cost of capital by regulators. Generally, the term structure of both risk free rates and credit spreads is upwards sloping. Thus if the regulator uses longer term rates (two periods in the preceding analysis) to set allowable cash flows, but the company borrows on a shorter term basis (one period in the preceding analysis), it stands to make an abnormal return on equity (albeit one involving some risk). For date one, the expected return on equity exceeds the required return by the difference between long and short term borrowing costs at date 0. For date two, the expected return on equity will exceed the required return if long term borrowing rates remain above short term rates.

In conclusion, use of a debt maturity equal to the regulatory horizon involved in resetting of allowable expected cash flows is the only approach consistent with achieving the goals of access pricing regulation. That does, however, leave two possible feasible approaches for regulation. One is to continue to use regulatory reset periods less than the maturity of the asset under consideration, in which case the debt maturity used should equal the length of the regulatory reset period.[11] The second approach would be for the regulator to set the allowable cash flows over the entire life of the asset at the time of its purchase using a debt maturity equal to the asset life, and never resetting the cost of capital involved in allowable cash flows. Such an approach, of setting the regulatory reset period equal to the underlying asset life, would also achieve access pricing goals. However, it would increase risk faced by the access provider (relative to use of a shorter reset period) and would require access price decisions at the time of each significant asset purchase, in contrast to the current approach which enables one regular price determination process to apply across all assets regardless of the time of purchase.

[11] In practice the regulatory period involves cash flows during the regulatory period including some return of capital. In that case, it would seem appropriate for the debt maturity to match the duration of the allowable cash flows over the period – where the end of period regulatory asset base is included as a cash flow in the duration calculation. Thus, with a five year regulatory period, a debt maturity somewhat less than five years might be appropriate.

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