EXPERT SESSION 1: FURTHER NOTES

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1. Introduction

At the first Expert Session, on 10 February 2022, a number of issues were raised that warrant further analysis. The first was the implications of debt for the NPV = 0 test, and in particular whether the term of the allowed cost of debt must (like the cost of equity) match the regulatory cycle in order to satisfy this test. The second issue was whether the NPV = 0 test was satisfied over each regulatory cycle as well as over the entire life of the asset. The third was the alleged use of a ten-year discount rate by those who value the future cash flows of the regulated businesses.

2. The Implications of Debt for the NPV = 0 Test

In an earlier paper (*The Appropriate Term for the Allowed Cost of Capital*, 9 April, 2021), I explained why a regulator should use an allowed cost of equity for the current regulatory cycle equal to the regulatory term (of five years). To simplify the analysis of this issue, I omitted debt, taxes and opex. I also assumed a regulatory cycle of one year with revenues set now and due in one year. The regulated resetting process in one year implies that the firm also expects to receive a value in one year for subsequent cash flows equal to the regulatory asset value in one year. So, at the current moment, with a regulatory asset value of *A*, the regulator sets depreciation for the first year (DEP_1) and an allowed rate of return *k* on the asset value *A*. These cash flows plus the regulatory asset value in one year ($A - DEP_1$) must be valued at some rate *d*. So, the value now of the regulated business will be

$$V_0 = \frac{[Ak + DEP_1] + (A - DEP_1)}{1 + d}$$

Because these benefits in the numerator arise in one year, the correct discount rate is the one year cost of equity $ke01$. The regulator must then choose the allowed rate *k* so that V_0 is equal to the current regulatory asset value of *A* (the NPV = 0 test):

$$A = \frac{[Ak + DEP_1] + (A - DEP_1)}{1 + ke_{01}}$$

The solution to this is that the allowed rate k must equal the discount rate, which is the one year cost of equity. By extension, when the regulatory cycle is five years, the allowed cost of equity must be the five-year rate.

I now consider how debt would alter this proof, and in particular whether the term of the allowed cost of debt must also match the regulatory cycle. As before, taxes and opex are still omitted. Let V_0^E be the value of equity at time 0 (now). Paralleling the first equation above, the value now for equity is the revenues to be received in one year, less the interest payment on debt, less the repayment of debt (or additional borrowing in one year) to maintain the leverage ratio, plus the regulatory book value for equity in one year (B_1^E), all discounted at the current one year cost of equity (k_{e01}). In addition, the revenues comprise the allowed cost of capital on equity applied to the current regulatory book value of equity ($B_0^E k$) plus the allowed cost of capital on debt applied to the current regulatory book value of debt ($B_0^D k_d$) plus the depreciation allowance (DEP_1). The allowed cost of debt reflects the efficient debt strategy of the firm, which could be debt of a term longer than one year. Whatever this efficient strategy is, it is also reflected in the expected payment of interest, i.e., the interest payment for a firm following whatever efficient strategy is assumed by the regulator will be $B_0^D k_d$. So, letting DR_1 denote the debt repayment at time 1 (which is additional borrowing if negative), the value now of equity is

$$V_0^E = \frac{[B_0^E k + B_0^D k_d + DEP_1] - B_0^D k_d - DR_1 + B_1^E}{1 + ke_{01}}$$

As shown here, the allowed cost of debt equals the interest payment made by an efficient firm and therefore the allowance in the revenue matches the expected payment. The debt repayment at time 1 is the current debt value less the debt value at time 1, and these values will match the regulatory book values for an efficiently operating firm, i.e., the firm's actual leverage matches that adopted by the regulator. So

$$V_0^E = \frac{[B_0^E k + B_0^D k_d + DEP_1] - B_0^D k_d - (B_0^D - B_1^D) + B_1^E}{1 + ke_{01}}$$

This is

$$V_0^E = \frac{[B_0^E k + B_0^D k_d + DEP_1] - B_0^D k_d - B_0^D + B_1^D + B_1^E}{1 + ke_{01}}$$

The sum of the last two terms in the numerator is the book value of regulatory assets at time 1, which comprises the book value of regulatory assets at time 0 less DEP_1:

$$V_0^E = \frac{[B_0^E k + B_0^D k_d + DEP_1] - B_0^D k_d - B_0^D + (B_0^D + B_0^E - DEP_1)}{1 + ke_{01}}$$

Cancelling of terms in the numerator leaves

$$V_0^E = \frac{B_0^E k + B_0^E}{1 + ke_{01}}$$

Satisfying the NPV = 0 test requires that the combined market value of equity and debt at time 0 be equal to the combined regulatory book values, and therefore that the market value of equity equal its regulatory book value (because the market value of debt will match its book value). So $V_0^E = B_0^E$ and therefore

$$B_0^E = \frac{B_0^E k + B_0^E}{1 + ke_{01}}$$

Satisfying this equation requires that the allowed rate of return on equity (*k*) equals the discount rate, which is the one-year cost of equity. So, as before, satisfying the NPV = 0 test requires that the allowed cost of equity must match that for the regulatory cycle. However, there are no restrictions on the term of the allowed cost of debt; it is for a term corresponding to the efficient debt strategy, whatever that is.

3. Satisfying the NPV = 0 Test over the Entire Life of the Assets

In an earlier paper (*The Appropriate Term for the Allowed Cost of Capital*, 9 April, 2021), I examined the NPV = 0 test, by considering a scenario with no debt, taxes or opex, a regulatory cycle of one years, and an asset life of two years. I commence by repeating that analysis here.

Suppose that regulated assets are purchased now for A, with a life of two years, the regulatory cycle is one year, prices are set at the beginning of each year, and the resulting revenues are received at the end of each year. In addition, there is no opex, capex, or taxes. Let the regulatory depreciation of the asset base for the first year be denoted DEP_1, in which case that for the second year is the residue of $A – DEP_1$. Consider first the position at the end of the first year (time 1), at which point a price or revenue cap will be set to yield revenues at time 2 (REV_2). These expected revenues are set equal to depreciation of ($A – DEP_1$) plus the allowed cost of capital (at some rate k_1 observable at time 1) applied to the undepreciated book value of the assets at time 1 of ($A – DEP_1$). The value at time 1 (V_1) of this business will be the expectation at time 1 of these future revenues, discounted at the one-year cost of equity prevailing at time 1 (ke_{12}):

$$V_1 = \frac{E(REV_2)}{1 + k_{e12}} = \frac{(A - DEP_1)k_1 + (A - DEP_1)}{1 + k_{e12}} \qquad (1)$$

At the current time (time 0), the price or revenue cap will be set to yield revenues at time 1 (REV_1). These expected revenues are set equal to depreciation of DEP_1 plus the allowed cost of capital (at some rate k_0 observable at time 0) applied to the undepreciated book value of the assets at time 0 (A). The value at time 0 (V_0) of this business will be the expectation now of REV_1 plus V_1, discounted at the one-year cost of equity prevailing at time 0 (ke_{01}):

$$V_0 = \frac{E(REV_1) + E(V_1)}{1 + k_{e01}} = \frac{[Ak_0 + DEP_1] + E(V_1)}{1 + ke_{01}} \qquad (2)$$

The NPV = 0 principle requires that $V_0 = A$. This can only occur if the allowed cost of capital k_1 in the numerator of equation (1) matches the discount rate k_{e12} in that equation (which is the one-year cost of equity prevailing at time 1) and the allowed cost of capital k_0 in the numerator of equation (2) matches the discount rate k_{e01} in that equation (which is the one-year cost of equity prevailing at time 0). In this case, equation (1) becomes

$$V_1 = \frac{(A - DEP_1)k_{e12} + (A - DEP_1)}{1 + k_{e12}} = A - DEP_1 \qquad (3)$$

and equation (2) becomes

$$V_0 = \frac{[Ak_{e01} + DEP_1] + (A - DEP_1)}{1 + ke_{01}} = A \tag{4}$$

This was the example in my earlier paper. Equation (4) says that $V_0 = A$, i.e., the value now of all future cash flows from the regulatory assets equals the initial investment of A. So, the NPV = 0 test is satisfied over the entire life of the assets. However, if V_0 had instead been defined as the value now of the regulatory cash flows arising in one year plus the regulatory asset value in one year, equation (2) would have become

$$V_0 = \frac{E(REV_1) + (A - DEP_1)}{1 + k_{e01}} = \frac{[Ak_0 + DEP_1] + (A - DEP_1)}{1 + ke_{01}}$$

Offsetting the DEP_1 terms yields

$$V_0 = \frac{Ak_0 + A}{1 + ke_{01}}$$

Setting the allowed rate of return on equity for the first period (k_0) equal to the one-year cost of equity prevailing at the present time for the first year (k_{e01}) then yields $V_0 = A$, i.e., the NPV = 0 test is satisfied over the first period. Equation (3) shows it is satisfied over the second period. So, it is satisfied over each of the regulatory cycles, as well as over the entire life of the project as per equation (4).

Another way of looking at the value now of all future cash flows on the regulated assets (V_0) would be to note that the cash flows to be received in the individual years are:

Year 1: $Ak_{e01} + DEP_1$

Year 2: $(A - DEP_1)k_{e12} + (A - DEP_1)$

The value V_0 is the sum of the value now of the first's year's cash flows plus the value now of the second year's cash flows. The discount rate applicable to the first year's cash flows is k_{e01}. In respect of the second year's cash flows, they are valued firstly at time 1 to yield V_1, and then V_1 is valued back to the current time. The first step, to yield V_1, is shown in equation (3), and the second step to value V_1 and the first year's revenues back to the present time is shown in equation (4). So, again, the NPV = 0 test is satisfied over the entire life of the assets.

4. Valuing the Future Cash Flows of the Regulated Businesses

It has been argued that those who value regulated businesses use a ten-year rate in doing so rather than a rate matching the regulatory cycle of five years, because the future cash flows extend beyond five years, and the AER should therefore also use a ten-year discount rate and hence a ten-year allowed rate. Implicit in this is that these valuers are forecasting the cash flows from the regulated businesses. Since the cash flows beyond five years depend upon the allowed rates of return by regulators in 5, 10, 15 etc years', this requires forecasting future interest rates, which is difficult and full of opportunity for error. However, if regulators are doing their job, the present value of the future cash flows for the regulated assets will be equal to the current Regulatory Asset Value (RAV), subject only to the possibility that the regulated business in question is expected to outperform the regulatory allowances. If the expected degree of outperformance is 10% on average per regulatory cycle, the regulated business would be worth 10% more than RAV. This approach requires no forecasting of future cash flows in dollar terms and therefore no need for a discount rate. The regulated business might also have additional value arising from the future possibility of entering into unregulated activities with positive NPV. If so, this would be valued as a separate exercise whose discount rates would have no relevance to the rate that the regulator should allow on the regulated activities.

On the other hand, valuers may feel sufficiently sceptical about regulators that they do want to forecast future cash flows and therefore require a discount rate or rates. Suppose a person were valuing the future cash flows of an unregulated business, with cash flows arising in 5, 10 and 15 years' time. In general, the correct practice would be to value these cash flows (C_5, C_{10}, and C_{15}) using the current 5, 10 and 15 year rates, i.e.,

$$V = \frac{E(C_5)}{(1+k_{0,5})^5} + \frac{E(C_{10})}{(1+k_{0,10})^{10}} + \frac{E(C_{15})}{(1+k_{0,15})^{15}}$$

However, a reasonable approximation may be achieved by applying the ten-year discount rate to all cash flows, because any (likely slight) error resulting from this may not affect the price ultimately paid for the asset, because the valuation is merely one input into a negotiation exercise. The same reasoning might then be applied to valuation of a regulated business for the purpose of buying or selling it.

This reasoning does not imply that a regulator should use a ten-year rate. The computational exercises carried out by regulators flow directly through to the prices paid by customers and the revenues received by the regulated businesses, even down to a one basis point variation in the allowed rate. By contrast, a one basis point variation in the cost of capital estimated by a valuer would be unlikely to affect the transaction price, or perhaps even a 50 basis point variation in the estimated cost of capital. So, precision in the regulatory exercise is far more important than in the exercises carried out by valuers. This is reflected in the reports that the AER writes on the cost of capital, being vastly more complex than the parallel exercises by valuers. Furthermore, at the current reset, the regulator is only concerned with the next five years and therefore only concerned with the discount rate for the next five years, and therefore only concerned with the allowed rate for the next five years. So, even if the regulator were in principle to replicate the behaviour of the private sector valuers, the regulator's greater need for precision would compel it to look inside the average ten-year rate used by the valuers to the rate relevant to the next five years, and this rate used by the valuers is the five-year rate despite it being buried within the average rate used by the valuers.

5. Conclusions

At the first Expert Session, on 10 February 2022, a number of issues were raised that warrant further analysis. The first was the implications of debt for the NPV = 0 test, and in particular whether the term of the allowed cost of debt must (like the cost of equity) match the regulatory cycle in order to satisfy this test. This paper shows that, unlike the cost of equity, the allowed cost of debt need not match the term of the regulatory cycle. The second issue was whether the NPV = 0 test was satisfied over each regulatory cycle as well as over the entire life of the asset. This paper shows that both hold. The third was the alleged use of a ten-year discount rate by those who value the future cash flows of the regulated businesses. This paper shows that, even if valuers are sufficiently sceptical about regulators that they feel the need to forecast and hence discount future cash flows, any use of a single discount rate by valuers is an approximation and regulators should not replicate it because regulators need to adopt much greater precision.