

Electricity Distribution Businesses - Draft Decisions Paper - Default Price Path

Derivation of a formula for the 2012/13 allowable revenue, taking into account intra-year timing of cash flows

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This derivation establishes a formula for the 2012/13 allowable revenue, given an EDB 's costs, tax parameters, growth rates, WACC etc. Recognising that revenue and opex are continuous throughout the year (rather than being concentrated at year-end), it models these as revenues derived mid-year and as if opex is expended at mid-year. Tax cash flows are deemed to occur at year-end¹. Half of the value of commissioned assets is modelled as being spent at the start of that year and half at year-end.

Some preliminary matters are presented immediately below, before the derivation itself.

There are several instances in this derivation where the following identity is used:

$$PV(a + b) = PV(a) + PV(b)$$

where PV() refers to 'present value'.

This identity is referred to as the "PV identity". In this derivation, in the model specification and in the model itself, present values are all calculated as at 1 April 2012. The present value calculations all refer to the present value of a series of 3 annual amounts relating to the 3 year period from 1 April 2012 to 31 March 2015.

The 3 annual amounts refer to either:

- Amounts that are modelled as occurring at the end of the year;
- Amounts that are modelled as occurring at mid-year; or
- Amounts that are a mixture of end-of-year and mid-year amounts.

The present values of these 3 types of amounts are referred to as $PV_{end}()$, $PV_{mid}()$ and $PV_{mixed}()$ respectively.

The amount of the tax expense can be written as:

$$\text{Tax expense} = (\text{Revenue} - \text{Tax Deductions etc}) * t$$

where: t = tax rate; and

"Tax Deductions etc" refers to depreciation, opex, and all the other parameters required to make the equation for tax expense above correct².

¹ Tax cash flows occur at each of the provisional tax dates plus the date of payment of the final tax balance. It would appear that assuming a mid-year timing for the average of tax payment would be too early by a significant amount.

² The expression for tax expense from the model specification is:

Applying the PV identity to this equation gives:

$$PV_{end}(\text{Tax expense}) = PV_{end}(\text{Revenue}) * t - PV_{end}(\text{Tax Deductions etc}) * t$$

For this equation to be valid, the present value calculation of Tax Revenues must treat them as occurring at year end, while a present value of the revenues themselves must recognise that they are deemed to occur at mid-year. Because there is a half year difference between the timings:

$$PV_{end}(\text{Revenues}) = PV_{mid}(\text{Revenues}) / (1 + \text{half-year-WACC})$$

$$\text{where half-year-WACC} = \sqrt{1+WACC} - 1$$

This completes the consideration of the preliminary matters. The derivation proper follows.

The fundamental structure of the model is that the revenues must be such that the following equation applies:

$$PV_{mid}(\text{Revenue}) = PV_{mixed}(\text{Projected Total Costs})$$

Projected Total Costs for each year can be separated into Tax expense and non-tax costs, such that

$$\text{Projected total costs} = \text{Tax expense} + \text{non-tax costs}$$

Applying the PV identity to this equation gives:

$$PV_{mixed}(\text{Projected Total Costs}) = PV_{end}(\text{Tax expense}) + PV_{mixed}(\text{non-tax costs})$$

$$\therefore PV_{mid}(\text{Revenues}) = PV_{end}(\text{Tax expense}) + PV_{mixed}(\text{non-tax costs})$$

$$\therefore PV_{mid}(\text{Revenues}) = PV_{end}(\text{Revenue}) * t - PV_{end}(\text{Tax Deductions etc}) * t + PV_{mixed}(\text{non-tax costs})$$

$$\therefore PV_{mid}(\text{Revenues}) - PV_{end}(\text{Revenue}) * t = PV_{mixed}(\text{non-tax costs}) - PV_{end}(\text{Tax Deductions etc}) * t$$

$$\therefore PV_{mid}(\text{Revenues}) - PV_{mid}(\text{Revenue}) * t / \sqrt{1+WACC} = PV_{mixed}(\text{non-tax costs}) - PV_{end}(\text{Tax Deductions etc}) * t$$

$$\therefore PV_{mid}(\text{Revenues}) * (1 - t/\sqrt{1+WACC}) = PV_{mixed}(\text{non-tax costs}) - PV_{end}(\text{Tax Deductions etc}) * t$$

$$\therefore PV_{mid}(\text{Revenues}) = (PV_{mixed}(\text{non-tax costs}) - PV_{end}(\text{Tax Deductions etc}) * t) / (1 - t/\sqrt{1+WACC})$$

While the right-hand-side of this equation can be calculated directly to determine the amount of $PV_{mid}(\text{Revenues})$, the 2012/13 revenue cannot be directly calculated from this present value. To

Tax expense = (Revenue - Depreciation - Opex - Term Credit Spread Differential - Interest + Permanent Differences + Amortisation of Initial Difference in Asset Values + Amortisation of Revaluations)*t Removing the "Revenue" term from the right-hand-side of this equation and reversing the signs means that "Deductions etc" is equal to:

Depreciation + Opex + Term Credit Spread Differential + Interest + Permanent Differences - Amortisation of Initial Difference in Asset Values - Amortisation of Revaluations

determine the 2012/13 revenue, a variable will be assigned to this revenue, an equation developed that incorporates this variable, and the equation solved algebraically to provide an expression that can be evaluated.

Let $R = 2012/13$ allowable revenue

$\Delta CPI_s =$ change in CPI from Year $s-1$ to Year s

$RRG_s =$ Real revenue growth to be applied for year s

$X =$ real rate of change of prices in a CPI minus X regime

The Allowable Revenue for 2013/14 ($AR_{2013/14}$) is:

$$R * (1 + \Delta CPI_{2013/14}) * (1 + RRG_{2013/14}) * (1 - X)$$

And the Allowable Revenue for 2014/15 ($AR_{2014/15}$) is:

$$AR_{2013/14} * (1 + \Delta CPI_{2014/15}) * (1 + RRG_{2014/15}) * (1 - X)$$

The revenues for the three year period can therefore be written as the series:

$$\{AR_{2012/13};$$

$$AR_{2013/14};$$

$$AR_{2014/15}\}$$

which has the values:

$$\{R;$$

$$R * (1 + \Delta CPI_{2013/14}) * (1 + RRG_{2013/14}) * (1 - X);$$

$$R * (1 + \Delta CPI_{2013/14}) * (1 + RRG_{2013/14}) * (1 - X) * (1 + \Delta CPI_{2014/15}) * (1 + RRG_{2014/15}) * (1 - X)\}$$

Dividing this series by R gives the revenue profile, i.e a series indicating each of the revenues scaled by a factor such that the first scaled revenue is unity. The revenue profile is therefore:

$$\{1;$$

$$(1 + \Delta CPI_{2013/14}) * (1 + RRG_{2013/14}) * (1 - X);$$

$$(1 + \Delta CPI_{2013/14}) * (1 + RRG_{2013/14}) * (1 - X) * (1 + \Delta CPI_{2014/15}) * (1 + RRG_{2014/15}) * (1 - X)\}$$

The values in this Revenue Profile will be referred to as:

$$\{RP_{2012/13};$$

$$RP_{2013/14};$$

RP_{2014/15} }

Note that {AR_{2012/13}; AR_{2013/14}; AR_{2014/15}} = R * {RP_{2012/13}; RP_{2013/14}; RP_{2014/15}}

Therefore

$$PV_{\text{mid}}(\text{Revenues}) = R * PV_{\text{mid}}(\text{RP}_{2012/13}; \text{RP}_{2013/14}; \text{RP}_{2014/15})$$

Therefore

$$R = PV_{\text{mid}}(\text{Revenues}) / PV_{\text{mid}}(\text{RP}_{2012/13}; \text{RP}_{2013/14}; \text{RP}_{2014/15})$$

Each of the amounts on the right-hand-side of the equation above can be calculated directly. An equation that allows the direct calculation of PV_{end}(Revenues) has been derived, as noted previously. The equation for R immediately above therefore provides a method of determining R that can be applied directly.

While the equation for R may be applied directly, care will be needed in its application. The present value calculations need to recognise that some of the cash flows occur at mid-year, while other cash flows and other amounts occur at year-end. This recognition may be achieved by noting that:

1. If the *annual* discount rate to be applied is WACC, then the discount rate to be applied to discount an amount by six months will be $\sqrt{1+WACC} - 1$.
2. The determination of PV_{mid}(RP_{2012/13}; RP_{2013/14}; RP_{2014/15}) will be the PV determination of mid-year amounts.
3. The Excel function NPV() simply applied to a range of three cells gives the present value as at the start of the three years to which the range refers, assuming that each of the three amounts are end-of-year amounts.
4. The Excel function NPV(RP_{2012/13}; RP_{2013/14}; RP_{2014/15}) would discount the cash flows by six months more than required. The amount so calculated may be multiplied by $\sqrt{1+WACC}$ to obtain the correct present value.
5. The amount PV_{end}(Tax Deductions etc) relates solely to tax effects, which occur at year-end. Note that even though opex forms part of this calculation and is modelled as occurring at mid-year, the *tax effect* of opex deductibility occurs at year end, and therefore a six month adjustment to opex amounts when determining PV_{end}(Deductions etc) must not be applied.
6. The determination of PV_{mixed}(non-tax costs) needs to recognise that opex is modelled as occurring on average at mid-year. This recognition would be achieved by multiplying the simple NPV(opex values) amount by $\sqrt{1+WACC}$ to obtain the correct present value. All of the other non-tax costs occur at year-end. The value of PV_{mixed}(non-tax costs) shall be determined as the sum of PV_{mid}(opex) plus PV_{end}(non-tax costs excluding opex).

A necessary but not sufficient check of the correctness of this derivation and its application would be to check the return on investment achieved by the allowable revenues. This check would need to recognise the value of the investment at the start and end of the three year period (including recognition of deferred tax), and the amounts of all cash flows including tax payable. If the return on investment so calculated is equal to the WACC, then the check test will be passed.