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Our Reference: UE.SU.01

Mr Lyndon Rowe
Chairman
Economic Regulation Authority, WA
P.O. Box 8469
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BY EMAIL TO: publicsubmissions@erawa.com.au

Dear Mr Rowe,

Guidelines for the Rate of Return for Gas Transmission and Distribution Networks: Response to background papers prepared for the stakeholder workshop held on 7th November 2013

This letter has been prepared by United Energy and Multinet Gas and addresses matters in relation to the term of the risk-free rate used in computing the cost of debt.

Chairmont, in its report of 5 November 2013, *Cost of Debt: Comparative Analysis*, argues that if the ERA were to use swap rates to determine the base-rate component of the cost of debt and were to reset rates every *k* years, then for the zero net present value (NPV) principle to be satisfied, the regulator would have to employ *k*-year swap rates to set the component[1, 2]. The ERA makes a similar argument in its *Explanatory Statement for the Draft Rate of Return Guidelines*. The ERA argues that since it resets the cost of debt every five years, then it must set the cost of debt equal to the yield on a five-year corporate bond to ensure the zero-NPV principle holds[3]. The arguments that Chairmont and the ERA make are incorrect.

[1] Chairmont, *Cost of Debt: Comparative Analysis*, 5 November 2013, pages 17-24.

[2] The zero-NPV principle states that the discounted value of the revenues, less capital and operating expenditure and taxes, that the regulatory asset base (*RAB*) is expected to generate over the regulatory period, plus the discounted value of the *RAB* at the end of the regulatory period, must match the *RAB* today.

[3] The ERA plans to compute the yield on a five-year corporate bond as the sum of the yield on a five-year Commonwealth Government Security and a debt risk premium.

ERA, *Explanatory Statement for the Draft Rate of Return Guidelines*, 6 August 2013, pages 71-76 and 219-227.

The evidence indicates that[4]:

- Australian electricity and gas network service providers (NSPs) on average issue debt that has a term of 10 years.
- The ERA estimates the cost of equity using a sample of Australian electricity and gas NSPs that have on average in the past issued debt with a term of 10 years to maturity and that have faced five-year regulatory cycles; and
- 10-year swap rates and corporate bond yields have on average in the past sat above corresponding five-year swap rates and corporate bond yields.

It follows from these empirical facts that if the ERA were to:

- Use five-year swap rates to determine the base-rate component of the cost of debt.
- Reset the rates every five years; and
- Reset the debt risk premium every five years,

then unless the ERA were to:

- Simultaneously raise the cost of equity that it sets to offset the losses that NSPs would make on the cost of debt,

then the zero-NPV principle would be violated. Similarly, it also follows that if the ERA were to:

- Use the yield on a five-year corporate bond to determine the cost of debt; and
- Reset the cost of debt every five years,

then unless the ERA were to:

- Simultaneously raise the cost of equity that it sets to offset the losses that NSPs would make on the cost of debt,

the zero-NPV principle would be violated.

We demonstrate these claims to be true using arguments that Professor Grundy of the University of Melbourne makes in his November 2010 report, *Determination of the WACC in the Setting of a 5 year Regulatory Cycle*. These arguments are themselves based on the Nobel-prize winning work of Modigliani and Miller (1958) [5].

<u>Theory</u>

Professor Grundy (2010) notes that in a world without taxes and transaction costs the analysis of Modigliani and Miller (1958) implies that, holding the investment policy of a firm fixed, the

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4 ERA, *Explanatory Statement for the Draft Rate of Return Guidelines*, 6 August 2013, pages 74-75 and 169.

5 Grundy, B., *Determination of the WACC in the Setting of a 5 year Regulatory Cycle*, University of Melbourne, 13 November 2010.

Miller, M. and Modigliani, F., *The cost of capital, corporation finance and the theory of investment*, American Economic Review, 1958, pages 261-297.

firm's weighted average cost of capital (*WACC*) will be independent of the firm's choice of capital structure[6]. In particular, the firm's *WACC* will not depend on whether the firm decides to issue five-year or 10-year debt. Thus:

$$WACC = \left(\frac{D}{V}\right) R_{D\,given\ 10-year\ debt} + \left(\frac{E}{V}\right) R_{E\,given\ 10-year\ debt}$$

$$= \left(\frac{D}{V}\right) R_{D\,given\ 5-year\ debt} + \left(\frac{E}{V}\right) R_{E\,given\ 5-year\ debt} \quad (1)$$

Here *D* and *E* are the market values of the firm's debt and equity, *V* is the value of the firm and $R_{D\ given\ n\text{-}year\ debt}$ and $R_{E\ given\ n\text{-}year\ debt}$ are the costs to the firm of issuing debt and equity when the firm issues *n*-year debt and chooses a debt-to-value ratio of *D*/*V*.

Equation (1) suggests that by issuing five-year debt instead of 10-year debt, the firm will not be able to lower its *WACC*. It will lower its cost of debt, but it will simultaneously raise its cost of equity. If this were not the case, then arbitrage opportunities would exist.

Suppose, for example, that:

$$(D/V) = 0.6, \qquad R_{D\,given\ 10-year\ debt} = 5.00, \qquad R_{E\,given\ 10-year\ debt} = 10.00 \quad (2)$$

Then the firm's *WACC* must be:

$$WACC = \left(\frac{D}{V}\right) R_{D\,given\ 10-year\ debt} + \left(\frac{E}{V}\right) R_{E\,given\ 10-year\ debt}$$

$$= 0.6 \times 5.00 + (1-0.6) \times 10 = 7.00 \quad (3)$$

It follows that if $R_{D\ given\ 5\text{-}year\ debt}$ = 4.80, then:

$$R_{E\,given\ 5-year\ debt} = \left(WACC - \left(\frac{D}{V}\right) R_{D\,given\ 5-year\ debt}\right) / \left(\frac{E}{V}\right)$$

$$= (7.00 - 0.6 \times 4.80)/(1-0.6) = 10.30 \quad (4)$$

Thus by issuing five-year debt instead of 10-year debt the firm will lower its cost of debt, but will simultaneously raise its cost of equity.

It follows from (1) that if, as empirically appears to be the case, the 10-year cost of debt lies on average above the five-year cost of debt, then:

6 Grundy, B., *Determination of the WACC in the Setting of a 5 year Regulatory Cycle*, University of Melbourne, 13 November 2010.

Miller, M. and Modigliani, F., *The cost of capital, corporation finance and the theory of investment*, American Economic Review, 1958, pages 261-297.

$$WACC_5 < WACC_{10} = WACC_{TRUE} \; , \tag{5}$$

where $WACC_{TRUE}$ is the firm's true *WACC* and

$$WACC_5 = \left(\frac{D}{V}\right) R_{D\,given\ 5-year\ debt} + \left(\frac{E}{V}\right) R_{E\,given\ 10-year\ debt}$$

$$WACC_{10} = \left(\frac{D}{V}\right) R_{D\,given\ 10-year\ debt} + \left(\frac{E}{V}\right) R_{E\,given\ 10-year\ debt} \tag{6}$$

In other words, if the ERA were to estimate the cost of equity from a sample of firms that typically issue 10-year debt and were to combine this estimate with an estimate of the cost of five-year debt, then it would underestimate the firm's *WACC*. In the numerical example provided above, the ERA would estimate the *WACC* to be:

$$WACC_5 = \left(\frac{D}{V}\right) R_{D\,given\ 5-year\ debt} + \left(\frac{E}{V}\right) R_{E\,given\ 10-year\ debt}$$

$$= 0.6 \times 4.80 + (1 - 0.6) \times 10.00 = 6.88 <$$

$$WACC_{10} = \left(\frac{D}{V}\right) R_{D\,given\ 10-year\ debt} + \left(\frac{E}{V}\right) R_{E\,given\ 10-year\ debt} \tag{7}$$

$$= 0.6 \times 5.00 + (1 - 0.6) \times 10.00 = 7.00 = WACC_{TRUE}$$

One can easily extend this analysis to situations in which the ERA estimates the base rate component of the cost of debt using bonds of one term to maturity and the debt risk premium using bonds of another term to maturity. To demonstrate that the arguments that Chairmont and the ERA make are incorrect, however, it is not necessary to do so and so, for brevity, we do not extend the analysis. Professor Grundy, however, does provide an analysis of situations like these[7].

Note that in the analysis above we take the investment policy of the firm to be fixed. Changing the length of the regulatory cycle may lead to a change in the risk or risks that the firm faces and so in its *WACC*. The ERA and other Australian regulators, though, have historically used a five-year regulatory cycle and so estimates of the cost of equity that the ERA uses will be based on the presumption that the length of the cycle is fixed at five years.

To summarise, Professor Grundy's analysis indicates that if the ERA were to:

- Use five-year swap rates to determine the base-rate component of the cost of debt.
- Reset the rates every five years; and

[7] Grundy, B., *Determination of the WACC in the Setting of a 5 year Regulatory Cycle*, University of Melbourne, 13 November 2010.

- Reset the debt risk premium every five years,

then unless the ERA were to:

- Simultaneously raise the cost of equity that it sets to offset the losses that NSPs would make on the cost of debt,

then the zero-NPV principle would be violated. Similarly, Professor Grundy's analysis indicates that if the ERA were to:

- Use the yield on a five-year corporate bond to determine the cost of debt; and
- Reset the cost of debt every five years,

then unless the ERA were to:

- Simultaneously raise the cost of equity that it sets to offset the losses that NSPs would make on the cost of debt,

then the zero-NPV principle would be violated.

Empirical evidence

The ERA provides in its *Explanatory Statement for the Draft Rate of Return Guidelines* empirical evidence on the term of debt issued by Australian electricity and gas NSPs. The ERA also provides evidence on the remaining term to maturity of the debt that electricity and gas NSPs have outstanding. The ERA finds that the equally weighted (value-weighted) mean term to maturity of debt when issued for a sample of electricity and gas NSPs is 11.5 (11.16) years[8]. It finds that the equally weighted (value-weighted) mean remaining term to maturity of debt outstanding for the sample is 6.0 (6.43) years. The ERA concludes from this that[9]:

> 'The average term to maturity for bonds at issuance was approximately 10 years while the average of the remaining term to maturity was approximately 5 years ...'

The ERA also contends that[10]:

> '... it is the average remaining term to maturity that determines the debt profile of a firm at a given time. That is, the yield required to service a firm's cost of debt is a function of the remaining term to maturity, and not the term to maturity at issuance.'
>
> '... the term to maturity at issuance is irrelevant for the pricing of a firm's debt, and consequently irrelevant for determining the relevant term to maturity for estimating the risk-free rate of return.'

These passages and the analysis of Chairmont indicate that both Chairmont and the ERA misunderstand what the yield to maturity on a bond represents. The yield to maturity on a bond

8 ERA, *Explanatory Statement for the Draft Rate of Return Guidelines*, 6 August 2013, page 74.

9 ERA, *Explanatory Statement for the Draft Rate of Return Guidelines*, 6 August 2013, page 74.

10 ERA, *Explanatory Statement for the Draft Rate of Return Guidelines*, 6 August 2013, page 75.

will be a function of the returns to holding the bond not solely over the first year of its life but over each of the remaining years of its life.

Consider, for simplicity, a zero-coupon bond. Campbell, Lo and MacKinlay (1997) show that the log yield to maturity of a zero-coupon bond will be given by[11]:

$$\log(1+Y_{nt}) = y_{nt} = \left(\frac{1}{n}\right)\sum_{i=0}^{n-1} r_{n-i,\,t+1+i} \quad , \qquad (8)$$

where Y_{nt} denotes the yield on an n-year zero-coupon bond at the end of year t, log(.) denotes a natural logarithm, y_{nt} is the log yield on the bond and $r_{n-i,t+1+i}$ is the continuously compounded return to holding the bond from the end of year $t+i$ (when the bond will have become a bond with a term of $n-i$ years to maturity) to the end of year $t+1+i$.

Equation (8) says that the log yield to maturity of a zero-coupon bond is a simple average of the continuously compounded returns to holding the bond over each year of its life.

Alternatively, one can rewrite (8) as implying that:

$$Y_{nt} = \left(\prod_{i=0}^{n-1}(1+R_{n-i,t+1+i})\right)^{1/n} - 1 \ , \qquad (9)$$

where $R_{n-i,t+1+i}$ is the not continuously compounded return to holding the bond from the end of year $t+i$ to the end of year $t+1+i$. [12]

Equation (9) says that the yield on an n-year zero-coupon bond will be a geometric average of the returns to holding the bond over each year of its life.

Importantly, equations (8) and (9) make clear that *the yield on an n-year bond does not measure the return that one can expect to earn from holding the bond over the first year of its life*. It measures the return to holding the bond over each year of its life – including over years in which the term to maturity of the bond will have fallen far below n.

Campbell, Lo and MacKinlay (1997) also show that the log yield to maturity on a coupon-paying bond will be, approximately, a weighted average of the returns to holding the bond over each year of its life[13]. They show that the log yield on a coupon-paying bond that trades at par will be approximately given by:

$$y_{nt} = \left(\frac{1-\rho}{1-\rho^n}\right)\sum_{i=0}^{n-1} \rho^i r_{n-i,t+1+i} \quad , \qquad (10)$$

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[11] Campbell, J., A. Lo and C. MacKinlay, The econometrics of financial markets, Princeton University Press, Princeton, NJ, page 399.

[12] If the price of the bond were, for example, \$100 at the end of year of year $t+i$ and \$110 at the end of year $t+1+i$, then $R_{n-i,t+1+i}$ would be 100 × (110 – 100) ÷ 100 = 10 per cent. This return is often referred to as a holding-period return.

[13] Campbell, J., A. Lo and C. MacKinlay, The econometrics of financial markets, Princeton University Press, Princeton, NJ, page 408.

where ρ = 1/(1 + C) =exp(– y_{nt}) and C is the coupon rate of the bond. So it is also true for a coupon-paying bond that that *the yield on an n-year bond does not measure the return that one can expect to earn from holding the bond over the first year of its life*.

The ERA states that[14]:

> 'The debt structure of a particular business is expected to remain relatively constant across various periods.'
>
> '...overall, network service provider (NSP) instrument's term to maturity at issuance tend to centralise around 10 to 11 years while the remaining term to maturity tends to centralise around 4 to 6 years. This outcome is consistent with what would be observed if an NSP issued 10 per cent of its debt every year with a maturity of 10 years; the average remaining term to maturity would be 5.5 years.'

These comments suggest that the ERA believes that regulated energy utilities, while issuing debt with a term to maturity of around 10 years, follow a policy of maintaining an average remaining term to maturity of around 5.5 years. In other words, the ERA believes from its analysis that regulated energy utilities issue new debt and retire existing debt in such a way as to keep the average remaining term to maturity of the debt that they have outstanding constant at 5.5 years.

It follows that the ERA would do better to use the mean return to a 5.5-year bond over the first year of its life to set the cost of debt than the yield on a five-year bond. The yield on a five-year bond will reflect not just the return to holding a five-year bond over the first year of its life but also over subsequent years when the term to maturity of the bond will have fallen. The use of a five-year yield to set the cost of debt would only be appropriate if the ERA believed that the term to maturity of the debt that regulated energy utilities currently have outstanding is five years and that these utilities will not issue new debt going forward and so will emerge debt-free six years from now.

It is generally accepted that the term structure of yields is on average upward sloping[15]. This empirical regularity suggests that *the mean return to a 5.5-year bond over the first year of its life will on average significantly exceed the yield to maturity on a five-year bond*. The mean return to a 5.5-year bond, though, as we show below, is likely to come close to matching the average yield on a 10-year bond.

An example

Equations (7) and (8) can be used to demonstrate algebraically that the yield on an *n*-year bond will in general differ from the mean return to holding the bond over the first year of its life. An example can be used to illustrate how the yield on an *n*-year bond can differ from the mean return to holding the bond over the first year of its life.

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[14] ERA, *Explanatory Statement for the Draft Rate of Return Guidelines*, 6 August 2013, pages 72-74.

[15] It is generally accepted that the term structure of yields is on average upward sloping, whether the yields in question are zero-coupon yields or the yields are par yields. In other words, the evidence indicates that the term structure of zero-coupon yields is on average upward sloping and the term structure of par yields is on average upward sloping.

We assume, for simplicity, that the mean holding-period return on a zero-coupon bond is a positive linear function of its term to maturity. This assumption is made for ease of exposition and for algebraic tractability[16].

The presumption made can be written as:

$$E(r_{n-i,t+1+i}) = \alpha + \beta(n-i) \ , \tag{11}$$

where $\alpha > 0$ and $\beta > 0$ are parameters. With this assumption:

$$E(r_{5.5,t+1}) = \alpha + 5.5\beta \ , \tag{12}$$

while from (8),

$$y_{5t} = \left(\frac{1}{5}\right)\sum_{i=0}^{4} r_{5-i,t+1+i} = \left(\frac{1}{5}\right)\sum_{i=0}^{4}(\alpha + \beta(5-i)) = \alpha + 3\beta \ , \tag{13}$$

and, also from (8),

$$y_{10t} = \left(\frac{1}{10}\right)\sum_{i=0}^{9} r_{5-i,t+1+i} = \left(\frac{1}{10}\right)\sum_{i=0}^{9}(\alpha + \beta(10-i)) = \alpha + 5.5\beta \tag{14}$$

Thus if the mean holding-period return on a zero-coupon bond is a positive linear function of its term to maturity, then the yield on a 10-year bond will match exactly the mean holding-period return on a 5.5-year bond over the first year of its life. On the other hand, the yield on a five-year bond will fall below the mean holding-period return on a 5.5-year bond over the first year of its life. Lally (2012) provides an estimate of the average gap between the yields on 10-year and 5-year Commonwealth Government Securities of 23 basis points[17]. Thus even for default-free bonds the gap between the yield on a 10-year bond and a five-year bond is not a trivial quantity.

Summary

We emphasise that if the ERA were to:

- Use five-year swap rates to determine the base-rate component of the cost of debt.
- Reset the rates every five years; and
- Reset the debt risk premium every five years,

then unless the ERA were to:

- Simultaneously raise the cost of equity that it sets to offset the losses that NSPs would make on the cost of debt,

16 One could also generate an example in which the mean holding-period return on a coupon-paying bond is a nonlinear function of its term to maturity but the analysis would be less straightforward.

17 Lally, M., The risk free rate and the present value principle, 22 August 2012, page 16.

then the zero-NPV principle would be violated. Similarly, we emphasise that if the ERA were to:

- Use the yield on a five-year corporate bond to determine the cost of debt; and
- Reset the cost of debt every five years,

then unless the ERA were to:

- Simultaneously raise the cost of equity that it sets to offset the losses that NSPs would make on the cost of debt,

then the zero-NPV principle would be violated.

Chairmont and the ERA appear to have misunderstood what the yield to maturity on a bond represents. The yield to maturity on a bond will be a function of the returns to holding the bond not solely over the first year of its life but over each of the remaining years of its life. The ERA has provided evidence that regulated energy utilities, while issuing debt with a term to maturity of around 10 years, follow a policy of maintaining an average remaining term to maturity of around 5.5 years. The ERA has, however, suggested that the yield on a five-year corporate bond should be used to determine the cost of debt. We emphasise that the use of a five-year yield to set the cost of debt would only be appropriate if the ERA believed that the term to maturity of the debt that regulated energy utilities currently have outstanding is five years, and that these utilities will not issue new debt going forward and so will emerge debt-free six years from now.

If the ERA has further questions about this submission, then please do not hesitate to contact Jeremy Rothfield, Network Regulation and Compliance Manager, on (03) 8846 9854.

Yours sincerely,

Jeremy Rothfield
Network Regulation and Compliance Manager