# THE COST OF DEBT

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## EXECUTIVE SUMMARY

This paper has addressed a number of issues raised with me by the ERAWA, and my views are as follows.

Firstly, unregulated firms require DRP estimates in the course of estimating the NPV of a proposed investment project, and the appropriate DRP for this purpose is the prevailing rate on debt for the period that the firm borrows for. By contrast, if existing debt or equity is valued, the historic DRP for the term for which the firm borrows still appears in the cash flows for both debt and equity that are valued, but these cash flows are valued using prevailing rates which include the prevailing DRP for the residual term to maturity when valuing the bonds.

Secondly, and in respect of regulated firms, the same points apply. In addition, their output prices are periodically reset by a regulator and the regulator must choose a methodology for doing so. An important principle that should guide regulatory decisions is the NPV = 0 principle and, since the behaviour of firms may be affected by the regulatory policy, the principle should be viewed as a compatible combination of regulatory policy and firm actions that satisfies the NPV = 0 principle; this compatible combination must involve a course of action by a firm that is feasible in the absence of regulation and a regulatory policy whose imposition would not cause the firm to change this behaviour. Faced with regulatory regimes of the kind recently adopted by the ERAWA, and its immediate predecessor regime, businesses have (sensibly) continued to borrow long-term (with staggering) so as to deal with refinancing risk and have additionally used interest-rate swap contracts to align the risk-free rate component of their cost of debt with the regulatory cycle (and therefore with the rate allowed by the regulator). Since the ERAWA allows a DRP that reflects the rate prevailing at the beginning of each year, and firms pay the trailing average DRP, this combination of firm and regulatory policy does not satisfy the NPV = 0 principle. However, satisfying the NPV = 0 principle is only one of many considerations in choosing a regulatory policy. Furthermore, it is possible for a regulator to achieve a close approximation to the NPV = 0 principle, by using an allowed rate of return that matches or at least approximates that paid by benchmark firms (Australian utilities) on average over time and this implies use of a ten-year DRP. So, the ERAWA's current and previous policy will approximately satisfy the NPV = 0 principle if the DRP used by them is the ten-year DRP.

Thirdly, in respect of estimating the DRP, and in the course of valuing prospective projects, unregulated firms require the prevailing DRP for a term matching that for which they borrow, and this can be estimated from recent trades on existing bonds with a residual term to maturity matching that for which the firm in question borrows. In respect of regulated firms, satisfying the NPV = 0 principle would require use of a ten-year trailing average of that DRP, but a close approximation can be achieved when using the prevailing DRP so long as that DRP is for a term matching the term for which benchmark firms borrow (about ten years). To estimate these DRPs, at the required points in time, the process is as described for unregulated firms.

Fourthly, whether the DRP is updated annually or only at the beginning of a cycle has no implications for the previous points. Whether one engages in annual updating or updating only at the beginning of each regulatory cycle, one *cannot* perfectly satisfy the NPV = 0 principle because firms are paying the trailing average DRP (due to staggering their borrowing and the inability to hedge the difference) and it is not viable for them to act otherwise. Similarly, whether one engages in annual updating or updating only at the beginning of each regulatory cycle, the NPV = 0 principle is approximately satisfied providing one allows the ten-year DRP.

Fifthly, in assessing the relative merits of updating the DRP annually or only at the beginning of a cycle, my preferred criteria for assessing any regulatory policy is that it should satisfy the NPV = 0 principle, it should incentivise firms to act efficiently especially in relation to opex, capex and new entry to the regulated sector, it should be possible and simple to implement, it should minimise bankruptcy risk for the firm, it should give rise to a low average output price to consumers, it should give rise to low volatility in the output price to consumers, and if a change in regime occurs any transitional process used should be simple to implement, simple to understand, and minimise the one-off gains or losses experienced by firms as a result of the regime change. Applying these criteria to the issue of updating the DRP annually or only at the beginning of the cycle, both approaches fail to satisfy the NPV = 0 principle, but only trivially providing that the ten-year DRP is used, both would only slightly raise bankruptcy risk, both would give rise to the same average output price, both would involve similar output price volatility, and neither would require a transitional process regardless of which regime were considered to be the current regime. The two points of distinction between the

approaches are that annual DRP updating would involve more effort and would send superior signals to firms contemplating capex. The effort involved in annual updating relative to resetting only at the beginning of the cycle would seem to be less important than the superior capex signal. Consequently, annual updating would seem to be superior.

I have also reviewed submissions from CEG. I agree with some of the points raised by CEG but none of them are substantial. By contrast, I disagree with CEG's claim that its preferred approach of a trailing average DRP does not give rise to capex incentive problems, and I do not agree that the wording of rule 87(3) of the NGR requires use of a trailing average DRP.

## 1. Introduction

The ERAWA's current policy in respect of the cost of debt is to set it as the sum of the risk free rate prevailing at the beginning of the regulatory cycle (for the term of the cycle), the DRP prevailing at the beginning of each year (for a term in excess of two years), the costs of raising debt, and the transactions costs of the interest rate swap contracts required to align the risk-free rate component of its actual borrowing with the regulatory cycle (ERAWA, 2013). In response to various criticisms of this approach, the ERAWA has raised the following questions with me:

- What theories guide the choice of the term for the DRP for both regulated and unregulated firms?
- Given the response to this, what is the best means to empirically estimate the DRP for regulated and unregulated firms in order to achieve the correct term?
- Would annual updating of the DRP change any aspect of the response to the previous questions?
- Is it preferable to update the DRP annually or set and fix it at the beginning of each regulatory cycle?
- Critique aspects of the reports by CEG (2014) and ATCO (2014) that are relevant to these matters.

This paper seeks to address these questions.

## 2. Theoretical Issues Underlying the Choice of the DRP Term for Unregulated Firms

In respect of unregulated firms, the usual purpose for specifying a DRP term is to estimate the NPV of a proposed investment project, because projects are in general partly debt financed, interest payments are a cost, and the cost varies with the term of the borrowing. So, if the project has a life of (say) 20 years and the firm's policy is to borrow for ten years, then the expected cash flows to equity holders will be net of the interest payments on ten year debt (at the current rate $k_{d0}$ for the first ten years and the expected rate in ten years' time $k_{d10}$ for the last ten years). Letting $X_t$ denote the expected unlevered cash flows for year $t$, $B_t$ the borrowing level at the beginning of year $t$ (with any repayments made at year ends), $T_c$ the

corporate tax rate (at which the interest payments attract a tax saving), and $k_e$ the cost of equity, the present value of the cash flows to equity holders is

$$S_0 = \frac{X_1 - k_{d0}(1-T_c)B_0 - (B_0 - B_1)}{1+k_e} + ..... + \frac{X_{20} - k_{d10}(1-T_c)B_{19} - B_{19}}{(1+k_e)^{20}}$$

Assuming as usual that the repayments of debt are made so as to maintain the debt to value ratio over the life of the project, denoted $L$, this is equivalent to

$$S_0 + B_0 = \frac{X_1}{1+k_e(1-L)+k_{d0}(1-T_c)L} + ..... + \frac{X_{20}}{\left[1+k_e(1-L)+k_{d10}(1-T_c)L\right]^{20}}$$

This says that the value now of the project is the expected unlevered cash flows discounted at the project WACC, with the cost of debt within the WACC corresponding to that on debt of the term that the firm borrows for (ten years). Definitionally, the current ten-year cost of debt is the current ten-year risk free rate plus the ten-year DRP. Similarly, the ten-year cost of debt in ten years' time is the ten-year risk free rate plus the ten-year DRP at that time.

Over time, the debt may be valued and the equity in the project may be valued as part of the equity value of the firm. In respect of the debt value, this will be the promised payments discounted using the prevailing promised rate for the residual term to maturity. So, if the debt has one year to maturity, the value then will be the promised payments (which reflect the historic ten-year DRP) discounted using the prevailing one year promised rate (which includes the prevailing one year DRP). In respect of the equity value, this will be the expected cash flows to equity holders (which are net of the historically determined ten-year cost of debt) discounted at the prevailing cost of equity. So, in respect of valuation, the historic ten-year DRP still appears in the cash flows for both debt and equity, but these cash flows are valued using prevailing rates (which include the prevailing DRP for the residual term to maturity when valuing the bonds).

In summary, unregulated firms require DRP estimates in the course of estimating the NPV of a proposed investment project, and the appropriate DRP is the prevailing rate on debt for the period that the firm borrows for. By contrast, if existing debt or equity is valued, the historic DRP for the term for which the firm borrows still appears in the cash flows for both debt and

equity, but these cash flows are valued using prevailing rates which include the prevailing DRP for the residual term to maturity when valuing the bonds.

## 3. Theoretical Issues Underlying the Choice of the DRP Term for Regulated Firms

In respect of regulated firms, the points made in the previous section still apply. In addition, the output prices of the firm are periodically reset by a regulator and the regulator must choose a methodology for doing so. An important principle that should guide regulatory decisions is that they should give rise to revenues for the business that just cover its reasonable costs including the cost of capital, i.e., the revenues should have a present value (net of operating costs) that is equal to the RAB ("NPV = 0" principle). Revenues in excess of this constitute the very monopoly profits that regulation is designed to eliminate whilst revenues below this point will discourage the business from replacing assets as they wear out. Naturally, perfect conformity with this principle is an ideal rather than a requirement for regulatory policy, minor departures from it are not important, and other considerations also matter.

Implicit in this statement about how a regulator should act is a presumption that the actions of a regulator do not change the behavior of regulated entities, i.e., the regulator chooses a policy that reduces the prices of a firm, thereby reducing the NPV of the business to zero, and the firm does not react. In respect of debt policy this is not the case; there are a range of policies that a firm might pursue and the regulator's choice of policy might lead the firm to change its policy, leading to a further change in regulatory action, and so on. Under such conditions, the NPV = 0 principle should be viewed not simply as a regulatory policy that gives rise to NPV = 0 but a compatible combination of regulatory policy and firm actions that satisfies the NPV = 0 principle; this compatible combination must involve a course of action by a firm that is feasible in the absence of regulation and a regulatory policy whose imposition would not cause the firm to change this behavior ("matching" regulatory policy). Naturally there may be more than one combination that satisfies this definition and Lally (2014, section 2.1) provides some examples of this.

In respect of the possible debt policies that a firm could pursue, some may not be feasible and therefore could not in conjunction with a matching regulatory policy satisfy the NPV = 0 principle as presented above. Even if they are feasible, some policies may be so inefficient

that they would be shunned by most firms (unviable) and such policies should therefore be dismissed from consideration. Furthermore, even if a debt policy is viable, and therefore feasible, there may be no regulatory policy in conjunction with it that satisfies the NPV = 0 principle.[1]

The first possible debt policy is to roll over all debt at the same point, and this might be done to align the firm's borrowing with the regulatory cycle. Although the policy is feasible, the resulting refinancing risk would be unacceptably high and therefore this strategy is not viable. The AER (2009, pp. 151-154) make the same point.

A second possible debt policy would be to borrow long-term (say ten years) and stagger the borrowing so that only a small proportion of the debt matured in any one year. This would reduce the refinancing risk to a low level. This strategy is viable and generally employed in the private sector (AER, 2009, pp. 151-154). The matching regulatory policy would be for the allowed cost of debt to be set in accordance with the trailing average cost, and this combination of corporate debt policy and regulatory policy would therefore satisfy the NPV = 0 principle. Under this approach, the regulator would set the DRP in accordance with the trailing average for a term equal to the term for which benchmark firms (ideally, similar but unregulated firms) borrow.

A third possible debt policy would involve borrowing long-term (say ten years), staggering the borrowing so that only a small proportion matured each year, and entering interest-rate and credit-default swap contracts to change the effective term of the debt. The first two parts of this arrangement would reduce the refinancing risk to a minimal level. In addition the swap contracts could be used to align the cost of debt with that allowed by the regulator, and thereby eliminate interest rate risk to the business. This strategy is not feasible because credit-default swap contracts are in general either not available on the desired bonds or in sufficient quantities for many of the regulated businesses in question (Chairmont Consulting, 2013, page 5).

A fourth possible debt policy would involve borrowing long-term (say ten years), staggering the borrowing so that only a small proportion matured each year, and entering interest-rate

[1] This approach could be further pursued to identify optimal debt policies, but this matter is too subjective to admit clear conclusions. Consequently, judgements about the optimality of a debt policy are avoided.

swap contracts to change the effective term of the risk-free rate component of the cost of debt, i.e., the third possibility subject to removal of the credit-default swap contracts. These interest rate swap contracts could be used to align the risk-free rate component of the cost of debt with that allowed by the regulator, and thereby eliminate this source of interest rate risk to the business. This strategy is viable so long as interest rate swap contracts are available in the require volumes. SFG (2012, page 25) claims that the swaps market lacks the depth to accommodate businesses with large debt levels (if the swaps were entered into over the same short period of about one month that is used by regulators in setting the risk-free rate at the beginning of the regulatory cycle, in order to fully hedge the risk). Furthermore, the QTC (2013, page 8) argues that concentrating the swap transactions in this short period used by regulators (so as to fully hedge the risk) would expose the regulated entity to "opportunistic pricing by other market participants". However, both concerns could be fully addressed by increasing the window over which the swap contracts were entered into. The result would be to generate some interest rate risk from the imperfect match in timing, but this would be trivial relative to not hedging this risk at all. It follows that this strategy is viable. The matching regulatory policy would be for the allowed risk free rate within the cost of debt to be set in accordance with the rate prevailing at the beginning of the regulatory cycle (for a term equal to the cycle) whilst the DRP would be set in accordance with the trailing average. This combination of corporate debt policy and regulatory policy would therefore also satisfy the NPV = 0 principle. Under this approach, the regulator would set the DRP in the same way as for the second option, i.e., in accordance with the trailing average for a term equal to the term for which benchmark firms (ideally, similar but unregulated firms) borrow.

Thus, only two possible debt strategies for a business are viable, and each has a matching regulatory policy such that the combination satisfies the NPV = 0 principle. The first involves borrowing long-term and staggering the borrowing to ensure that only a small proportion of the debt would mature in any one year; this reduces refinancing risk to a minimal level. The matching regulatory policy would be for the allowed cost of debt to be set in accordance with the trailing average cost (for a term matching that for benchmark firms). The second debt strategy additionally involves the use of interest rate swap contracts (relating to the risk-free rate component of the cost of debt). The matching regulatory policy would be for the allowed risk free rate within the cost of debt to be set in accordance with the rate prevailing at the beginning of the regulatory cycle (for a term equal to the cycle) whilst

the DRP would be set in accordance with the trailing average (for a term matching the borrowing term for benchmark firms).

By contrast with these regulatory policies, the ERAWA's regulatory regime involves setting the risk-free rate within the allowed cost of debt in accordance with the rate prevailing at the beginning of the regulatory cycle (for the term of the cycle) and setting the DRP annually in accordance with the prevailing rate (on bonds with a residual term to maturity of at least two years). In addition, its earlier policy differed only in resetting the DRP only at the beginning of the cycle. Faced with regulatory regimes like this, businesses have continued to borrow long-term (with staggering) so as to deal with refinancing risk and have additionally used interest-rate swap contracts to align the risk-free rate component of their cost of debt with the regulatory cycle (and therefore for the rate allowed by the regulator). Since the ERAWA allows a DRP that reflects the rate prevailing at the beginning of each year, and firms pay the trailing average DRP, this combination of firm and regulatory policy does not satisfy the NPV = 0 principle. There is a debt policy that could be combined with this regulatory policy to satisfy the NPV = 0 principle, involving borrowing annually for a one-year term and using interest rate swap contracts to convert the risk-free rate component of the succession of one-year bonds into five-year debt, but the resulting refinancing risk makes it unviable.[2] However, it does not follow that the ERAWA's regulatory policy is inappropriate. Satisfying the NPV = 0 principle is only one of many considerations in choosing a regulatory policy and these will be examined later. Furthermore, minor departures from the NPV = 0 principle are inconsequential, and Lally (2010, Appendix 1) finds that the violations are minor when resetting the DRP at the beginning of the cycle providing that the DRP term that is used is that of the benchmark firm. Using the same approach, the violations would be similarly minor for annual DRP resetting.[3] The benchmark firm could reasonably be equated with

[2] Similarly, the very similar regulatory policy of using the prevailing cost of debt at the beginning of the regulatory cycle, for a term equaling the cycle, in conjunction with a debt policy of borrowing at the beginning of each cycle for the term of the cycle also would satisfy the NPV = 0 principle. However, the refinancing risk associated with this policy also makes it unviable.

[3] By way of comparison, even firms in highly competitive markets (which are very similar to regulated firms in the sense that both face output prices that reflect the costs of an efficient operator) would face prices that reflected prevailing rather than historical costs and therefore the prevailing DRP rather than a ten-year trailing average. For example, if the ten-year trailing average exceeded the current rate, any tendency for prices in the competitive industry to reflect the ten-year trailing average would lead to new entrants undercutting the incumbents. Thus, even firms in highly competitive markets would not satisfy the NPV = 0 principle, although the deviations would be mean zero over time. It is only possible for regulators to set prices that reflect historical DRP costs rather than current costs, and thereby satisfy the NPV = 0 principle at all times, because such firms are natural monopolies.

Australian utilities, for which the average debt term from issuance is about ten years (CEG, 2013, pp. 9-10; PwC, 2013, pp. 10-11), and therefore the DRP incurred by the benchmark firm is a ten-year trailing average of the ten year DRP.[4] By contrast, the ERAWA averages over the DRP estimates on a set of bonds with at least two years to maturity and therefore is unlikely to achieve an average term to maturity of ten years. In fact, the average is about five years (ERAWA, 2013, para 566). Thus, *if* the DRP for five-year bonds differs from that on ten-year bonds, the DRP allowed by the ERAWA will not match that incurred on average by the benchmark firm.

In summary, and in addition to the points made in the previous section, the output prices of a regulated firm are periodically reset by a regulator and the regulator must choose a methodology for doing so. An important principle that should guide regulatory decisions is the NPV = 0 principle and, since the behaviour of firms may be affected by the regulatory policy, the principle should be viewed as a compatible combination of regulatory policy and firm actions that satisfies the NPV = 0 principle; this compatible combination must involve a course of action by a firm that is feasible in the absence of regulation and a regulatory policy whose imposition would not cause the firm to change this behaviour. Faced with regulatory regimes of the kind recently used by the ERAWA, and its current policy, businesses have (sensibly) continued to borrow long-term (with staggering) so as to deal with refinancing risk and have additionally used interest-rate swap contracts to align the risk-free rate component of their cost of debt with the regulatory cycle (and therefore for the rate allowed by the regulator). Since the ERAWA allows a DRP that reflects the rate prevailing at the beginning of each year, and firms pay the trailing average DRP, this combination of firm and regulatory policy does not satisfy the NPV = 0 principle. However, satisfying the NPV = 0 principle is only one of many considerations in choosing a regulatory policy. Furthermore, it is possible for a regulator to achieve a close approximation to the NPV = 0 principle, by using an allowed rate of return that matches or at least approximates that paid by benchmark firms (Australian utilities) on average over time and this implies use of a ten-year DRP. So, the ERAWA's current and previous policy will approximately satisfy the NPV = 0 principle if the DRP used by them is the ten-year DRP.

[4] This remains true even though the average residual term to maturity on such debt will be about five years, because the DRP that is paid is determined at issuance.

## 4. Estimating the DRP

In respect of unregulated firms, and as discussed in section 2, these firms need a cost of debt (which embodies a DRP) for purposes of estimating their WACC (for use in project evaluation), and the cost of debt will be for the term corresponding to the firm's borrowing policy. Thus, if the firm's policy is to borrow for ten years (on average over different types of debt), then the firm should estimate the prevailing cost of debt (and therefore the DRP) for ten year bonds. This is typically done using secondary market data on existing bonds, whose yields to maturity reflect their residual term to maturity. Thus, if the firm's policy is to borrow for ten years and therefore the prevailing ten-year DRP is sought, then existing bonds with a residual term to maturity of about ten years will be sought (and many of these will have had terms to maturity at issuance that were in excess of ten years). Alternatively, if one used a bond curve of the appropriate credit rating, such as that of Bloomberg or the RBA, one would draw the desired value from the ten-year point on the curve. A not uncommon practice is for firms to estimate the prevailing cost of debt (and therefore the DRP) using their own (traded) bonds. However, if the firm's practice is to borrow for ten years, most secondary-market trades would be on bonds with a shorter residual term to maturity, and such bonds would be unsuitable. The error from doing so might not be substantial, and the practice might therefore be pragmatically justified. However, at the very least, one should adjust any such estimate for the current differential between the ten-year risk free rate and the risk free rate for the residual term to maturity of these bonds. Thus, if the traded bond examined has a residual term to maturity of three years, a yield to maturity of 8%, ten-year government bonds currently yield 6%, and three-year government bonds currently yield 5.6%, the current yield to maturity on ten-year bonds of the firm should be estimated at 8.4% rather than 8%.

In respect of regulated firms, and as discussed in section 3, the regulator must choose a regulatory policy and this involves choosing a DRP term. Satisfying the NPV = 0 principle would require use of a ten-year trailing average of that DRP, but a close approximation can be achieved when using the prevailing DRP so long as that DRP is for a term matching the term for which benchmark firms borrow (about ten years). To estimate these DRPs, at the required points in time, the process is as described in the previous paragraph.

In summary, and in the course of valuing prospective projects, unregulated firms require the prevailing DRP for a term matching that for which they borrow, and this can be estimated from recent trades on existing bonds with a residual term to maturity matching that for which the firm in question borrows. In respect of regulated firms, satisfying the NPV = 0 principle would require use of a ten-year trailing average of that DRP, but a close approximation can be achieved when using the prevailing DRP so long as that DRP is for a term matching the term for which benchmark firms borrow (about ten years). To estimate these DRPs, at the required points in time, the process is as described for unregulated firms.

## 5. The Significance of Annual Updating

As discussed in section 3, the ERAWA's policy is to update the DRP annually whilst other regulators update only at the beginning of the regulatory cycle, and this raises the question of whether annual updating has any implications for the previous discussion. The answer is no. Whether one engages in annual updating or updating only at the beginning of each regulatory cycle, one *cannot* perfectly satisfy the NPV = 0 principle because firms are paying the trailing average DRP (due to staggering their borrowing and the inability to hedge the difference) and it is not viable for them to act otherwise. Similarly, whether one engages in annual updating or updating only at the beginning of each regulatory cycle, the NPV = 0 principle is approximately satisfied providing one allows the ten-year DRP. However the choice of annual updating or updating at the beginning of the regulatory cycle has other implications that will be addressed in the next section.

## 6. The Merits of Annual Versus Cycle Beginning Updating

I now assess whether annual updating of the allowed DRP is better or worse than updating only at the beginning of the regulatory cycle ('cycle updating'). To do so, it is necessary to formulate a set of criteria and then rate the two competing policies against those criteria. The criteria (in no particular order of importance) are as follows:

(1) It should satisfy the NPV = 0 principle, i.e., there is a viable debt policy (feasible and not so inefficient that firms would avoid it) that in conjunction with the regulatory policy will satisfy the NPV = 0 principle.

(2) It should incentivise firms to act efficiently, especially in relation to opex, capex, and new entry to the regulated sector.

(3) It should be possible, and simple, to implement it.
(4) It should minimise bankruptcy risk for the firm.
(5) It should give rise to a low average output price to consumers.
(6) It should give rise to low volatility in the output price to consumers.
(7) If a change in regime occurs, any transitional process used should be simple to implement, simple to understand, and minimise the one-off gains or losses experienced by firms as a result of the regime change.

In respect of criterion (1), and as discussed in section 3, neither policy satisfies the NPV = 0 principle. However, both policies approximately satisfy this principle so long as the DRP term that is used is that of ten-year bonds.

In respect of criterion (2), a firm's decisions regarding capex and entry to a sector will be driven by prevailing costs of capital because these will be incurred in these circumstances. In respect of new entrants to the regulated sector, their entry would initiate a regulatory cycle and they would receive the prevailing DRP at that point under both regulatory regimes.[5] So, the choice of annual or cycle beginning updating of the DRP has no effect. In respect of capex, annual updating of the DRP is superior to updating only at the beginning of the cycle because firms would therefore receive a DRP that was stale by only up to one year rather than up to five years. Assuming (reasonably) that the capex timing and extent is predictable, the risk free rate component of this risk can be hedged with a forward-rate contract (as noted by SFG, 2012, page 28). However, the risk of movement in the DRP cannot be hedged. The difference between annual and beginning of cycle updating of the DRP relative to the total compensation to capex over its entire life is likely to be quite small in general but significant cases can (and have) arisen. If the regulator uses the DRP at the beginning of the cycle, and the prevailing DRP is above that at the beginning of the cycle, firms may defer capex; if the prevailing DRP is above that at the beginning of the cycle, firms may undertake capex that is inefficient.

[5] This presumes that the new entrant is a new operator in the industry rather than one who conducts a takeover of an existing operator. In the latter event, a firm buys the equity of an existing operator and inherits the existing debt. However, if the equity purchase is at least partly debt financed, the cost of this finance will reflect prevailing rates and therefore the situation would be similar to that for capex, as discussed next. In particular, when the regulator uses the rate at the beginning of the cycle, prevailing rates higher than those at the beginning of the cycle will discourage such takeovers and prevailing rates that are lower will encourage inefficient takeovers.

For example, suppose the DRP is reset at the beginning of the cycle, the DRP at the beginning of the current cycle was 2.0% and the current DRP (two years later) is 4.5%.[6] Per $1000 of capex, with leverage of 60% and fixed-rate borrowing for at least three years, the firm would then incur DRP costs in the last three years of the cycle of .045*3*.60*$1000 = $81 per $1000 of capex whilst the compensation received under DRP resetting only at the beginning of the cycle would be .02*3*.60*$1000 = $36. The shortfall is therefore $45. Furthermore, in the absence of such a shortfall, the present value of the total compensation for debt costs paid over the life of the asset, in the form of depreciation of $600 and allowed cost of debt on the residual balance each year, would be $600.[7] So, the DRP shortfall of $45 in the first cycle would then represent 7.5% of the total lifetime compensation. This is a substantial sum and might discourage the firm from undertaking the capex until the end of the cycle, when the allowed DRP would be reset at the prevailing value.

In respect of criterion (3), annual updating requires more effort. However a regulator will typically be involved in a series of different regulatory exercises with different cycles. Thus, the incremental effort arising from annual updating may not be substantial.

In respect of criterion (4), involving bankruptcy risk, this is aggravated when the regulator sets the DRP at the beginning of the regulatory cycle whilst firms actually pay the trailing average. In particular, if the DRP suddenly rises, the allowed DRP remains fixed for the remainder of the regulatory cycle (usually five years) whilst the trailing average rate that is paid will rise over that period, and this mis-match raises the risk that the regulated entity would be unable to meet its debt obligations and therefore face bankruptcy risk.[8] In addition, as the DRP reverts to its earlier level, the allowed value will at some point fall below the trailing average, producing another mis-match that raises bankruptcy risk. By contrast, if the

[6] These figures correspond to the DRP values at the beginning of 2008 and 2010 presented in Appendix 1.

[7] This is true regardless of the life of the asset, the regulatory depreciation scheme, and the appropriate cost of capital.

[8] The issue does not arise in respect of the risk free rate component of the cost of debt because the rate allowed is that prevailing at the beginning of the regulatory cycle and the same rate is effectively paid by businesses due to using interest rate swap contracts to align their borrowing terms to the regulatory cycle. The issue would not arise if the regulator used a trailing average for just the DRP because the regulatory allowance would then closely correspond to the DRP incurred by the firm. In addition, the issue would not arise if the regulator used a trailing average for the entire cost of debt because regulated firms could then be expected to desist from interest rate swap contracts and thereby incur a cost of debt that closely corresponded to that allowed by the regulator.

regulator resets the DRP annually, the problem will be largely absent as the DRP rises because the allowance will run ahead of the trailing average that firms incur. Instead, the problem will be limited to the time when the DRP declines because the allowance will then be below the trailing average at some point. In assessing these risks, it is necessary to consider the other cash flows of the firm, most particularly the cash flows arising from the allowed cost of equity, because they provide a cushion. This issue is examined in Appendix 1, using data that spans an entire DRP shock, and it reveals that the additional bankruptcy risk under both regulatory schemes is trivial in the period examined.

In respect of criterion (5), the average output prices under the two regulatory approaches would be the same so long as they both use the ten-year DRP.

In respect of criterion (6), involving the volatility in output prices, annual updating of the DRP will induce more frequent changes in output prices (annually rather than five-yearly) but these changes in any randomly chosen year are likely to be less pronounced than those from five-yearly resetting. So, if volatility is interpreted as the standard deviation of the time series of output prices, there is no reason ex-ante to suppose that volatility will be greater with annual DRP resetting. The key issue may be the date of a cycle; if it coincides with conditions that give rise to an extreme output price and these conditions are only temporary, then DRP resetting at the beginning of the cycle will lock-in the extreme output price for five years whilst annual DRP resetting will ameliorate this problem. Accordingly, the question of which regulatory policy gives rise to greater volatility in output prices is an empirical one and is examined in Appendix 2 using data from 2003-2016. It reveals that volatility could be higher under either approach, depending upon the commencement date of the regulatory cycle relative to the DRP shock. The same is true of a hybrid process, in which prices are changed only five yearly but the changes are designed to produce the same aggregate cash flow to firms as would arise under annual resetting.

In respect of criterion (7), the ERAWA's current regime involves annual DRP resetting (ERAWA, 2013), although it has yet to be applied to a regulatory situation. Instead, the most recent regulatory cases have involved resetting the DRP at the commencement of the cycle. However, I will treat the current regime as involving annual DRP resetting and therefore a transitional issue could only arise if the ERAWA switched back to resetting at the beginning of a cycle. Transitional processes serve four purposes: to mirror the transitional process that

the regulated entity would go through, to initiate the switch to the new regulatory regime without the need to collect historical data, to minimise gains or losses that regulated business would experience from the regime change relative to what they would have experienced under the earlier regime, and to smooth a price shock to consumers. For example, if one switches from using the prevailing DRP to using a trailing average, with a ten-year DRP, one would immediately be confronted by the need to collect DRP values for the past ten years and the lack of such data or lack of confidence in the available data might discourage a regulator from collecting such data, thereby requiring a transitional process from the current to the new regime. However, in switching from annual DRP resetting to beginning of cycle resetting, none of these four issues arise. In particular, there is no need for the firm to change its behaviour; it continues to borrow for ten years (with staggering) and to use interest rate swap contracts to convert the risk-free rate component of its cost of debt from ten to five years and to align this with the regulatory cycle. In addition, there is no need to collect historical data. In addition, the future revenue path of a firm would be very similar under the two regimes and therefore gains or losses from a regime switch would be minor. Finally, any switch in regime would occur at the beginning of a regulatory cycle, at which point prices would be the same under the two regimes, and therefore there would be no price shock to consumers.

In summary, both annual and cycle beginning resetting of the DRP fail to satisfy the NPV = 0 principle, but only trivially providing that the DRP term that is used is that of ten-year bonds, both would only slightly raise bankruptcy risk, both would give rise to the same average output price, both would involve similar output price volatility, and neither would require a transitional process regardless of which regime were considered to be the current regime. The two points of distinction between the approaches are that annual updating would involve more effort and would send superior signals to firms contemplating capex. The effort involved in annual updating relative to resetting only at the beginning of the cycle would seem to be less important than the superior capex signal. Consequently, annual updating would seem to be superior.

## 7. Review of Submissions

ATCO (2014, sections 10.9, 10.10) raises a number of points relevant to this paper but they are presented in more detail in CEG (2014). Accordingly, I review the latter paper.

CEG (2014, paras 294-302) argues that the failure to adopt annual DRP resetting does not pervert capex incentives because additional capex will not receive any additional cost of capital compensation until the beginning of the next regulatory cycle, at which point the prevailing DRP will be received under either annual or cycle beginning DRP resetting. Instead, CEG argues that incentives relate to compensation over the entire life of the asset. These arguments relate to the possibility of the firm undertaking unscheduled capex during the cycle, and the claim that there is no cost of capital compensation until the beginning of the next regulatory cycle is not true in respect of some electricity investments. For example, ERAWA (2014, section 7.3) explicitly provides for ex-post cost of capital compensation for some unscheduled investments from the time of the capex, including the cost of capital. If compensation is based upon the DRP at the beginning of the cycle rather than the current DRP, this capex may be deferred by firms until the end of the current cycle (up to five years). In addition, CEG's argument does not address the possibility of scheduled intra-cycle capex being deferred by firms because the DRP prevailing at the scheduled time of the capex is below the compensation offered when the DRP is reset at the beginning of the cycle (up to five years before). The previous section presents an example in which the compensation shortfall is 7.5% of the present value of all compensation for debt over the life of the asset, and this proportion may be sufficiently large to induce deferral of the capex for up to five years.

Furthermore, since CEG favours compensation based upon the trailing average DRP, the shortfall could be even larger and therefore the discouragement to a firm undertaking capex at the contemplated time is even greater than when the allowed DRP is reset at the beginning of the cycle at the prevailing rate.[9] In fact, in the example presented in the previous section and based upon a prevailing DRP at the beginning of the cycle of 2.0% and a value of 4.5% two years later (at the contemplated date for the capex), the ten-year trailing average DRP was 1.37% at the beginning of the cycle and 1.86% two years later. So, the DRP compensation granted under a trailing average would be either 1.86% or 1.37% (depending upon whether the trailing average is annually updated or not) whilst the DRP incurred on the new debt would be 4.5%, leading to a DRP shortfall over the remaining three years of the cycle

[9] The purpose of the present paper is not to assess the merits of a trailing average but (inter alia) the merits of annual versus beginning of cycle resetting of the DRP. However, CEG's critique of annual updating is so intertwined with the merits of a trailing average that some incursions into this matter are unavoidable. My views on the overall merits of a trailing average DRP versus use of the rate prevailing at the beginning of the cycle have been expressed elsewhere (Lally, 2014) and I favour the latter approach over the former.

equivalent to either 8% or 9% of the present value of the total compensation for borrowing received over the life of the asset (compared to 7.5% with DRP resetting at cycle beginning at the prevailing rate). Remarkably, CEG finishes its discussion of this issue by acknowledging that the allowed cost of capital under a trailing average (or DRP resetting at cycle beginning) would in a case like the above be "temporarily below the actual cost of capital" and therefore invokes quality of service standards to explain why a firm would not be discouraged from undertaking capex at the contemplated time under such conditions (CEG, 2014, para 302). This would seem to constitute a clear acceptance of the incentive problem regarding capex when the DRP is not reset annually.

Notwithstanding this acceptance of the incentive problem at the time capex is contemplated, CEG (2014, para 301) argues that the incentive problem is greater over the life of the asset for annual DRP updating than a trailing average because there is no guarantee that, over the life of the asset, the DRP compensation under annual resetting would match the DRPs paid by the firm. It is true that lifetime compensation could be too high or low under annual DRP resetting (and even under DRP resetting only at cycle beginning) but the differential is not known ex-ante, it could be in either direction, the expected difference is zero, and the average differential over the life of an asset is likely to be small. By contrast, in respect of intra-cycle capex, the DRP shortfall or excess is observable at the time the capex is contemplated and therefore large shortfalls are likely to induce deferral of the capex. A further potential concern here is whether annual DRP updating would pose a material bankruptcy risk to the firm at any time during the asset life, but the analysis in Appendix 1 reveals that this is not the case.

CEG (2014, paras 303-309) also argues that allocative efficiency is higher when the volatility of output prices is lower, and therefore annual resetting of the DRP is inferior to regulatory use of a trailing average DRP. This point only bears on the merits of annual versus cycle beginning resetting of the DRP if output prices are more volatile under one of these two regulatory policies. However, as discussed in Appendix 2, there is no material distinction here.

CEG (2014, Appendix G) argues that the appropriate regulatory approach to setting the allowed cost of debt must be consistent with the way in which firms behave, capable of being replicated by firms, involve low transactions costs for firms in the course of replicating, and

yield low price volatility to consumers.[10] In respect of observed behaviour, CEG claims (correctly) that benchmark firms borrow for about ten years, with staggering so that only a small proportion of debt requires refinancing in any one year. In respect of replication, CEG consider that it is important for a regulated firm to be able to replicate a strategy used by a regulator so as to minimise their risk and therefore maximise their incentive to invest. Compared to my favoured criteria listed in section 6, there is agreement on the desirability of low volatility in output prices. In addition, CEG's criterion of low transactions costs is subsumed within my criterion relating to low average output prices, i.e., low transactions costs are not important per se but only as a contributor to low prices to consumers. In addition, CEG's criteria that a policy should accord with the way in which firms behave, and that it can be replicated by firms, is subsumed within my criteria involving satisfying the NPV = 0 principle and minimising bankruptcy risk. Thus, I agree with the individual criteria proposed by CEG but add several more considerations. CEG gives considerable attention to the requirement that a regulatory policy should accord with the way in which firms behave. Since I consider this to be subsumed within the NPV = 0 principle and the minimisation of bankruptcy risk, I therefore think that CEG's criterion is desirable and that the ERAWA's approach does not fully satisfy both tests. However, as discussed in section 6, the bankruptcy risks are not large and the departures from the NPV = 0 principle are empirically trivial.

The additional criteria proposed by me are that the policy should not give rise to undesirable incentives, most particularly in respect of capex and new entrants to the regulated sector, it should be possible and simple to implement it, it should minimise bankruptcy risk for the firm, and if a change in regime occurs, any transitional process used should be simple to implement, simple to understand, and minimise the one-off gains or losses experienced by firms as a result of the regime change. These additional criteria are not only important in general but one of them (avoiding undesirable incentives in respect of capex) gives rise to the conclusion in section 6 that annual DRP updating would seem to be superior to updating only at the beginning of the cycle.

CEG (2014, section 2) also notes that rule 87(3) of the NGR requires that the allowed rate of return must be "commensurate with the efficient financing costs of a benchmark efficient entity", argues that this requires an allowed DRP that matches the financing policy of the

[10] CEG (ibid, para 329) also refer to minimal divergence between the cost of debt incurred by the firm and that allowed by the regulator. This seems to be covered by the ability of firms to replicate the regulator's strategy.

benchmark firm, that the benchmark policy is staggered borrowing, and therefore that the regulatory policy should be a trailing average DRP. Prima facie, this argument is not relevant to the choice of annual versus beginning of cycle updating of the DRP. However, if CEG's argument were correct, both approaches would be contrary to rule 87(3) of the NGR. Obviously, this is a legal issue, on which I can claim no expertise. However, if CEG are right, the commonly employed Australian regulatory practice of using the DRP prevailing at the beginning of the cycle would be contrary to the rule and would have presumably been successfully challenged; since this hasn't occurred, CEG's argument has not been accepted in respect of beginning of cycle updating, and the same point applies to annual DRP updating. Furthermore, looking at the rule 87(3) wording as an economist, it seems to me to say no more than that the allowed rate should closely correspond on average to the rate incurred by an efficient benchmark entity over the life of the assets, and all of the regulatory policies under discussion here would meet that test. Furthermore, even if the wording of rule 87(3) were interpreted to mean close correspondence between the allowed and incurred costs over even short periods, CEG's preferred policy of a trailing average DRP would fail that test for intra-cycle capex (as discussed earlier in this section); in that case, none of the policies under discussion would satisfy rule 87(3).

In summary, I agree with some of the points raised by CEG but none of them are substantial. By contrast, I disagree with CEG's claim that its preferred approach of a trailing average DRP does not give rise to capex incentive problems, and I do not agree that the wording of rule 87(3) of the NGR requires the use of a trailing average DRP.

## 8. Conclusions

This paper has addressed a number of issues raised by the ERAWA and the conclusions are as follows.

Firstly, unregulated firms require DRP estimates in the course of estimating the NPV of a proposed investment project, and the appropriate DRP for this purpose is the prevailing rate on debt for the period that the firm borrows for. By contrast, if existing debt or equity is valued, the historic DRP for the term for which the firm borrows still appears in the cash flows for both debt and equity that are valued, but these cash flows are valued using

prevailing rates which include the prevailing DRP for the residual term to maturity when valuing the bonds.

Secondly, and in respect of regulated firms, the same points apply. In addition, their output prices are periodically reset by a regulator and the regulator must choose a methodology for doing so. An important principle that should guide regulatory decisions is the NPV = 0 principle and, since the behaviour of firms may be affected by the regulatory policy, the principle should be viewed as a compatible combination of regulatory policy and firm actions that satisfies the NPV = 0 principle; this compatible combination must involve a course of action by a firm that is feasible in the absence of regulation and a regulatory policy whose imposition would not cause the firm to change this behaviour. Faced with regulatory regimes of the kind recently adopted by the ERAWA, and its immediate predecessor regime, businesses have (sensibly) continued to borrow long-term (with staggering) so as to deal with refinancing risk and have additionally used interest-rate swap contracts to align the risk-free rate component of their cost of debt with the regulatory cycle (and therefore with the rate allowed by the regulator). Since the ERAWA allows a DRP that reflects the rate prevailing at the beginning of each year, and firms pay the trailing average DRP, this combination of firm and regulatory policy does not satisfy the NPV = 0 principle. However, satisfying the NPV = 0 principle is only one of many considerations in choosing a regulatory policy. Furthermore, it is possible for a regulator to achieve a close approximation to the NPV = 0 principle, by using an allowed rate of return that matches or at least approximates that paid by benchmark firms (Australian utilities) on average over time and this implies use of a ten-year DRP. So, the ERAWA's current and previous policy will approximately satisfy the NPV = 0 principle if the DRP used by them is the ten-year DRP.

Thirdly, in respect of estimating the DRP, and in the course of valuing prospective projects, unregulated firms require the prevailing DRP for a term matching that for which they borrow, and this can be estimated from recent trades on existing bonds with a residual term to maturity matching that for which the firm in question borrows. In respect of regulated firms, satisfying the NPV = 0 principle would require use of a ten-year trailing average of that DRP, but a close approximation can be achieved when using the prevailing DRP so long as that DRP is for a term matching the term for which benchmark firms borrow (about ten years). To estimate these DRPs, at the required points in time, the process is as described for unregulated firms.

Fourthly, whether the DRP is updated annually or only at the beginning of a cycle has no implications for the previous points. Whether one engages in annual updating or updating only at the beginning of each regulatory cycle, one *cannot* perfectly satisfy the NPV = 0 principle because firms are paying the trailing average DRP (due to staggering their borrowing and the inability to hedge the difference) and it is not viable for them to act otherwise. Similarly, whether one engages in annual updating or updating only at the beginning of each regulatory cycle, the NPV = 0 principle is approximately satisfied providing one allows the ten-year DRP.

Fifthly, in assessing the relative merits of updating the DRP annually or only at the beginning of a cycle, my preferred criteria for assessing any regulatory policy is that it should satisfy the NPV = 0 principle, it should incentivise firms to act efficiently especially in relation to opex, capex and new entry to the regulated sector, it should be possible and simple to implement, it should minimise bankruptcy risk for the firm, it should give rise to a low average output price to consumers, it should give rise to low volatility in the output price to consumers, and if a change in regime occurs any transitional process used should be simple to implement, simple to understand, and minimise the one-off gains or losses experienced by firms as a result of the regime change. Applying these criteria to the issue of updating the DRP annually or only at the beginning of the cycle, both approaches fail to satisfy the NPV = 0 principle, but only trivially providing that the ten-year DRP is used, both would only slightly raise bankruptcy risk, both would give rise to the same average output price, both would involve similar output price volatility, and neither would require a transitional process regardless of which regime were considered to be the current regime. The two points of distinction between the approaches are that annual DRP updating would involve more effort and would send superior signals to firms contemplating capex. The effort involved in annual updating relative to resetting only at the beginning of the cycle would seem to be less important than the superior capex signal. Consequently, annual updating would seem to be superior.

I have also reviewed submissions from CEG. I agree with some of the points raised by CEG but none of them are substantial. By contrast, I disagree with CEG's claim that its preferred approach of a trailing average DRP does not give rise to capex incentive problems, and I do not agree that the wording of rule 87(3) of the NGR requires use of a trailing average DRP.

**APPENDIX 1: Bankruptcy Risk**

This Appendix estimates the bankruptcy risk under annual and beginning of cycle updating of the allowed DRP, and arising from the fact that the firm instead pays the trailing average DRP.

Let *S* denote the book value of equity, *B* the book value of debt, $k_e$ the cost of equity, $k_d$ the cost of debt, superscript *A* denote that allowed by the regulator, superscript *P* that actually paid by the firm, and *X* denote all other cash flow components, then the net cash flows of the business are as follows:

$$NCF = Sk_e^A + Bk_d^A - Bk_d^P + X$$

Under beginning of cycle updating, the allowed cost of equity is the sum of the five-year risk free rate prevailing at the beginning of the regulatory cycle, $R_f^c$, and an allowed risk premium ($MRP\beta_e$) whilst the allowed cost of debt is the sum of the five-year risk-free rate prevailing at the beginning of the regulatory cycle ($R_f^c$) and the DRP at the same point ($DRP^c$). In addition, firms engage in interest rate swaps to ensure that the risk-free rate component within the cost of debt paid by them matches that allowed under the current regime ($R_f^c$). Finally, the DRP component of the cost of debt that businesses pay would be the trailing average (denoted with the superscript *TA*). So, the last equation becomes:

$$\begin{aligned} NCF &= S[R_f^c + MRP\beta_e] + B(R_f^c + DRP^c) - B(R_f^c + DRP^{TA}) + X \\ &= S[R_f^c + MRP\beta_e] + B(DRP^c - DRP^{TA}) + X \end{aligned}$$

To limit the scope of the analysis, the additional cash flows *X* are deleted from the analysis. In addition, I adopt an MRP estimate of 6% corresponding to the (rounded) midpoint of the range proposed by ERAWA (2013, para 665), the leverage ratio of 60% adopted by the ERAWA (2013, para 257), and an equity beta of 0.60 corresponding to the midpoint of the range proposed ERAWA (2013, para 747). So, per $100 of asset book value, the last equation becomes

$$NCF = \$40[R_f^c + .06(.60)] + \$60(DRP^c - DRP^{TA}) \quad (1)$$

To assess bankruptcy risk, it is necessary to consider the entire course of a DRP shock because risks may be greatest as the shock subsides. I have therefore drawn upon the Bloomberg BBB ten-year series from 2005-2011 (AER, 2011, Figure A.6) supplemented with data for regulated utilities provided by the QCA for the period 2000-2013, as shown in Lally (2014, Table 1) and reproduced in the first two columns of Table 1 below.[11] Collectively this data indicates that the DRP was stable at about 1.3% until the beginning of 2007, rose to about 4.5% at the beginning of 2010 and declined to about 3.2% at the beginning of 2013. In addition, I assume that the DRP reverts to its earlier level of 1.3% over the period 2014-2016, as shown in Table 1 below. In addition, I assume that the average debt term is 10 years, in which case the DRP paid in each year is the ten-year trailing average, as shown in the third column of Table 1.

Table 1: Bankruptcy Risk

| Year | *DRP* | $DRP^{TA}$ | $DRP^c$ | $R_f^c$ | *NCF* |
|---|---|---|---|---|---|
| 2007 | 1.3 | 1.3 | 1.3 | 6.05 | $3.86 |
| 2008 | 2.0 | 1.37 | 1.3 | 6.05 | $3.82 |
| 2009 | 3.0 | 1.54 | 1.3 | 6.05 | $3.72 |
| 2010 | 4.5 | 1.86 | 1.3 | 6.05 | $3.52 |
| 2011 | 4.0 | 2.13 | 1.3 | 6.05 | $3.36 |
| 2012 | 3.6 | 2.36 | 3.6 | 3.39 | $3.54 |
| 2013 | 3.2 | 2.55 | 3.6 | 3.39 | $3.43 |
| 2014 | 2.6 | 2.68 | 3.6 | 3.39 | $3.35 |
| 2015 | 2.0 | 2.75 | 3.6 | 3.39 | $3.31 |
| 2016 | 1.3 | 2.75 | 3.6 | 3.39 | $3.31 |
| 2017 | 1.3 | 2.75 | 1.3 | 6.05 | $2.99 |
| 2018 | 1.3 | 2.68 | 1.3 | 6.05 | $3.03 |

[11] The DRP values before 2007 are all 1.3% and are therefore not shown in the Table.

I start by considering a regulatory policy of resetting the DRP at the beginning of each (five year) cycle. For this policy, I start by considering businesses for which the (five year) regulatory cycle begins in 2007. In this case the DRP allowed under the current regime is shown in the fourth column of Table 1, i.e., 1.3% for 2007-2011 (because this was the prevailing rate at the beginning of 2007), followed by 3.6% for 2012-2016 (because this was the prevailing rate at the beginning of 2012), followed by 1.3% for 2017-2021 (because this was the prevailing rate at the beginning of 2017). The fifth column of Table 1 shows the allowed risk free rate, being 6.05% for 2007-2011 (corresponding to the average five-year rate in January 2007), 3.39% for 2012-2016 (corresponding to the average five-year rate in January 2012), and an assumed 6.05% for 2017-2021 (corresponding to the assumed rate in January 2017, due to an assumed reversion of the risk-free rate back to its 2007 value in ten years). The last column of Table 1 then shows the results for equation (1) in dollars per $100 of regulatory asset book value.

Since the lowest allowed value for the DRP is 1.3% and the highest value paid by a firm (the trailing average) is 2.75%, then the highest bankruptcy risk occurs when these values coincide, which they do in 2017. The result is an adverse cash flow of $0.87 (the DRP differential on $60 of debt), which reduces the NCF of the business by 23%. This is not a trivial shock. However, it is cushioned by the risk-free rate being negatively correlated with the DRP. It would also have been preceded by a series of DRP differentials with an accumulated outcome at the end of 2016 of $3.21, which would fully cushion the adverse shock in 2017. Furthermore, a business is unlikely to have cash flows based exclusively upon this regulatory situation. For example, if it also had cash flows from another regulatory situation in which a cycle commenced in 2008, the allowed DRP in 2017 would have been 3.2% (the prevailing rate at the last reset in 2013), and this would have exceeded the trailing average in 2017 of 2.75%. So, per $100 of asset base, this regulatory situation would have favourably affected NCF in 2017 by $0.27. If these two regulatory activities were the only activities in the firm, and had equal RABs, the aggregate adverse impact in 2017 would have been $0.60, which would have reduced the NCF of the business by only about 8%.

Turning now to a regulatory policy of resetting the DRP each year, the lowest allowed DRP would be 1.3%, the highest value paid by a firm (the trailing average) would be 2.75%, and these values coincide in 2017, which produces the highest bankruptcy risk. The result would

be an adverse cash flow of $0.87 (the DRP differential on $60 of debt), which would reduce the NCF of the business by 23%. This is exactly the same as with DRP resetting at the beginning of the cycle. The only difference is in the series of gains or losses that precede that maximum shock in 2017. However the accumulated profit from these shocks, at the end of 2016, is $3.73 and this is similar to that from DRP resetting at the beginning of the cycle. In addition, as noted above, the maximum adverse shock in 2017 would also be cushioned if the firm had other activities.

This analysis presumes that the regulatory cycle commences in 2007. For alternative commencement points, the results would differ but the bankruptcy risk arising in 2017 shown in Table 1 is the most extreme outcome possible over all cycle commencement points. Thus, results for alternative cycle commencement dates are not shown.

In summary, regardless of whether the regulator resets the DRP annually or at the beginning of the regulatory cycle, there will be years under some regulatory cycles in which the allowed DRP is significantly below the trailing average paid by the firm. However this is cushioned by the cash flow arising from the allowed cost of equity (which is negatively correlated with the DRP), accumulated profits from earlier favourable discrepancies between the allowed and incurred DRPs, and other activities by the firm (including regulated activities subject to different cycles). The effect of these cushions is that the adverse DRP shocks would not generate a significant risk of bankruptcy.

**APPENDIX 2: Variation in Output Prices Over Time**

This Appendix examines the variation over time in output prices, under both annual resetting of the DRP and five-yearly resetting. In both cases, the risk free rate is set at the beginning of the cycle.

Letting *S* denote the book value of equity, *B* the book value of debt, $k_e$ the cost of equity, $k_d$ the cost of debt, superscript *A* denote that allowed by the regulator, and *Y* denote all other revenue components, then the revenues of the business are as follows:

$$REV = Sk_e^A + Bk_d^A + Y$$

When resetting the DRP at the beginning of the cycle, the allowed cost of equity is the sum of the risk free rate prevailing at the beginning of the regulatory cycle, $R_f^c$, and an allowed risk premium ($MRP\beta_e$) whilst the allowed cost of debt is the sum of the risk-free rate prevailing at the beginning of the regulatory cycle ($R_f^c$) and the DRP at the same point ($DRP^c$). So, the last equation becomes:

$$REV = S[R_f^c + MRP\beta_e] + B(R_f^c + DRP^c) + Y$$

To limit the scope of the analysis, the additional revenues *Y* are deleted from the analysis. In addition, as with Appendix 1, I adopt an MRP estimate of 6% corresponding to the (rounded) midpoint of the range proposed by ERAWA (2013, para 665), the leverage ratio of 60% adopted by the ERAWA (2013, para 257), and an equity beta of 0.60 corresponding to the midpoint of the range proposed ERAWA (2013, para 747). So, per $100 of asset book value, the last equation becomes

$$REV = \$40[R_f^c + .06(.60)] + \$60(R_f^c + DRP^c) \qquad (2)$$

Since output variations are reflected in *Y*, this formula (2) will reflect variation over time in output prices due to variation in the allowed cost of capital. By contrast, if the DRP is reset each year, denoted $DRP^A$, then revenue will be as follows:

$$REV = \$40[R_f^c + .06(.60)] + \$60(R_f^c + DRP^A) \quad (3)$$

To assess variation in revenues under equations (2) and (3), from 2003 to 2013, I have drawn upon the Bloomberg BBB ten-year series from 2005-2011 (AER, 2011, Figure A.6) supplemented with data for regulated utilities provided by the QCA for the period 2000-2013, as shown in Lally (2014, Table 1) and reproduced in the first two columns of Table 2.[12] Collectively this data indicates that the DRP was stable at about 1.3% until the beginning of 2007, rose to about 4.5% at the beginning of 2010 and declined to about 3.2% at the beginning of 2013. To enable two complete cycles to be examined, I assume that the DRP reverts to the pre-GFC level of 1.3% over the period 2014-2016, as shown in the second column of Table 2. In addition, the five-year risk-free rate averaged over January in each year is shown in the third column of Table 2.

For each of the possible regulatory cycles, I consider the results from the beginning of the regulatory cycle during which the DRP spike commenced (during 2007) until the end of the following regulatory cycle (a total period of ten years). Consider the regulatory activities with cycles commencing in 2007 and 2012. The revenues under equations (2) and (3) are shown in the fourth and fifth columns of Table 2 respectively, and the standard deviations are shown at the bottom of the columns. With annual resetting of the DRP, the standard deviation is more than doubled because all of the revenues under annual resetting lie *outside* the revenue range observed under resetting only at the beginning of the cycle (apart from the first year in each cycle, when the two approaches coincide). However, the reverse occurs for regulatory situations with cycles commencing in 2005 and 2010. For this situation, the revenues under equations (2) and (3) are shown in the seventh and eighth columns of Table 2 respectively, and the standard deviations are shown at the bottom of the columns. With annual resetting of the DRP, the standard deviation is now about 30% less because most of the revenues under annual resetting now lie *within* the revenue range observed under resetting only at the beginning of the cycle. These are the two extreme cases. For the remaining three

[12] The DRP values before 2007 were about 1.3% and are therefore not shown in the Table.

cases, involving regulatory cycles commencing in 2003/2008/2013, and 2004/2009, and 2006/2011, annual resetting produces standard deviations of 1.48, 0.50, and 0.68 respectively whilst resetting at cycle beginning yields results of 0.98, 0.59 and 0.91. So, for annual DRP resetting, the standard deviation is lower in 3/5 cases. Averaged over the five scenarios, the standard deviation from annual DRP resetting is 1.0 whilst that from resetting at cycle beginning is 0.83. Thus, there is no systematic tendency for output prices to be higher under annual DRP resetting with the outcome depending upon the commencement date of the regulatory cycle relative to that of the DRP shock.

Table 2: Volatility in Output Prices

| Year | *DRP* | $R_f$ | *REV-C* | *REV-A* | *REV-H* | *REV-C* | *REV-A* | *REV-H* |
|---|---|---|---|---|---|---|---|---|
| 2005 | .013 | .0526 | | | | 7.48 | 7.48 | 7.48 |
| 2006 | .013 | .0518 | | | | 7.48 | 7.48 | 7.48 |
| 2007 | .013 | .0605 | 8.27 | 8.27 | 8.27 | 7.48 | 7.48 | 7.48 |
| 2008 | .02 | .0634 | 8.27 | 8.69 | 8.27 | 7.48 | 7.90 | 7.48 |
| 2009 | .03 | .0350 | 8.27 | 9.29 | 8.27 | 7.48 | 8.50 | 7.48 |
| 2010 | .045 | .0527 | 8.27 | 10.19 | 8.27 | 9.41 | 9.41 | 9.70 |
| 2011 | .04 | .0528 | 8.27 | 9.89 | 8.27 | 9.41 | 9.11 | 9.70 |
| 2012 | .036 | .0339 | 6.99 | 6.99 | 7.99 | 9.41 | 8.87 | 9.70 |
| 2013 | .032 | .0294 | 6.99 | 6.75 | 7.99 | 9.41 | 8.63 | 9.70 |
| 2014 | .026 | | 6.99 | 6.39 | 7.99 | 9.41 | 8.27 | 9.70 |
| 2015 | .02 | | 6.99 | 6.03 | 7.99 | | | |
| 2016 | .013 | | 6.99 | 5.61 | 7.99 | | | |
| Standard Deviation | | | 0.67 | 1.66 | 0.15 | 1.02 | 0.71 | 1.17 |

Another possible approach would be to reset prices only at the beginning of each cycle but in doing so to allow for not only the prevailing cost of debt but differences between the cost of debt under annual resetting and beginning of cycle resetting over the previous cycle, so that businesses receive the same aggregate cash flows as they would under annual resetting but prices are adjusted only five yearly. However the effect of this hybrid approach could be to produce even more volatility than under both of the other two approaches, depending upon

the commencement date of the regulatory cycle relative to that of the DRP shock. For example, for cycles beginning in 2007 and 2012, the volatility in prices is lower than both of the other approaches, as shown in the sixth column of Table 2; this occurs because the fall in prices occurring under beginning of cycle resetting is significantly mitigated. By contrast, for cycles beginning in 2005 and 2010, the volatility in prices is higher than both of the other approaches, as shown in the last column of Table 2; this occurs because the rise in prices occurring under beginning of cycle resetting is significantly aggravated. Across all five cycles, this hybrid approach produces the least volatile results in one case, the most in two cases, and its average standard deviation is almost identical to that under beginning of cycle resetting.

In summary, there is no systematic tendency for output prices to be more variable over time under annual resetting of the DRP compared to resetting only at the beginning of the cycle. Output prices could vary more with annual DRP resetting or with resetting only at the beginning of the cycle depending upon the commencement date of the regulatory cycles relative to that of the DRP shock. The same is true of a hybrid process, in which prices are changed only five yearly but the changes are designed to produce the same aggregate cash flow to firms as would arise under annual resetting.

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