REVIEW OF SUBMISSIONS ON THE TRAILING AVERAGE COST OF DEBT

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EXECUTIVE SUMMARY

In response to recent submissions on the issue of whether to use a trailing average for setting the allowed cost of debt, the QCA has raised a number of questions with me, including my views on arguments raised by the QTC, and my principal conclusions are as follows.

Firstly, with the exception of replicating the cost of debt incurred by an efficient comparable unregulated firm, the QTC's criteria for choosing a regulatory approach to the cost of debt are insufficiently comprehensive. Furthermore, the goal of replicating the cost of debt incurred by an efficient comparable unregulated firm is inappropriate because such comparator firms do not exist and regulation changes the revenues of a firm, so that some cost policies that were sensible prior to regulation might not be so post regulation.

Secondly, none of the deficiencies in the prevailing methodology that are alleged by the QTC are valid or substantial. In particular, the prevailing methodology does not assume that all debt rolls over at the end of a regulatory cycle, the mismatches in respect of existing debt are not inherently important, the NPV = 0 violations for new businesses are trivial, the NPV = 0 violations for capex are not significant, and it is the illiquidity of CDS contracts rather than their nature which prevents them from being (currently) used to hedge the DRP risk arising from the prevailing methodology.

Thirdly, none of the advantages in the trailing average regime claimed by the QTC are both important and substantial. In particular, and in respect of existing debt, the close match that is achieved between the regulatory allowance and the cost incurred by an efficient benchmark firm under the trailing average regime is not an inherently important consideration. Instead, these mismatches matter only to the extent that they induce bankruptcy risk and violations of the NPV = 0 requirement, but the violations and risks arising under the prevailing regime are not significant and therefore the gain from the trailing average regime is not significant. In respect of new investment, the QTC's favoured approach of initially using the prevailing DRP and gradually adjusting towards the trailing average provides only slightly superior investment signals to those under the prevailing regime with a five-yearly resetting, and would provide slightly inferior investment signals to those under the prevailing regime with annual resetting.

Fourthly, the question of whether efficient unregulated firms that are comparable to regulated ones use interest rate swap contracts to shorten their effective debt term cannot be empirically resolved because efficient unregulated businesses that are otherwise similar to regulated ones do not exist; the very fact of being similar implies that they too would likely be regulated and, even if such unregulated firms did exist, the requirement to be similar to regulated businesses would imply that they were monopolistic providers of basic services and therefore would be unlikely to be efficient. In addition, the existence of interest rate swap contracts enables a firm to decouple its contractual borrowing term (and hence the level of refinancing risk) from its effective borrowing term in respect of the risk-free rate component (and hence its expected interest costs and volatility in its net cash flows), this practice is widespread, and therefore it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Finally, having argued that relevant comparators would not use swap contracts to shorten the effective term of their debt, the burden of proof on this matter therefore lies with the QTC and they have not presented any. Thus, the (significant) possibility exists that such firms do use swaps to shorten their effective debt term, and therefore regulatory setting of the cost of debt at the ten-year rate under a trailing average regime is exposed to the significant possibility of overstating the allowance. This is a significant drawback to the use of a trailing average risk-free rate.

Fifthly, when estimating the DRP using the methodology favoured by the QCA, the use of a trailing average with annual updating (as favoured by the QTC) is more complex than the prevailing (on-the-day) regime with five-yearly resetting and this is a drawback to the use of a trailing average with annual updating.

Sixthly, in comparing the hybrid approach with application of the trailing average to the entire cost of debt, the fact that the latter approach would replicate the behaviour of an efficient unregulated firm is not important. By contrast, it is true that the latter approach would produce a smoother price path for consumers than the hybrid approach but it gives rise to greater incentive problems for capex and new entrants (or greater complexity if these problems are addressed), requires a transitional regime that will embody some drawback regardless of the choice of transitional regime, and it would allow too high a cost of debt by failing to mirror the behaviour of otherwise similar unregulated firms (by copying the

average borrowing term of such firms whilst ignoring the interest rate swap contracts that such firms would likely engage in and which have the effect of reducing the risk-free rate component of their cost of debt). Thus, if a trailing average were used, it should be limited to the DRP.

Seventhly, in conducting price/performance monitoring, mismatches between the ten-year trailing average DRP incurred by a firm and the prevailing rate allowed under the present regime are a more significant issue than with price/revenue capping. However, even the most extreme mismatches observed in the US historical data between the ten-year trailing average DRP incurred by a firm and the prevailing rate allowed under the present regime would not give rise to a material difference between the estimated WACC under the present regime and that reflecting the DRP actually incurred by a business, and therefore would not be sufficiently significant to prompt a decision to impose price control upon a regulated business. In addition, adoption of the same methodology across both price/performance monitoring and price/revenue capping is desirable. In view of these points, I favour application of the prevailing regime to price/performance monitoring as well as price/revenue capping.

Eighthly, in respect of the general practice for firms to borrow money and temporarily invest the proceeds before using these proceeds to retire other debt, this will not give rise to a differential between the borrowing and lending rates if firms invest the proceeds into a bond that maintains their existing interest rate. By contrast, if they invest the proceeds into the risk-free asset, they will incur a cost in the form of an interest differential but will also lower their cost of debt, with zero net effect. Since the lower cost of debt will be observed and therefore used by a regulator, this suggests that the regulator should compensate firms for the interest rate differential on the temporary borrowing. However, this would require empirical evidence that the firms used as comparators to set the allowed DRPs for regulated businesses do invest these proceeds in bonds with lower interest rates than those paid by these firms, and such evidence is both lacking and would be difficult to assemble. Furthermore, regulatory use of the promised interest rate over compensates firms (because part of the promised rate is merely compensation to lenders for the default option possessed by equity holders). In partial mitigation, regulators should not make an additional allowance for the interest rate differential on the temporary borrowing even if the temporary borrowing is invested into bonds with lower interest rates than those paid on the firms' debt.

I have also been asked to comment upon the QTC's claim that otherwise comparable (efficient) unregulated firms with stable revenues and relatively high gearing would not use swaps to achieve a short-term base interest rate exposure on their debt portfolios. As discussed above, this issue cannot be empirically resolved but it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Thus, the (significant) possibility exists that such firms (if they existed) would use swaps to shorten their effective debt term, and therefore regulatory setting of the cost of debt at the ten-year rate under a trailing average regime is exposed to the significant possibility of overstating the allowance.

I have also been asked to comment upon the implications for the risk attitudes of firms subject to the present regime using interest rate swap contracts. The use of swaps by such firms is consistent with them being concerned with both risk and expected interest costs, and this is consistent with an efficient unregulated firm with stable revenues also using such contracts to shorten their effective debt term and thereby trade off the gains from lower expected interest costs against higher risk.

I have also been asked to identify the general conditions under which the trailing average will likely lead to an overstatement or understatement of the cost of debt and to comment on whether regulated firms (subject to a trailing average) are likely to be in a position to adopt a debt management strategy that over-recovers their allowed cost of debt. A trailing average risk-free rate that is allowed by a regulator will likely overstate the cost of debt if comparable firms borrow long-term, use interest rate swap contracts to shorten the effective risk-free rate term, and regulators set the allowance in accordance with only the borrowing term. However, even if regulators acted in this way, it would not offer any opportunity for firms to over recover their allowed cost of debt.

I have also been asked to assess whether a regulated firm subject to the on-the-day regime can structure a prudent debt portfolio given that unregulated firms would not choose to refinance all of their debt at a point in time. Firms subject to the on-the-day regime could match their borrowing to the regulatory cycle, and therefore incur refinancing risk, or stagger their borrowing so as to minimise refinancing risk and therefore be exposed to (bankruptcy) risk arising from disparities between the allowed DRP (the prevailing rate at the reset point)

and the incurred cost (the ten-year trailing average of the ten-year DRP). The refinancing risk from the first option is huge whilst the bankruptcy risk from the second option is empirically trivial. So, the prudent course of action is to stagger the borrowing and this unsurprisingly corresponds to the actual behaviour of regulated businesses subject to the on-the-day regime. Thus, regulated firms subject to the on-the-day regime can structure a prudent debt portfolio and such firms generally do this.

1. Introduction

In response to recent submissions on the issue of whether to use a trailing average for setting the allowed cost of debt, the QCA has raised the following matters with me:

(a) review and assess the arguments raised in the QTC and Unitywater submissions on the QCA's draft decision on the trailing average cost of debt

(b) assess QTC's claim that the trailing average approach will not overstate the cost of debt, including addressing the following points:

    (i) otherwise comparable unregulated firms with stable revenues and relatively high gearing would not use interest rate swaps to achieve a short-term base interest rate exposure on its debt portfolio

    (ii) regulated firms of interest to the QCA will not have an incentive to use swaps to lock in a fixed base interest rate for the term of the regulatory period

(c) Identify the general conditions under which the trailing average will likely lead to an overstatement or understatement of the cost of debt and comment on whether regulated firms (subject to a trailing average) are likely to be in a position to adopt a debt management strategy that over-recovers their allowed cost of debt.

(d) Assess whether a regulated firm subject to the on-the-day regime can structure a prudent debt portfolio given that unregulated firms would not choose to refinance all of their debt at a point in time.

(e) Review and analyse the QTC submission's appendices to the extent they are relevant to supporting the QTC's claims.

This report seeks to examine these questions. I start by reviewing submissions, and this is limited to the QTC's (2014) submission because Unitywater (2014) raises no additional points.

2. Review of the QTC's Submission

2.1 Cost of Debt Objectives

The QTC (2014, section 2.2) asserts that the principal objectives in choosing a regulatory approach to the cost of debt are

(a) Replicate to the extent possible the cost of debt that would be incurred by a prudent and efficient benchmark debt management strategy, with the benchmark firm being a comparable unregulated one (ibid, page 1).[1]

(b) Provide incentives for the benchmark firm to undertake efficient capital expenditure, including the amount and timing of the expenditures.

Subsequently, the QTC implicitly added two further criteria:

(c) It should be possible and simple to implement it (ibid, section 10).

(d) It should minimise changes in the cost of debt at the start of the regulatory cycle (ibid, page 29)

I interpret these criteria as applying to a price control situation. By contrast, but in the same context of price control, I consider that the appropriate 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 minimise the average output price to consumers.

(6) It should minimise 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 comparing these two sets of criteria, the QTC's (a) is broader than my (1) and (4), i.e., satisfying the QTC's (a) would satisfy my (1) and (4) but as a mere side effect rather than because of any equivalence in the criteria. However the QTC's view that the cost policies of an efficient benchmark firm (defined as a similar but unregulated firm) should be replicated by a regulator is unjustified. Efficient, similar unregulated firms do not exist, because they would likely be regulated if they were similar and, even if not, they would have to be monopolistic providers of necessities and therefore would be unlikely to be efficient.

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[1] The QTC also refers to minimizing the difference between the annual cost of debt allowed and that incurred by an efficiently financed benchmark firm, but this is equivalent to (a).

Furthermore, regulation changes the revenue stream of a firm: the firm's output prices decline (because regulation is undertaken to deal with monopoly profits), and they are reset at some pre-specified frequency. Consequently, a policy adopted by an unregulated firm and relating to its costs that was sensible pre-regulation might no longer be sensible once regulation is introduced. So, the QTC's criterion of replicating the debt policy of an otherwise identical efficient unregulated firm is inappropriate and it remains so even if some of the consequences of this approach do (by chance) accord with those of the approach I favour and even if some of the policies of otherwise identical unregulated firms (such as staggering their debt) would also be efficient policies for a regulated firm.

Apart from (a), the QTC's criteria are a subset of those favoured by me. In particular, the QTC's (c) matches my (3), the QTC has no counterpart to my (5) and (7), the QTC's (b) is embraced by my (2) but without consideration of incentives for new entry, and the QTC's (d) is embraced by my (6). So, apart from their (a), the QTC's criteria are too narrow and as argued above (a) is inappropriate. Thus, I consider that the criteria invoked by the QTC are unsatisfactory.

In summary, with the exception of replicating the cost of debt incurred by an efficient comparable unregulated firm, the QTC's criteria for choosing a regulatory approach to the cost of debt include only some of the criteria that I consider to be important. Furthermore, the goal of replicating the cost of debt incurred by an efficient comparable unregulated firm is inappropriate because such comparator firms do not exist and because regulation changes the revenues of a firm, so that some cost policies that were sensible prior to regulation might not be so once regulation is introduced.

2.2 Alleged Deficiencies in the Prevailing Methodology

The QTC (2014, section 3) argues that there are a number of deficiencies in the prevailing (on-the-day) methodology. Firstly, it is claimed that this methodology assumes that the firm's entire debt balance is rolled-over at a single point in time (the regulatory reset point), which would expose the firm to very substantial refinancing risk for which no compensation is provided. However the premise is false; the prevailing methodology does not assume (i.e., require) roll-over of all debt at the regulatory reset point. Users of this methodology understand that regulated firms do stagger their borrowing to minimise refinancing risk and therefore that there will be a mismatch between the DRP incurred (a trailing average that

follows from staggering the borrowing) and the prevailing DRP allowed by the regulator. For example, the QCA (2014a, page iii) refers to this mismatch and to a related paper (Lally, 2010a) that does likewise. Given this recognition of a mismatch, and therefore the necessity of staggering borrowing, there is no basis for compensating firms for refinancing risk that they will neither face nor be presumed to face. Nevertheless, the mismatch is a disadvantage of the prevailing regime, because it leads to violations of the NPV = 0 principle and it also raises bankruptcy risk, but these disadvantages are small and are offset by the advantages of this methodology. In particular, it is simple to implement (and understand) and it avoids potentially substantial transitional problems from switching to a new regime. In respect of the latter point, Lally (2014a) identifies a number of problems arising from switching from the prevailing regime to a trailing average, favours transitional arrangements proposed by the AER that minimise these problems, and notes the considerable opposition to such arrangements from regulated businesses.

Secondly, the QTC claims that the mismatches between the DRP incurred by an efficiently operating firm (a trailing average that follows from staggering the borrowing) and the prevailing DRP allowed by the regulator are significant. To investigate the extent of this mismatch, the QTC draws upon historical data from the US over the period 1953-2014 (because Australian data is only available back to 2005), estimates the time-series model underlying this data (a mean-reverting model), uses this model to simulate the monthly outcomes over a 200 year period, determines the standard deviation of the resulting mismatches (under both annual and five-yearly resetting), repeats the simulations, and then averages over the standard deviations from these repeated simulations. The result is an average standard deviation of 0.87% for one-yearly resets and 0.73% with five-yearly resets, and the QTC therefore concludes that the on-the-day approach does not provide a good approximation to the efficient DRP costs of a firm. As noted previously, these mismatches give rise to violations of the NPV = 0 principle and they also raise bankruptcy risk. However I do not consider that either of these problems is substantial (see Lally, 2014b). The QTC disputes the first of these points (relating to the NPV = 0 principle) but not the second (bankruptcy risk), and discussion of that first point appears in the next paragraph. Thus, at this point, the issue is merely whether mismatches are important over and above their impact on these two issues. I do not consider that they are, and the QTC presents no argument for why mismatches are inherently important (in a price capping situation).

Furthermore, even if mismatches were considered to be inherently important, they dissipate as the time period over which they are measured increases, and therefore one would need to both specify a time period over which they should be measured and justify it. The QTC specifies the time period as one year, but offers no defence of this particular period. Had the averaging period been (say) five years, the standard deviation of the mismatches would have been considerably less. For example, using the actual data used by the QTC (as opposed to their simulations), and commencing with annual resetting of the DRP in March 1963 (when there is ten years of historical data to compare the allowed DRP with the ten-year trailing average), the standard deviation of the annual mismatches (each involving the difference between the DRP in March with the ten-year trailing average) is 0.72%, which is similar to the QTC's (2014, Table 2) simulation result.[2] By contrast, if these annual differences are averaged over the preceding five years, the standard deviation (of the five-year average) drops to 0.37%. Averaged over a longer period, the standard deviation would be even lower. In addition, even the figure of 0.72% is not material relative to the buffer that absorbs it: the allowed cost of equity (averaging 12%, comprising an average risk-free rate of 6% in the QTC's data and a risk premium of 6%). Per $100 of asset value, comprising $55 of debt and $45 of equity, the 0.72% shortfall on the debt would be $0.40 whilst the cost of equity allowance would be $5.40. So, the DRP shortfall would be only 7% of the buffer. Lest one suspect that the worst shortfalls are much worse than the standard deviation of 0.72%, the worst shortfall in the QTC's annual data is in fact only 0.89% (March 1989).[3]

In addition to the question of the significance of the DRP mismatches arising from the prevailing regime, they have a very desirable feature; they are favourable to firms when the prevailing DRP is high relative to its ten-year trailing average, this occurs when economic conditions are unfavourable, and therefore when the true MRP is likely to be above its allowed value (which has always been 6% from the QCA). For example, in the US series presented by the QTC, the highest margins for the prevailing DRP over its ten-year trailing

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[2] I am cautious about using the simulation results. Although they incorporate results for a wider range of possible outcomes over time, they are subject to errors in modelling the underlying pattern and two such errors are evident: assuming that the random shocks in the model are normally distributed (when this is clearly not the case, in the sense that upward DRP shocks are more pronounced than downward shocks) and assuming that the same model applies at all times (whereas the speed of mean reversion is clearly much higher after a very large upward shock to the DRP).

[3] The most extreme differences involve allowed DRPs that *exceed* the ten-year trailing average, and the maximum such case is a difference of 3.54% (December 2008).

average occur in 2008-09 (3.54%), 1974-75 (1.85%), 2001-2002 (1.71%), 1970-71 (1.67%), and 1980-81 (1.18%); these periods correspond to the set of US recessions since 1970. Similarly, the DRP mismatches are most unfavourable to firms when the prevailing DRP is low relative to its ten-year trailing average, this occurs when economic conditions are favourable and therefore when the true MRP is likely to be below its allowed value. Thus, the prevailing regime has the desirable effect of producing DRP mismatches that at least partly offset likely MRP estimation errors.

Thirdly, the QTC argues that the mismatches induce violations of the NPV = 0 principle and they analyse this issue later in their Appendix B.5. To do this, the QTC draw upon the US data referred to in the previous two paragraphs and use this to determine the standard deviation of the actual change in the DRP over the course of five years. The result is 1.25%, and therefore an extreme change (defined by the QTC to be three standard deviations) would be 3.75%. Following the approach in Lally (2010a, Appendix 1), this implies a departure from the NPV = 0 requirement equivalent to a WACC error in perpetuity of 0.27%.[4] However, the analysis in Lally (2010a, Appendix 1) involves the *expected* change in the DRP over the course of five years. Thus, to examine an extreme event here, the appropriate course of action would be to start with an extreme DRP value, use the mean reversion model estimated by the QTC to determine the expected DRP five years later, and then convert this expected change in the DRP into a departure from the NPV = 0 requirement. Using the QTC's US data, the mean DRP is 1.86% and its standard deviation is 0.84%. So, using the QTC's definition of an extreme event (three standard deviations), an extreme DRP would be 4.38%. The QTC's (2014, Appendix B) mean reversion model is as follows:

$$DRP_1 = DRP_0 + .0235(.0192 - DRP_0) \qquad (1)$$

Substituting a current DRP of 4.38% into this model yields an expected DRP in one month of 4.32%. Repeating this process for a further 59 months yields an expected DRP in five years of 2.51%. So, if a regulated business was established at a time at which the prevailing DRP was 4.38%, it would receive compensation at that rate for five years under the prevailing regime and, at the end of that period, the DRP would be reset for a further five years at an expected rate of 2.51% whilst the incurred DRP would remain at 4.38% for the entire ten-

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[4] The QTC discloses only the figure of 0.27% and the other two figures are deduced from that.

year period. Thus, during the second five-year term, the firm would be under compensated by 1.87% per year. Following the analysis in Lally (2010a, Appendix 1), this expected DRP shortfall is equal to 1.7% of the regulatory asset value (RAB) of the firm as follows:

$$NPV_0 = .55V_0^B(1-.30)\left[\frac{(.025-.0438)}{(1.1)^6} + ... + \frac{(.025-.0438)}{(1.1)^{10}}\right] = -.017V_0^B$$

Following the analysis in Lally (2010a, Appendix 1) again, this is equivalent to a WACC shortfall of 0.15% in perpetuity. This is only half of the figure of 0.27% claimed by the QTC (2014, page 41). Furthermore, the QTC's choice of three standard deviations as an extreme outcome would only embrace 1% of the outcomes in their US data series. A more reasonable definition of an extreme event would be the 95th percentile, which corresponds to a DRP of 3.20%. Given such a DRP value, and invoking equation (1) again, the expected DRP in five years would be 2.2%, which implies an expected DRP shortfall equal to 0.9% of the RAB, which is equivalent to a WACC error in perpetuity of only 0.08%.

Furthermore, the analysis in Lally (2010a, Appendix 1) assumes that a new regulated business borrows for ten years and then rolls it over. However, for large new investments, this would lead to significant refinancing risk every tenth year. So, consistent with the fact that firms stagger their borrowing and use debt with an average term of ten years, a more realistic assumption is that the firm will instead undertake 10% of the borrowing for a one year term, then roll it over for ten years, undertake a further 10% of the borrowing for a two year term, then roll it over for ten years, and so forth, so as to attain the desired staggering of debt in ten years' time. In this case, assuming a flat term structure for the DRP, the DRP incurred over the first ten years would be as follows, with a ten-year trailing average applying beyond the tenth year:

Yr 1: DRP_0 (2)

Yr 2: $.9DRP_0 + .1DRP_1$ (2)

Yr 3: $.8DRP_0 + .1DRP_1 + .1DRP_2$ (2)

.... (2)

Yr 10: $.1DRP_0 + .1DRP_1 + .1DRP_2 + ... + .1DRP_9$ (2)

Using the expected values for these DRPs, in accordance with equation (1) above, and an allowed DRP of 3.2% for the first five years followed by an expected value of 2.2% for the next five years, the present value of the DRP shortfall would now be only 0.3% of the initial RAB as follows:[5]

$$NPV_0 = .55V_0^B(1-.30)\left[\frac{(.032-.032)}{1.1} + .\frac{(.032-.029)}{(1.1)^2} + ... + \frac{(.022-.020)}{(1.1)^{10}}\right] = -.003V_0^B$$

This is equivalent to a WACC shortfall in perpetuity of 0.02%, which is even less than the figure of 0.036% in Lally (2010a, Appendix 1). Thus, the QTC's estimate of the equivalent WACC error in perpetuity of 0.27% is far too high and the appropriate figure is about 0.02%, which is inconsequential. These results are summarised in Table 1.

Table 1: Effect of DRP Mismatches for a New Business Under the On-The-Day Approach

	NPV Impact	WACC Impact
No debt staggering, three sigma DRP event	-1.7%	-0.15%
No debt staggering, 95th percentile DRP event	-0.9%	-0.08%
Debt staggering, 95th percentile DRP event	-0.3%	-0.02%

Fourthly, the QTC argues that the prevailing methodology compensates new borrowing (for new investment) at the rate prevailing at the beginning of the regulatory cycle rather than at the (later) time of the borrowing, and therefore provides a poor investment signal. The deficiency in the investment signal arises from two phenomena: capex occurring within a regulatory cycle (and therefore experiencing an initial DRP cost equal to that prevailing at the time of the capex whilst the initial regulatory allowance would be the DRP prevailing at the beginning of the cycle), and expected mismatches between the DRP allowed and that paid over the residual life of the debt. Initial mismatches will be most pronounced for capex near the end of a regulatory cycle, but such mismatches are quickly mitigated at the end of the regulatory cycle, whilst initial mismatches are least pronounced for capex shortly after the

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[5] Differences beyond the tenth year add little to this and are therefore ignored.

beginning of the cycle but persist for longer (until the end of that cycle). This suggests that the greatest problems will be for capex undertaken about half-way through a cycle.

To investigate the significance of this issue, I draw upon the actual US data presented by the QTC (as opposed to their simulations) and consider a regulatory cycle of five years. So, for each month from October 1955 (2.5 years after the commencement date of the US data) until August 2014, I determine the difference between the DRP in that month and 2.5 years earlier. Incentive signals are worst when the DRP at the beginning of the cycle is lower than at the cycle midpoint (because desirable investment is then discouraged). So, I focus upon such cases. The worst case is in December 2008, when the prevailing DRP was 6.01% and the rate 2.5 years earlier was 1.67%; so, initially, the DRP that would be incurred would be 4.34% higher than the allowed rate. However, as before, a more appropriate case to examine would be the 95th percentile of the entire distribution of these differences, which involves an initial shortfall of 1.4% (corresponding initially to a DRP incurred of about 3.0% and an allowance 2.5 years earlier of about 1.6%). Invoking the mean-reversion model for the DRP shown in equation (1), and starting with a mid-cycle DRP of 3.0%, the expected DRP after 2.5 years (the cycle end) is 2.4%, that expected five years later is 2.0%, and that expected a further 2.5 years later is 1.9% (which is the mean). So, under the prevailing regulatory regime, the firm would receive a DRP allowance of 1.6% for the remaining 2.5 years of the first cycle followed by an expected allowance of 2.4% for the next five years, 2.0% for the next five years, and 1.9% thereafter. By contrast, if the firm borrows for ten years and rolls it over, it will pay a DRP of 3.0% for the first ten years and an expected rate of 1.9% thereafter. So, the payment for the first ten years (3.0%) exceeds that allowed for the first 2.5 years (1.6%), the expected allowance for the next five years (2.4%), and that for the next 2.5 years (2.0%).[6] Following the analysis in Lally (2010a, Appendix 1), the NPV impact of this shortfall over the first ten years is 2.5% of the RAB at the date of the capex as follows:

$$NPV_0 = .55V_0^B(1-.30)\left[\frac{(.016-.03)}{1.1} + \frac{(.016-.03)}{(1.1)^2} + \frac{0.5(.016-.03)}{(1.1)^{2.5}}\right]$$

$$+.55V_0^B(1-.30)\left[\frac{(.024-.03)}{(1.1)^{3.5}} + ... + \frac{(.024-.03)}{(1.1)^{7.5}}\right]$$

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[6] After the first ten years, the expected differences are trivial and are therefore ignored.

$$+.55V_0^B(1-.30)\left[\frac{(.02-.03)}{(1.1)^{8.5}}+\frac{(.02-.03)}{(1.1)^{9.5}}+\frac{.5(.02-.03)}{(1.1)^{10}}\right]$$

$$=-.025V_0^B \tag{3}$$

Following Lally (2010a, Appendix 1), this is equivalent to a WACC shortfall in perpetuity of 0.23%. This analysis presumes that capex undertaken in some month is debt funded by borrowing for ten years, and then rolled over. However, as noted above, a more realistic assumption for any substantial new investment would be for the firm to instead undertake 10% of the borrowing for one year, then roll it over for ten years, undertake a further 10% of the borrowing for two years, then roll it over for ten years, and so forth, so as to attain the desired staggering of debt in ten years' time. In this case, assuming a flat term structure for the DRP, the DRP incurred over the first ten years would be as shown in equations (2). Using the expected values for these DRPs, in accordance with equation (1) above, and substituting these for the DRP incurred of 3.0%, the present value of the shortfall shown previously in equation (3) falls to 1.7% of the initial RAB, which is equivalent to a WACC shortfall in perpetuity of 0.15%. This is not very significant, and it arises from a 95th percentile DRP event.

By contrast, with updating of the DRP allowance annually rather than five-yearly, the 95th percentile of the initial DRP shortfall falls from 1.4% to 0.8% (with typical values for a 0.8% shortfall of 2.7% at mid-year and 1.9% at year beginning). The present value of the DRP shortfall then falls to 0.7% of the initial RAB as follows:

$$NPV_0=.55V_0^B(1-.30)\left[\frac{(.019-.027)0.5}{(1.1)^{0.5}}+.\frac{(.0260-.0268)}{(1.1)^{1.5}}+....+\frac{(.0199-.0221)}{(1.1)^{9.5}}\right]=-.007V_0^B$$

This is equivalent to a WACC shortfall of 0.06%. All of these results are shown in Table 2 below. So, annual updating of the DRP allowance provides a superior match between the allowed DRP and the DRP incurred than five-yearly updating, with equivalent WACC shortfalls of 0.06% and 0.15% respectively, and therefore a superior investment signal. However the gain is small. Furthermore, in view of the DRP estimation methodology favoured by the QCA (2014b), annual updating would require considerably more effort and the additional effort may outweigh the small improvement in the investment signal.

Table 2: Effect of 95th Percentile DRP Mismatches Under the On-The-Day Approach

	NPV Impact	WACC Impact
Five-Yearly Updating, no debt staggering	-2.5%	-0.23%
Five-yearly updating, debt staggering	-1.7%	-0.15%
One-Yearly Updating, debt staggering	-0.7%	-0.06%

Fifthly, the QTC argues that the inability of firms to hedge the DRP risk arising from the prevailing methodology via the use of CDS contracts arises from the nature of these instruments rather than because they might not be available on the desired bonds or because of a lack of liquidity. In particular, firms cannot buy or sell protection on themselves and the contracts only hedge default risk, which is a minority component of the DRP (the principal part being compensation for illiquidity). However, even if firms cannot transact in contracts involving themselves, the CDS prices for firms in the same industry and credit rating are highly correlated and therefore most of the benefits of a firm transacting in contracts on itself are attainable through transacting in a portfolio of contracts on other firms of this type. For example, over the period since the RBA's DRP indexes have been constructed (January 2005 to November 2014), the correlation between the ten-year DRP series for A- and BBB bonds has been 0.93.[7] In respect of the contribution of illiquidity to the DRP, Dick-Nielsen et al (2012, Table 5) conclude that this was about 10% in the 2005-2007 period (pre-GFC) in the US for corporate BBB bonds rising to about 30% in the 2007-2009 period (during the GFC). Furthermore, Elton et al (2001) conclude that most of the DRP is compensation for the systematic risk on bonds. Both conclusions contradict the QTC's claims. Nevertheless, the fact that compensation for liquidity is at least part of the DRP but not also part of the CDS suggests that CDS contracts cannot hedge the DRP risk. However, these facts only imply that hedge transaction of this type will be imperfect and this is the normal situation for hedging transactions.

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[7] The data is from Table F3 on the Reserve Bank's website (www.rba.gov.au). This data is not perfect for illustrating the point because it involves two portfolios rather than one firm against a portfolio, and using two portfolios will raise the correlation. However, the RBA data also involves sets of firms with different credit ratings and different industry weights, which would reduce the correlation.

To illustrate the resulting errors, suppose that that the current five and ten year DRPs on firm A are 2.0% and 2.5%. In addition, and consistent with the Dick-Nielsen results cited above, suppose that the CDS prices for another firm (B) in the same industry are currently 90% of the aforementioned DRPs. In this case, if firm A undertakes ten-year borrowing (of say $100m) and seeks to convert the ten-year DRP into two successive five-year DRPs, it could sell a ten-year CDS on B's debt with a face value of 111% of its borrowing ($111m), buy a five-year CDS of the same face value, and buy another CDS of the same face value in five years. Firm B's current CDS prices on five and ten year contracts would be 1.8% and 2.25% respectively. In five years' time, suppose further that A's prevailing five-year DRP is now 2.8% and B's five-year CDS price is still 90% of this (2.52%). In this event, firm A will have converted its ten-year DRP into payments identical to those on two successive five-year DRPs as follows:

	Yr 1...............	Yr 5	Yr 6..............	Yr 10
Pay ten-year DRP	-$2.5m	-$2.5m	-$2.5m	-$2.5m
Receive ten-year CDS price	$2.5m	$2.5m	$2.5m	$2.5m
Pay five-year CDS price	-$2.0m	-$2.0m	-$2.8m	-$2.8m
Net effect	-$2.0m	-$2.0m	-$2.8m	-$2.8m
Pay five-year DRP	-$2.0m	-$2.0m	-$2.8m	-$2.8m

Now suppose that A's five-year DRP in five years is still 2.8% but B's CDS price is now 80% of this (2.24%), because the DRPs for A and B are imperfectly correlated and/or because B's ratio of CDS price to DRP has changed. Firm A must still enter five-year CDS contracts with a face value equal to 111% of its borrowing in order for the protection obtained on these contracts to offset the potential liability on the still outstanding ten-year CDS contracts. In this case, the net effect of the firm's actual transactions will be to match the consequences of five-year borrowing by it over the first five years but diverge over the next five years by 0.31% of the amount borrowed ($2.8m v $2.49m) as follows:

	Yr 1...............	Yr 5	Yr 6...............	Yr 10
Pay ten-year DRP	-$2.5m	-$2.5m	-$2.5m	-$2.5m
Receive ten-year CDS price	$2.5m	$2.5m	$2.5m	$2.5m
Pay five-year CDS price	-$2.0m	-$2.0m	-$2.49m	-$2.49m
Net effect	-$2.0m	-$2.0m	-$2.49m	-$2.49m

Pay five-year DRP	-$2.0m	-$2.0m	-$2.8m	-$2.8m

Thus, the fundamental problem associated with these CDS contracts is not their availability on the debt issuer in question, or the fact that firms might not be able to enter contracts involving themselves, or even that CDS prices are less than the DRP because DRPs embody illiquidity premiums and CDS prices don't. Instead, the fundamental problem is the lack of liquidity in these CDS contracts, i.e., large firms could not purchase CDS contracts in the required volumes (PwC, 2013, page 8; Chairmont, 2013, page 5).

In summary, none of the deficiencies in the prevailing methodology alleged by the QTC are valid or substantial. In particular, the methodology does not assume that all debt rolls over at the end of a regulatory cycle, the mismatches in respect of existing debt are not inherently important, the NPV = 0 violations for new businesses are trivial, the NPV = 0 violations for capex are not significant, and it is the illiquidity of CDS contracts rather than their nature which prevents them from being (currently) used to hedge the DRP risk arising from the prevailing methodology.

2.3 Allegedly Favourable Properties of the Trailing Average
The QTC (2014, section 4) argues that applying the trailing average cost to the existing debt coupled with applying the prevailing cost of debt to new borrowing satisfies the criteria it considers to be important: closely matching the regulatory allowance to the cost incurred by an efficient benchmark firm, and providing incentives for new investment that are both appropriate and superior to those from the prevailing regime. However, in respect of the existing debt, as noted earlier matching per se is not an important objective.

In respect of new investment, the QTC subsequently elaborates upon its arguments in its section 7. The QTC's favoured approach to borrowing associated with new investment is to allow the prevailing ten-year cost of debt on it and gradually adjust this allowance towards the trailing average, with annual adjustment. By contrast, under the prevailing regime, only new borrowing undertaken at the beginning of a regulatory cycle is correctly compensated and then only for the first regulatory cycle. New borrowing undertaken within a regulatory cycle is compensated at the rate prevailing at the beginning of the cycle (rather than at the rate prevailing at the time of borrowing) and new borrowing undertaken at the beginning of a cycle will be compensated during the next cycle at the rate prevailing at the beginning of the

second cycle rather than at the rate prevailing at the time of the borrowing. This suggests that the incentives for new investment are superior under the QTC's favoured DRP allowance, and the QTC (2014, section 7) argues that their favoured approach is significantly superior.

To investigate this issue, the QTC draws upon the US data referred to earlier, estimates the time-series model underlying this data (a mean-reverting model), uses this model to simulate the monthly outcomes over a 200 year period, determines the standard deviation of the mismatches (under both the QTC's favoured approach and the on-the-day approach with both annual and five-yearly resetting), repeats the simulations, and then averages over the standard deviations of these repeated simulations. Their important results are 0.38% for the QTC's favoured approach and 0.61% for the on-the-day regime with five-yearly resetting. However, for the purposes of assessing the impact of DRP mismatches on incentives for new investment, the important issue is the effect of the DRP mismatches on the NPV of new investment and the QTC do not assess this. Furthermore, the QTC's analysis assumes that the incurred DRP for the first ten years is that prevailing at the time of the borrowing and therefore assumes that all of the borrowing is for ten years (followed by roll-over). However, as discussed earlier, a more realistic assumption for any substantial new investment would be for the firm to instead undertake 10% of the borrowing for one year, then roll it over for ten years, undertake a further 10% of the borrowing for two years, then roll it over for ten years, and so forth, so as to attain the desired staggering of debt in ten years' time. Thus, the appropriate analysis is of the type undertaken earlier in section 2.2 and whose results appear in Table 2.

This earlier analysis revealed that, under the prevailing methodology, DRP mismatches between mid and beginning cycle values that were at the 95th percentile of the distribution gave rise to NPV shortfalls that were equivalent to a WACC shortfall of 0.06% in the case of annual updating and 0.15% for five-yearly updating. Consequently, annual updating provided a slightly superior investment signal. The QTC's approach also involves annual updating but the allowances accord with equation (2) rather than with the prevailing rate. So, the earlier analysis with annual updating is redone but with the DRP allowances in accordance with equation (2) rather than the prevailing rate. Thus, as in section 2.2, capex is assumed to be undertaken half-way through a year at a time when the prevailing DRP is 2.7% and the rate at the beginning of the year was 1.9%. Given the DRP of 2.7%, the subsequent expected values are determined using equation (1), the DRP incurred by the firm accords

with equation (2) with time 0 being the midpoint of the year in which the capex occurs, and the DRP allowed by the regulator also accords with equation (2) but with time 0 instead being the beginning of the same year. The NPV shortfall is then determined in the same fashion as equation (3) and the result is 1.0% of the RAB as follows:[8]

$$NPV_0 = .55V_0^B(1-.30)\left[\frac{(.019-.027)0.5}{(1.1)^{0.5}} + .\frac{(.0197-.0268)}{(1.1)^{1.5}} + ... + \frac{(.0217-.0221)}{(1.1)^{9.5}}\right] = -.010V_0^B$$

This is equivalent to a WACC shortfall in perpetuity of 0.09%. So, contrary to the QTC's claim, its approach is marginally inferior to the prevailing methodology with annual updating and only marginally superior to the prevailing methodology with five-yearly updating. The inferiority to the prevailing methodology with annual updating arises from the fact that the payments commence at the mid-year DRP of 2.7% but the allowances commence with the beginning year DRP of 1.9% and high weighting continues to be attached to that latter figure for many years under the QTC's approach. By contrast, under the prevailing methodology with annual adjustment, this historical figure of 1.9% affects the allowed rate for only the first six months of the new investment.

In summary, none of the advantages in the trailing average regime claimed by the QTC are both important and substantial. In particular, and in respect of existing debt, the close match that is achieved between the regulatory allowance and the cost incurred by an efficient benchmark firm under the trailing average regime is not an inherently important consideration. Instead, these mismatches matter only to the extent that they induce bankruptcy risk and violations from the NPV = 0 requirement, but the violations and risks arising under the prevailing regime are not significant and therefore the gain from the trailing average regime is trivial. In respect of new investment, the QTC's favoured approach of initially allowing the prevailing DRP and gradually adjusting towards the trailing average provides only slightly superior investment signals to those under the prevailing regime with a five-yearly resetting, and would provide slightly inferior investment signals to those under the prevailing regime with annual resetting.

2.4 Possible Overstatement of the Cost of Debt Using the Trailing Average

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[8] As usual, the summation is curtailed after ten years because the values beyond that have little effect.

Lally (2014b, page 43) argues that an efficient unregulated firm would choose its debt term and swap contracts to optimally trade off the reduced refinancing risk from longer-term debt, the increased risk-free rate component of the cost of debt from longer term debt, the transactions costs of the swap contracts, and the increased interest rate volatility from a shorter effective debt term. Thus, an efficient unregulated firm that was otherwise comparable to a regulated firm might borrow for ten years and use interest rate swap contracts to reduce the effective risk-free rate component of the cost of debt to (for example) three years. So, if a regulator sought to adopt a trailing average cost of debt with a term matching that for efficient unregulated firms, the trailing average cost of debt should be the three year average of the three year risk-free rate plus the ten-year average of the ten-year DRP plus the cost of the swap contracts.

In response to this argument, the QTC (2014, section 5.1) argues that the relevant comparators are natural monopolies that provide essential services and have high gearing levels. Since the service is essential, the income elasticity of demand will be low and therefore revenues will be very stable. Coupled with high gearing, such firms would seek a stable total cost of debt and therefore would seek long-term debt without using interest rate swap contracts to shorten the effective term. However the proposition that such firms would never use interest rate swap contracts is not obviously true and the QTC do not provide any evidence for it. Interest rate swaps enable firms to reduce their expected cost of debt at the expense of increased volatility in it. Some firms could be expected to shorten the effective maturity of the debt more than others, and the QTC offers one such example: firms whose output prices are positively correlated with interest rate movements (commodity firms), for whom the use of swaps not only reduces expected interest costs but reduces volatility in the firm's net cash flow. However, merely because a firm's revenues are stable and therefore shortening the maturity has the disadvantage of raising the volatility in the firm's debt costs and hence its net cash flows, it does not follow that such firms will *not* shorten the maturity; the most that could be said is that they will shorten the maturity less than commodity firms. Furthermore, one would expect variation in behaviour across firms depending upon management's attitude towards risk-return trade-offs.

The QTC (2014, section 5.1) also argues that the primary goal of debt management for all firms is to reduce risk in their net cash flows rather than to reduce expected interest costs and, in support of this, cite Martellini and Milhau (2011). However this paper contains no

empirical evidence and its conclusion follows from the rather restrictive assumptions that are made. In particular, the authors do not recognise either refinancing risk or the availability of interest rate swap contracts, and therefore their analysis is not capable of assessing the merits of a firm borrowing for (say) ten years in order to minimise refinancing risk and then swapping the risk-free rate component of the cost of debt into a shorter effective term to obtain the desired trade-off between expected interest costs and the risk arising from uncertain future interest rates. Furthermore, the authors assume that management's objective is to maximise a firm's value, and this assumption reduces much of management's interest in debt policy to irrelevance. For example, in the absence of bankruptcy risk and refinancing risk, the choice of long versus short term debt will not affect a firm's value and therefore this choice will be irrelevant if the goal is to maximize a firm's value. Accordingly, the possibility of management having different trade-offs for expected interest costs against risk compared to those embodied in market prices, and acting accordingly, does not arise.

In conclusion, three points are important. Firstly, the question of whether an efficient unregulated firm that was otherwise comparable to a regulated firm might use interest rate swap contracts to reduce the effective risk-free rate component of the cost of debt cannot be empirically resolved because efficient unregulated businesses that are otherwise similar to regulated ones do not exist. The very fact of being similar implies that they too would likely be regulated and, even if such unregulated firms did exist, the requirement to be similar to regulated businesses would imply that they were monopolistic providers of basic services (as noted by the QTC) and therefore would be unlikely to be efficient. Shielded by a thick layer of monopoly profits, such firms would not face sharp incentives to use swap contracts or any other instruments in order to optimise the trade-off between risk and expected costs. Secondly, the existence of interest rate swap contracts enables a firm to decouple its contractual borrowing term (and hence the level of refinancing risk) from its effective borrowing term in respect of the risk-free rate component (and hence its expected interest costs and volatility in its net cash flows). Since they can be decoupled, and doing so is common practice, it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Similarly, if everyone who rented a dwelling for a pre-set period was required to rent a phone for the same period and the opportunity to decouple these two contractual terms then arose, it would be remarkable if every member of some class of consumers did not change their behaviour. Thirdly, since the QTC argues that

relevant comparators would not use swap contracts to shorten the effective term of their debt, the burden of proof on this matter lies with them and they have not done so. Thus, the (significant) possibility exists that such firms (if they existed) would use swaps to shorten their effective debt term, and therefore regulatory setting of the cost of debt at the ten-year rate under a trailing average regime is exposed to the significant possibility of overstating the allowance. This is a significant drawback to the use of a trailing average risk-free rate, as argued in Lally (2014b).

The QTC (2014, section 5.3) also refers to a suggestion by the QCA (2014, page 17) that firms subject to a trailing average regime might continue to use interest rate swap contracts to match the risk-free rate component of their cost of debt to the regulatory cycle, and the QTC disputes this. However, whilst the QCA raise this possibility, they conclude that firms would likely not act in this way. Furthermore, whether firms depart from a strategy that would match their costs to those allowed by a regulator is irrelevant to the regulatory process; the regulator sets an allowance that should cover the costs of an efficient operator and the firm then acts as it wishes.

In summary, the question of whether efficient unregulated firms that are comparable to regulated ones use interest rate swap contracts to shorten their effective debt term cannot be empirically resolved because efficient unregulated businesses that are otherwise similar to regulated ones do not exist; the very fact of being similar implies that they too would likely be regulated and, even if such unregulated firms did exist, the requirement to be similar to regulated businesses would imply that they were monopolistic providers of basic services and therefore would be unlikely to be efficient. In addition, the existence of interest rate swap contracts enables a firm to decouple its contractual borrowing term (and hence the level of refinancing risk) from its effective borrowing term in respect of the risk-free rate component (and hence its expected interest costs and volatility in its net cash flows), this practice is widespread, and therefore it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Finally, having argued that relevant comparators would not use swap contracts to shorten the effective term of their debt, the burden of proof on this matter therefore lies with the QTC and they have not presented any such proof. Thus, the (significant) possibility exists that such firms do use swaps to shorten their effective debt term, and therefore regulatory setting of the cost of debt at the ten-year

rate under a trailing average regime is exposed to the significant possibility of overstating the allowance. This is a significant drawback to the use of a trailing average risk-free rate.

2.5 Consistency with the Cost of Equity

The QTC (2014, section 6) attributes to the QCA (2014a, page 24) the claim that the risk-free rate used in setting the allowed cost of equity *must* match that used in setting the allowed cost of debt in order to satisfy the NPV = 0 principle, and then argues that such matching is not required. I agree that such matching is not required to satisfy the NPV = 0 principle, as discussed in Lally (2010b, page 11). However, whilst a cursory reading of the QCA (2014a, page 24) suggests that they are making the claim attributed to them by the QTC, I consider that a closer reading suggests otherwise. In particular, the QCA claim that the risk free rate used within the cost of equity must be the prevailing rate with a term equal to the regulatory cycle in order to satisfy the NPV = 0 principle, and I agree with this. The QCA also claim that using the same rate for the cost of debt will *also* satisfy the NPV = 0 principle (because regulated businesses can use interest rate swap contracts to match the risk-free rate component of their cost of debt to the regulatory allowance), and I agree with this. I do not think that the QCA are ruling out the possibility of another choice for the risk-free rate component of the cost of debt that would also satisfy the NPV = 0 principle (a trailing average for an appropriate term).

2.6 The Choice of Benchmark

The QTC (2014, section 9) argues that staggering of debt portfolios is a near universal practice amongst both regulated and unregulated firms, this fact demonstrates its efficiency, and consistent with this a regulator should use a trailing average for the cost of debt. I agree that staggering is almost universally used and, coupled with its inherent merits, this reveals its efficiency. However, contrary to the QTC's claim, it does not follow that a regulator should use a trailing average. In respect of the risk-free rate component of the cost of debt, there is no conflict between firms staggering their borrowing and a regulator using the on-the-day method, because the use of interest rate swap contracts addresses the mismatch in costs that would otherwise arise. Even in respect of the DRP component, for which the mismatch arises due to a lack of liquidity in CDS contracts, this mismatch is only one of a number of features of the on-the-day regime, and some are favourable as discussed earlier. The act of focusing upon one (unfavourable) feature of a regime and rejecting it solely on that basis is not persuasive.

The QTC (2014, section 9) refers to the QCA's (2014, page 23) view that the relevant comparator firms (for estimating beta) are typically other regulated firms, notes that some such firms are subject to regulatory regimes that differ from that used by the QCA, and therefore suggests that the QCA should adopt the same cost of debt regime. However, I do not think the conclusion follows. The conclusion ought to be that the best comparators for estimating beta will be firms subject to the same regulatory regime as that adopted by the QCA. Furthermore, since the set of firms subject to exactly the same regulatory regime is likely to be small or even non-existent, it is necessary to use some comparators whose regulatory regimes are merely similar rather than identical. The impact of cost of debt methodology on beta is unlikely to be substantial. Thus, regulated firms subject to different cost of debt regimes would still be suitable comparators for the purpose of estimating beta. Nothing in this process implies that the QCA should adopt the cost of debt methodology to which these comparators are subject, nor should the comparators adopt the QCA's cost of debt regime merely because they estimated betas using some firms subject to that regime.

2.7 Complexity in the QTC's Approach

The QTC favours application of a trailing average to the existing debt and the prevailing rate applied to borrowing undertaken to support new investment, with gradual transition of the latter towards the trailing average. The QTC also favours annual resetting of the allowed cost of debt. In response to concerns about the complexity of its approach, the QTC (2014, section 10) argues that repeating a process annually rather than five-yearly does not make it more complex. However, the QTC's approach also involves a gradual transition from the prevailing rate to a trailing average for new borrowing and this is more complex to understand than either a trailing average or use of the prevailing rate. Furthermore, repeating a process annually rather than five-yearly is considerably more laborious if the DRP estimates required are of the type favoured by the QCA (2014b) rather than the RBA data referred to by the QTC (2014, section 10).

The QTC (2014, section 10) also argues that the additional effort involved in its favoured process is justified by the significant benefits arising from new investment signals. However, as discussed in section 2.3, these benefits relative to the prevailing methodology with five-yearly updating are trivial rather than significant and the use of annual updating with the prevailing regime leads to the latter outperforming the QTC's favoured approach.

In summary, when estimating the DRP using the methodology favoured by the QCA, the use of a trailing average with annual updating (as favoured by the QTC) is more complex than the prevailing (on-the-day) regime with five-yearly resetting and this is a drawback to the use of a trailing average with annual updating.

2.8 Hybrid Approach v Trailing Average

In discussing the relative merits of the trailing average versus the hybrid approach, the QCA (2014, page 32) argues that the hybrid approach provides a financial buffer to the firm in the event of a financial crisis arising, during which the risk-free rate falls but the firm will be receiving an allowed cost of debt set at an earlier point (the beginning of the cycle) at which the risk free rate was higher. This argument presumes that a firm subject to the hybrid regime would not use interest swap contracts to match the risk-free rate component of its cost of debt to the regulatory allowance under the hybrid approach. In response, the QTC (2014, section 11) argues that it is reasonable to suppose that such firms would have used such swap contracts.

I agree with the QTC's argument. The use of the swap contracts by a firm would lead to matching of the risk-free rate component of their cost of debt to the regulatory allowance, and thereby eliminating a source of risk for such firms. In addition, use of these contracts would have converted the ten-year swap rate paid by them into the five-year rate and the expected benefit from doing so (the reduction in the expected interest costs) would have exceeded the transactions costs of the swap contracts. In particular, Jemena (2013, page 22) estimates the transactions costs at 0.09% based upon quotes from its banks and Chairmont (2013, page 19) provides the even lower estimate of 0.05%. By contrast, the average differential between the five and ten year swap rates has been 0.28% from 1.1.1988 to 31.8.2014, 0.25% from 1.1.2000 to 31.8.2014, and 0.46% from 1.1.2010 to 31.8.2014 (using Bloomberg data). So, net of the transactions costs of the swaps, the swap transactions would have yielded expected benefits of at least 0.16% (as well as reducing risk). Despite all this, the entire issue is moot because the QCA does not recommend the hybrid approach. Instead it recommends the on-the-day regime (QCA, 2014, pp. 31-33).

The QTC (2014, section 11) also argues that the trailing average should be applied to the entire cost of debt rather than to only the DRP, because this corresponds to the costs incurred

by a benchmark efficient firm (defined to be unregulated). However, as argued in section 2.1, there is no merit is a regulator copying the behaviour of unregulated businesses because the act of regulating a business changes its revenue stream and therefore the policy of an unregulated business in respect of some costs may no longer be optimal once regulation is introduced. So, judgements about the merits of a particular regulatory policy must rest on other grounds. By contrast, if a particular type of behaviour is observed amongst both unregulated and regulated businesses, one could reasonably conclude that it was efficient and therefore that a regulator should act accordingly. A good example of this is the staggering of debt. This is efficient practice, even under the present regulatory regime. Thus, given the illiquidity of the CDS market, firms subject to the present regime will face a mismatch between their DRP costs and the DRP allowed. This is a drawback to the current regime but, as discussed earlier, it is a minor issue.

The QTC (2014, section 11) also argues that applying the trailing average to the entire cost of debt rather than just the DRP produces a smoother price path for consumers. This is correct, and acknowledged in Lally (2014b, section 8). However, smoothing can be achieved by other means (as discussed by the QCA, 2014a, page 36). Furthermore, as argued by Lally (2014b, section 8), application of the trailing average to the risk-free rate component of the cost of debt as well as the DRP gives rise to greater incentive problems for capex and new entrants (or greater complexity if these problems are addressed), and it would allow too high a cost of debt by failing to mirror the behaviour of otherwise similar unregulated firms (by copying the average debt term of such firms whilst ignoring the interest rate swap contracts that such firms would likely engage in and which have the effect of reducing the risk-free rate component of their cost of debt). In addition, as argued in Lally (2014a, section 2.1), application of the trailing average to the risk-free rate component of the cost of debt will overcompensate firms for the first ten years unless a transitional regime is adopted.

In summary, in comparing the hybrid approach with application of the trailing average to the entire cost of debt, the fact that the latter approach would replicate the behaviour of an efficient unregulated firm is not important. By contrast, it is true that the latter approach would produce a smoother price path for consumers than the hybrid approach but it gives rise to greater incentive problems for capex and new entrants (or greater complexity if these problems are addressed), will overcompensate firms for the first ten years unless a transitional regime is adopted, and it would allow too high a cost of debt by failing to mirror

the behaviour of otherwise similar unregulated firms (by copying the average debt term of such firms whilst ignoring the interest rate swap contracts that such firms would likely engage in and which have the effect of reducing the risk-free rate component of their cost of debt). Thus, if a trailing average were used, it should be limited to the DRP.

2.9 Price and Performance Monitoring

The QTC (2014, section 12) notes that some Queensland businesses will be subject to price or performance monitoring rather than price setting, and that the purpose will be to assess whether they have abused their monopoly powers. Accordingly, the QTC argues that this is best achieved with a trailing average applied to the cost of debt so as to match the behaviour of the businesses and therefore avoid situations in which price control is prompted merely because DRP mismatches lead to the WACC being incorrectly estimated. Thus, unlike price/revenue capping, these DRP mismatches are now an inherently important issue. However, as discussed in the previous section, it would be highly efficient for businesses subject to the prevailing regime to undertake interest rate swap contracts to match their incurred cost to that allowed by the regulator. Accordingly, the QTC's argument would be valid only for the DRP component of the cost of debt. In respect of this DRP component, the QTC (2014, Table 2) estimates the standard deviation of the annual mismatches between the trailing average DRP incurred by firms and the prevailing rate allowed under the current regime at 0.73%, and this is not a trivial number.

Nevertheless, three considerations point towards use of the prevailing methodology. Firstly, I would not expect price/performance monitoring to induce a decision to impose price control upon a business based solely upon the results from one year. Thus, the relevant standard deviation for mismatches should be for a longer period than one year. For example, if these annual DRP differences are averaged over the preceding five years, the standard deviation drops to 0.37%. Secondly, even without averaging, a figure of 0.73% would not have given rise to a material difference between the WACC estimated using the prevailing methodology and that arising from a ten-year trailing average DRP, and therefore would not have falsely signalled the need for price control to a material degree. In particular, suppose the prevailing risk-free rate was 6%, the equity risk premium for the business was also 6%, the prevailing DRP was 1.5%, the ten-year trailing average DRP was 2.23% (consistent with a differential of 0.73%), and leverage was 55%. In this case, the WACC estimated by the regulator would be

$$WACC = (.06 + .06).45 + (.06 + .015).55 = .095$$

By contrast, estimating the WACC with a ten-year trailing average DRP (2.23%) yields a 'true' WACC of 9.9%. So, if the regulated business earns a rate of return consistent with its 'true' WACC of 9.9%, the regulator's erroneous WACC estimate is only 0.4% lower and such a small difference would hardly induce a regulator to impose price controls in the mistaken belief that the businesses was exercising monopoly power. Lest one wonder about the worst mismatch in which the trailing average DRP exceeds the prevailing value (because this type of error is the one that has the potential to wrongly initiate price control), this occurred in March 1989 (in the US data presented by the QTC), when the prevailing DRP was 1.31%, the ten-year trailing average was 2.20% and the prevailing ten-year risk-free rate was 9.36%. So, assuming an equity risk premium of 6%, the estimated WACC using the prevailing DRP would have been 12.78% whilst the actual WACC using a ten-year trailing average DRP would have been 13.27%. So, the 'error' would have been only 0.50%, again insufficient to prompt a regulator to impose price control.

Thirdly, consistency in methodology is desirable across both price/revenue capping and price/performance monitoring. So, given my view that the current regime is the best for price/revenue capping, I would favour its application also to price/performance monitoring unless the advantage of a trailing average DRP over the current regime in respect of price/performance monitoring were very strong. However, the argument presented by the QTC is not strong as discussed above. So, consistency also favours application of the prevailing regime to price/performance monitoring.

In summary, in conducting price/performance monitoring, mismatches between the ten-year trailing average DRP incurred by a firm and the prevailing rate allowed under the present regime are a more significant issue than with price/revenue capping. However, even the most extreme mismatches observed in the historical data between the ten-year trailing average DRP incurred by a firm and the prevailing rate allowed under the present regime would not give rise to a material difference between the estimated WACC under the present regime and that reflecting the DRP actually incurred by a business, and therefore would not be sufficiently significant to prompt a decision to impose price control upon a business. In addition, adoption of the same methodology across both price/performance monitoring and

price/revenue capping is desirable. In view of these points, I favour application of the prevailing regime to price/performance monitoring as well as price/revenue capping.

2.10 Debt Raising Costs

The QTC (2014, section 13) argues that it is efficient for firms to issue new debt three months prior to the maturity of the debt it replaces, that this imposes a cost on the firm (the borrowing rate less the rate at which the funds would be deposited), and regulators should compensate firms for this cost. The QTC also argues that the appropriate asset for the funds to be invested in is one that does not change the firm's credit risk, that this implies investing in the risk-free asset, and therefore that the interest differential requiring compensation is that between the firm's borrowing rate and the risk-free rate. By contrast, the QCA (2014b, pp. 12-13) argues that there are difficulties in estimating these costs because additional assumptions must be made regarding the length of the early issue period and the nature of the short-term investment.

To investigate these points, I assume a one-period world, i.e., firms make decisions now and all future consequences arise at a single point of time (the end of the period). Suppose that an unlevered firm purchases assets for $200m and sets prices on its outputs that will deliver a payoff of <u>either</u> $103m or $317m in one year with equal probability. In addition, investors are risk neutral, the risk free rate is 5%, and there are no taxes (personal or corporate).[9] The value of the firm is then $200m as follows:

$$V = \frac{.5(\$103m) + .5(\$317m)}{1.05} = \$200m$$

So, the firm just covers its cost of capital. Now suppose that the firm borrows $100m, pays the proceeds to shareholders, and there are no bankruptcy costs in the event of a default, i.e., the possible payoffs from the firm in one year are still $103m or $317m with equal probability. The promised interest rate on the debt must be such that the expected payoff discounted at 5% is equal to the $100m borrowed. Since the promised rate *k* must be at least 5%, debt holders will receive the firm's entire payoff of $103m in the bad state (default) and the promised payoff of $100m(1+*k*) in the good state:

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[9] The example is intended only to illustrate the principle and not also the scale of the effect.

$$\$100m = \frac{.5(\$103m) + .5\$100m(1+k)}{1.05}$$

The solution is $k = .07$. So, a promised interest rate of 7% will allow the firm to borrow $100m. Since the assets of the firm are still worth $200m, the equity must be worth $100m. Now suppose instead that the firm borrows $110m, at the appropriate interest rate, invests $10m of this in the risk free asset, and pays the remaining $100m to shareholders. Relative to the first situation, both the firm's debt and it asset value will still be $10m more, which implies that its equity will still be worth $100m. Thus, shareholders are neither better nor worse off as a result of borrowing an extra $10m and investing it in the risk free asset. Nevertheless, relative to the first situation, the firm will be borrowing an additional $10m at some interest rate in excess of the 5% rate at which the $10m is invested, which suggests that shareholders bear the cost of the interest rate differential. However this apparent cost to the shareholders will be offset by the lower interest rate paid on the remaining debt. To determine the firm's borrowing rate in this new situation, the firm's assets will deliver payoffs that are now higher by $10.5m in both states, in which case debt holders will receive $113.5m in the bad state (default) and the promised payoff of $110m(1+$k$) in the good state. The promised interest rate k must now solve the following equation:

$$\$110m = \frac{.5(\$113.5m) + .5\$110m(1+k)}{1.05}$$

The solution is $k = .0682$. So, the apparent cost to shareholders of the additional debt (the borrowing cost of 6.82% over the risk-free rate of 5% on $10m equals $1.82m) is perfectly offset by the interest cost savings on the remaining debt (6.82% versus 7% on $100m).

Now suppose that the firm invests the $10m into a bond with the same interest rate as the firm would pay in the absence of this additional $10m of borrowing (7%). Following the above analysis, the bond would deliver $10.3 in one state and the promised payment of $10.7m in the other state.[10] Adding these payoffs to those arising when the firm had assets of

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[10] In the absence of the additional $10m of borrowing, the firm would be borrowing $100m, deliver possible payoffs of $103m and $317m with equal probability, and the promised interest rate would be 7%. So, in the default state, the bond holders would receive $103m. Per $10m of borrowing, the bond holders would then receive $10.3m. Thus, if the firm itself invested $10m into a similar bond issued by a different firm, it would receive $10.3m in the default state.

only $200m, the possible payoffs are then $317m + $10.7m = $327.7m and $103m + $10.3m = $113.3m. So, the firm's debtholders would receive $113.3m or their promised payment of $110m(1+$k$), and this implies that k = .07, i.e., the firm's borrowing rate of 7% would not change if the firm borrowed an extra $10m and invested it into bonds with a promised rate of 7%. All of these results are summarised in Table 3 below.

Table 3: Interest Rates on Various Borrowing Arrangements

	Borrowing Rate	Lending Rate
No additional borrowing	7%	n/a
Additional borrowing, invested in risk-free assets	6.82%	5%
Additional borrowing, invested in risky bonds	7%	7%

Conclusions can now be offered. Firstly, contrary to the QTC's claim, the additional borrowing would have to be invested in bonds with the same credit risk as the firm's own debt (rather than the risk-free asset) in order to maintain the firm's credit risk (i.e., its borrowing rate). In this event, there will be no differential between the firm's borrowing and lending rates on the additional borrowing. Secondly, if a firm did invest the additional borrowing in the risk-free asset, the apparent cost of doing so (the interest differential on the additional debt) would be perfectly offset by the lower interest rate on the rest of the firm's debt. Thirdly, since regulators estimate a firm's DRP by estimating the DRPs of comparator businesses and these latter DRPs depend upon the bonds purchased by these firms, consistency would require a regulator to examine the bonds purchased by the comparators, estimate the interest differential on these bonds, and incorporate any such differential in their allowances for the businesses that they are regulating. Fourthly, such an exercise would be tedious and the differential might be zero (in the event that the comparators invest in bonds of similar credit risk to themselves). Fifthly, the exercise cannot be supplanted by the presumption that firms invest these proceeds into risk-free assets. Finally, even if it were demonstrated that firms did invest these proceeds into the risk-free asset, and therefore might warrant an allowance for the interest rate differential in setting the allowed cost of a regulated business, this interest rate differential raises the question of why the borrowing rate exceeds the risk-free rate: the margin constitutes an allowance for the inferior liquidity of corporate bonds, an allowance for bankruptcy costs, and an allowance for the value of the default

option possessed by equity holders, and the inclusion of the latter in the cost of debt is unwarranted (because it is a mere transfer between debt holders and equity holders and therefore does not affect the true WACC).[11] Consequently, defining the cost of debt as the borrowing rate (the promised yield) gives rise to an overstatement in the cost of debt and hence the WACC. Furthermore the error in defining the cost of debt as the promised rate applies not just to the temporary borrowing undertaken by the firm (in the lead up to a debt roll-over) but to all of the firm's debt.

To illustrate this point, consider the example above in which the promised interest rate (6.82%) exceeds the risk-free rate (5%) solely because of this default option. In this case the appropriate cost of debt for a regulator to use in regulating such a firm would be the risk-free rate, i.e., the regulator should allow expected revenues to cover $210m for depreciation, $100(.05) for the cost of equity, and $110(.05) for the cost of debt, totalling $220.5m (of which $10.5m comes from the payoff on the holding of risk-free assets and the remaining $210m from the firm's output). The value of these expected revenues of $220.5m is $210m as follows:

$$V = \frac{\$220.5m}{1.05} = \$210m$$

This value of $210m matches the firm's investment and therefore the NPV = 0 requirement is satisfied. By contrast, if the regulator allowed a cost of debt of 6.82%, the expected revenues would rise to $222.5m and therefore the value of the firm would rise to $211.9m, which would exceed the cost of the assets by $1.9m. So, the NPV = 0 requirement would be violated.

This analysis does *not* imply that the appropriate cost of debt for a regulator to use is the risk-free rate. The appropriate rate should be the risk-free rate plus an allowance for the inferior liquidity of corporate debt plus an allowance for bankruptcy costs, and such a rate will be below the promised yield on debt. So, the promised yield on debt is too high. Since an appropriate deduction from the promised yield is too contentious to be feasible, a regulator has no option but to use the promised yield. However, in partial mitigation, it should not

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[11] In general, this margin also includes an allowance for systematic risk. However, in the analysis here, investors are assumed to be risk neutral and therefore this component is not present here.

make an additional allowance for the interest differential on temporary borrowing even if firms do invest the temporary borrowing in the risk-free asset.

In summary, in respect of the general practice for firms to borrow money and temporarily invest the proceeds before using these proceeds to retire other debt, this will not give rise to a differential between the borrowing and lending rates if firms invest the proceeds into a bond that maintains their existing interest rate. By contrast, if they invest the proceeds into the risk-free asset, they will incur a cost in the form of an interest differential but will also lower their cost of debt, with zero net effect. Since the lower cost of debt will be observed and therefore used by a regulator, this suggests that the regulator should compensate firms for the interest rate differential on the temporary borrowing. However, this would require empirical evidence that the firms used as comparators to set the allowed DRPs for regulated businesses do invest these proceeds in bonds with lower interest rates than those paid by these firms, and such evidence is both lacking and would be difficult to assemble. Furthermore, regulatory use of the promised interest rate over compensates firms (because part of the promised rate is merely compensation to lenders for the default option possessed by equity holders). In partial mitigation, regulators should not make an additional allowance for the interest rate differential on the temporary borrowing even if the temporary borrowing is invested into bonds with lower interest rates than those paid on the firms' debt.

3. Implications of a Trailing Average Cost of Debt

In the context of the QTC's claim that a trailing average cost of debt will not overstate a firm's cost of debt, the QCA has also asked me to assess the QTC's associated claim that otherwise comparable (efficient) unregulated firms with stable revenues and relatively high gearing would not use swaps to achieve a short-term base interest rate exposure on their debt portfolios. As discussed in section 2.4 above, this claim cannot be empirically resolved because efficient unregulated businesses that are otherwise similar to regulated ones do not exist; the very fact of being similar implies that they too would likely be regulated and, even if such unregulated firms did exist, the requirement to be similar to regulated businesses would imply that they were monopolistic providers of basic services and therefore would be unlikely to be efficient. However, since interest rate swap contracts enable a firm to decouple its contractual borrowing term (and hence the level of refinancing risk) from its effective borrowing term in respect of the risk-free rate component (and hence its expected interest

costs and volatility in its net cash flows), and this practice is widespread, it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Thus, the (significant) possibility exists that such firms do use swaps to shorten their effective debt term, and therefore regulatory setting of the cost of debt at the ten-year rate under a trailing average regime is exposed to the significant possibility of overstating the allowance. This is a significant drawback to the use of a trailing average risk-free rate.

Also, and again in the context of the QTC's claim that a trailing average cost of debt will not overstate a firm's cost of debt, the QCA has asked me to comment upon the use of swap contracts by firms subject to the prevailing regime. The issue here is that the QTC considers risk avoidance to be the crucial factor in firms' debt decisions, they interpret the QCA as arguing that expected interest costs are the crucial factor (QTC, 2014, page 15), and note that the use of swap contracts by firms subject to the prevailing regime supports their view about the importance of risk avoidance. However, I do not interpret the QCA as arguing that expected costs are the dominant consideration. In any event, I consider that firms are concerned with both matters (consistent with Unitywater, 2014, page 1). This would lead a firm subject to the prevailing regime to use swap contracts, so as to both reduce their expected interest costs and avoid interest rate risk. It would also be likely to lead to an efficient unregulated firm that was otherwise identical to a regulated one using them so as to shorten its effective debt term, thereby trading off expected interest costs against interest rate risk.

The QCA has also asked me to identify the general conditions under which the trailing average will likely lead to an overstatement or understatement of the cost of debt. As discussed in section 2.4, a trailing average cost of debt is likely to lead to an overstatement of the risk-free rate component of the allowed cost of debt. The general conditions under which this would occur are as follows:

(a) Firms are concerned with refinancing risk and mitigate this with a long average borrowing term coupled with staggering of the maturity dates. Thus, a firm that borrows for ten years and fully staggers the maturity dates would need to roll-over only 10% of the debt in any year, and the refinancing risk would therefore be low.

(b) Firms would also enter interest rate swap contracts to shorten the effective term of the debt and therefore reduce their expected interest payments.

(c) A regulator who allows a trailing average for the risk-free rate component of the cost of debt bases it upon the term for which firms borrow rather than the borrowing term adjusted in accordance with the swap contracts.

Of these conditions, only (b) is controversial. In respect of this, the QTC argues that relevant comparator firms (efficient, similar, unregulated firms) do not engage in such swap contracts. However, as discussed in section 2.4, no empirical evidence was presented by the QTC nor would it be possible to do so. Efficient unregulated businesses that are otherwise similar to regulated ones do not exist; the very fact of being similar implies that they too would likely be regulated and, even if such unregulated firms did exist, the requirement to be similar to regulated businesses would imply that they were monopolistic providers of basic services and therefore would be unlikely to be efficient. However, since interest rate swap contracts enable a firm to decouple its contractual borrowing term (and hence the level of refinancing risk) from its effective borrowing term in respect of the risk-free rate component (and hence its expected interest costs and volatility in its net cash flows), and are widely used for this purpose, it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Thus, it is likely that use of a trailing average risk-free rate for a term matching the borrowing term of comparable unregulated firms will overstate the cost of debt but it cannot be definitely proven.

The QCA has also asked me to assess whether regulated firms subject to a trailing average are likely to be in a position to adopt a debt management strategy that over-recovers their allowed cost of debt. Regardless of what term regulators adopt for the risk-free rate in using a trailing average, regulated firms should be presumed to match their behaviour so as to eliminate a source of interest rate risk (even if some firms act otherwise in order to reduce their expected costs at the expense of incurring risk). Thus, if regulators adopted a ten-year trailing average of the ten-year risk-free rate, regulated businesses should be presumed to continue to borrow for ten-years but to desist from using interest rate swap contracts. Alternatively, if regulators adopted a five-year trailing average of the five-year risk-free rate (upon observing that comparator firms borrowed for ten years and judging that they used swap contracts to shorten the effective term to five years), regulated businesses should be presumed to continue to borrow for ten-years and to enter swap contracts to shorten the effective term to five years. In neither case would firms be over recovering their allowed cost of debt; the problem instead would be that a regulatory allowance of a ten-year trailing

average of the ten-year risk-free rate would likely be too high. Naturally, some firms might depart from a strategy that matched the regulatory allowance. For example, if the regulatory allowance were a ten-year trailing average of the ten-year risk-free rate, a regulated firm might borrow for ten years and use swap contracts to convert the risk-free rate component into the three-year risk-free rate, and the expected effect would be interest costs that were lower than that allowed. However, the firm would thereby incur interest rate risk and therefore one could not describe this as an over recovery situation. Similar situations exist under all regulatory regimes.

In summary, in respect of the QTC's claim that otherwise comparable (efficient) unregulated firms with stable revenues and relatively high gearing would not use swaps to achieve a short-term base interest rate exposure on their debt portfolios, this issue cannot be empirically resolved but it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Thus, the (significant) possibility exists that such firms do use swaps to shorten their effective debt term, and therefore regulatory setting of the cost of debt at the ten-year rate under a trailing average regime is exposed to the significant possibility of overstating the allowance. In addition, the use of swap contracts by firms subject to the present regime is consistent with them being concerned with both risk and expected interest costs, and this is consistent with an efficient unregulated firm with stable revenues also using such contracts. In addition, the conditions under which a trailing average risk-free rate that is allowed by a regulator will likely overstate the cost of debt are that firms borrow long-term, they use interest rate swap contracts to shorten the effective risk-free rate term, and regulators set the allowance in accordance with only the borrowing term. Finally, even if regulators acted in this way, it would not offer any opportunity for firms to over recover their allowed cost of debt.

4. Prudent Debt Portfolios Under the Prevailing Regime

The QCA has also asked me to assess whether a regulated firm subject to the on-the-day regime can structure a prudent debt portfolio. It is uncontroversial that unregulated firms stagger their debt portfolios, and borrow long-term, so that only a small proportion of the debt requires roll-over in any year. In addition, the CDS market is not sufficiently well developed to allow large regulated businesses subject to the on-the-day regime to both

stagger their borrowing and hedge the DRP risk (PwC, 2013, page 8; Chairmont, 2013, page 5). This raises the question of whether a regulated firm subject to the on-the-day regime can structure a prudent debt portfolio. One option would be to roll-over all debt at the beginning of the regulatory cycle, for the term of the cycle, thereby avoiding any DRP risk. However, the resulting refinancing risk would be huge and, unsurprisingly, this option has not been adopted by firms subject to the on-the-day regime (AER, 2013, page 105). Instead, as with unregulated businesses, they borrow long-term (ten-year average) and stagger their borrowing. Given the liquidity limitations in the CDS market, large regulated businesses cannot hedge the resulting DRP risk. Whether their debt portfolios are then prudent depends upon the extent of this DRP risk, i.e., whether the bankruptcy risk arising from this DRP risk is material.

In respect of the empirical evidence on this matter, Lally (2014b, section 2.6) uses Australian data from 2007-2013 and finds that this additional risk is not material. Furthermore, as noted in section 2.2 and based upon US DRP data from 1953-2014, the worst such case arose in March 1989 when the prevailing DRP was 1.31% and the ten-year trailing average was 2.20%. So, for a business facing regulatory reset at the end of that month, the shortfall would have been 0.89%. Per $100 of RAB with leverage of 55%, the dollar shortfall would have been $0.50. However, since the US ten-year risk-free rate at that time was 9.36% and assuming an equity risk premium of 6%, the allowance for the cost of equity would have been $45(.0936+.06) = $6.91, and this would have constituted the buffer that would have absorbed the DRP shortfall of $0.50. So, the shortfall would have been only 7% of the buffer. Furthermore, over the entire set of points at which disparities could be observed in this data set for a firm with a five-year regulatory cycle and a regulatory reset on 31 March 1989 (31.3.1964, 31.3, 1969, ….,31.3. 2014), the average DRP disparity was close to zero (0.10%).

In summary, firms subject to the on-the-day regime could match their borrowing to the regulatory cycle, and therefore incur refinancing risk, or stagger their borrowing so as to minimise refinancing risk and therefore be exposed to (bankruptcy) risk arising from disparities between the allowed DRP (the prevailing rate at the reset point) and the incurred cost (the ten-year trailing average of the ten-year DRP). The refinancing risk from the first option is huge whilst the bankruptcy risk from the second option is empirically trivial. So, the prudent course of action is to stagger the borrowing and this unsurprisingly corresponds to the actual behaviour of regulated businesses subject to the on-the-day regime. Thus,

regulated firms subject to the on-the-day regime can structure a prudent debt portfolio and such firms generally do this.

5. Conclusions

I have examined arguments raised by the QTC and my principal conclusions are as follows. Firstly, with the exception of replicating the cost of debt incurred by an efficient comparable unregulated firm, the QTC's criteria for choosing a regulatory approach to the cost of debt are insufficiently comprehensive. Furthermore, the goal of replicating the cost of debt incurred by an efficient comparable unregulated firm is inappropriate because such comparator firms do not exist and regulation changes the revenues of a firm, so that some cost policies that were sensible prior to regulation might not be so post regulation.

Secondly, none of the deficiencies in the prevailing methodology that are alleged by the QTC are valid or substantial. In particular, the prevailing methodology does not assume that all debt rolls over at the end of a regulatory cycle, the mismatches in respect of existing debt are not inherently important, the $NPV = 0$ violations for new businesses are trivial, the $NPV = 0$ violations for capex are not significant, and it is the illiquidity of CDS contracts rather than their nature which prevents them from being (currently) used to hedge the DRP risk arising from the prevailing methodology.

Thirdly, none of the advantages in the trailing average regime claimed by the QTC are both important and substantial. In particular, and in respect of existing debt, the close match that is achieved between the regulatory allowance and the cost incurred by an efficient benchmark firm under the trailing average regime is not an inherently important consideration. Instead, these mismatches matter only to the extent that they induce bankruptcy risk and violations of the $NPV = 0$ requirement, but the violations and risks arising under the prevailing regime are not significant and therefore the gain from the trailing average regime is not significant. In respect of new investment, the QTC's favoured approach of initially using the prevailing DRP and gradually adjusting towards the trailing average provides only slightly superior investment signals to those under the prevailing regime with a five-yearly resetting, and would provide slightly inferior investment signals to those under the prevailing regime with annual resetting.

Fourthly, the question of whether efficient unregulated firms that are comparable to regulated ones use interest rate swap contracts to shorten their effective debt term cannot be empirically resolved because efficient unregulated businesses that are otherwise similar to regulated ones do not exist; the very fact of being similar implies that they too would likely be regulated and, even if such unregulated firms did exist, the requirement to be similar to regulated businesses would imply that they were monopolistic providers of basic services and therefore would be unlikely to be efficient. In addition, the existence of interest rate swap contracts enables a firm to decouple its contractual borrowing term (and hence the level of refinancing risk) from its effective borrowing term in respect of the risk-free rate component (and hence its expected interest costs and volatility in its net cash flows), this practice is widespread, and therefore it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Finally, having argued that relevant comparators would not use swap contracts to shorten the effective term of their debt, the burden of proof on this matter therefore lies with the QTC and they have not presented any. Thus, the (significant) possibility exists that such firms do use swaps to shorten their effective debt term, and therefore regulatory setting of the cost of debt at the ten-year rate under a trailing average regime is exposed to the significant possibility of overstating the allowance. This is a significant drawback to the use of a trailing average risk-free rate.

Fifthly, when estimating the DRP using the methodology favoured by the QCA, the use of a trailing average with annual updating (as favoured by the QTC) is more complex than the prevailing (on-the-day) regime with five-yearly resetting and this is a drawback to the use of a trailing average with annual updating.

Sixthly, in comparing the hybrid approach with application of the trailing average to the entire cost of debt, the fact that the latter approach would replicate the behaviour of an efficient unregulated firm is not important. By contrast, it is true that the latter approach would produce a smoother price path for consumers than the hybrid approach but it gives rise to greater incentive problems for capex and new entrants (or greater complexity if these problems are addressed), requires a transitional regime that will embody some drawback regardless of the choice of transitional regime, and it would allow too high a cost of debt by failing to mirror the behaviour of otherwise similar unregulated firms (by copying the average borrowing term of such firms whilst ignoring the interest rate swap contracts that

such firms would likely engage in and which have the effect of reducing the risk-free rate component of their cost of debt). Thus, if a trailing average were used, it should be limited to the DRP.

Seventhly, in conducting price/performance monitoring, mismatches between the ten-year trailing average DRP incurred by a firm and the prevailing rate allowed under the present regime are a more significant issue than with price/revenue capping. However, even the most extreme mismatches observed in the US historical data between the ten-year trailing average DRP incurred by a firm and the prevailing rate allowed under the present regime would not give rise to a material difference between the estimated WACC under the present regime and that reflecting the DRP actually incurred by a business, and therefore would not be sufficiently significant to prompt a decision to impose price control upon a regulated business. In addition, adoption of the same methodology across both price/performance monitoring and price/revenue capping is desirable. In view of these points, I favour application of the prevailing regime to price/performance monitoring as well as price/revenue capping.

Eighthly, in respect of the general practice for firms to borrow money and temporarily invest the proceeds before using these proceeds to retire other debt, this will not give rise to a differential between the borrowing and lending rates if firms invest the proceeds into a bond that maintains their existing interest rate. By contrast, if they invest the proceeds into the risk-free asset, they will incur a cost in the form of an interest differential but will also lower their cost of debt, with zero net effect. Since the lower cost of debt will be observed and therefore used by a regulator, this suggests that the regulator should compensate firms for the interest rate differential on the temporary borrowing. However, this would require empirical evidence that the firms used as comparators to set the allowed DRPs for regulated businesses do invest these proceeds in bonds with lower interest rates than those paid by these firms, and such evidence is both lacking and would be difficult to assemble. Furthermore, regulatory use of the promised interest rate over compensates firms (because part of the promised rate is merely compensation to lenders for the default option possessed by equity holders). In partial mitigation, regulators should not make an additional allowance for the interest rate differential on the temporary borrowing even if the temporary borrowing is invested into bonds with lower interest rates than those paid on the firms' debt.

I have also been asked to comment upon the QTC's claim that otherwise comparable (efficient) unregulated firms with stable revenues and relatively high gearing would not use swaps to achieve a short-term base interest rate exposure on their debt portfolios. As discussed above, this issue cannot be empirically resolved but it would be remarkable if an entire class of efficient firms decided that the optimal contractual term was the same as the optimal effective borrowing term, and therefore did not use interest rate swap contracts. Thus, the (significant) possibility exists that such firms (if they existed) would use swaps to shorten their effective debt term, and therefore regulatory setting of the cost of debt at the ten-year rate under a trailing average regime is exposed to the significant possibility of overstating the allowance.

I have also been asked to comment upon the implications for the risk attitudes of firms subject to the present regime using interest rate swap contracts. The use of swaps by such firms is consistent with them being concerned with both risk and expected interest costs, and this is consistent with an efficient unregulated firm with stable revenues also using such contracts to shorten their effective debt term and thereby trade off the gains from lower expected interest costs against higher risk.

I have also been asked to identify the general conditions under which the trailing average will likely lead to an overstatement or understatement of the cost of debt and to comment on whether regulated firms (subject to a trailing average) are likely to be in a position to adopt a debt management strategy that over-recovers their allowed cost of debt. A trailing average risk-free rate that is allowed by a regulator will likely overstate the cost of debt if comparable firms borrow long-term, use interest rate swap contracts to shorten the effective risk-free rate term, and regulators set the allowance in accordance with only the borrowing term. However, even if regulators acted in this way, it would not offer any opportunity for firms to over recover their allowed cost of debt.

I have also been asked to assess whether a regulated firm subject to the on-the-day regime can structure a prudent debt portfolio given that unregulated firms would not choose to refinance all of their debt at a point in time. Firms subject to the on-the-day regime could match their borrowing to the regulatory cycle, and therefore incur refinancing risk, or stagger their borrowing so as to minimise refinancing risk and therefore be exposed to (bankruptcy) risk arising from disparities between the allowed DRP (the prevailing rate at the reset point)

and the incurred cost (the ten-year trailing average of the ten-year DRP). The refinancing risk from the first option is huge whilst the bankruptcy risk from the second option is empirically trivial. So, the prudent course of action is to stagger the borrowing and this unsurprisingly corresponds to the actual behaviour of regulated businesses subject to the on-the-day regime. Thus, regulated firms subject to the on-the-day regime can structure a prudent debt portfolio and such firms generally do this.

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